AN INVESTIGATORY STUDY INTO THE SUPPLY CHAIN VOIDS OF WELSH INDUSTRIAL SECTORS

by

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A Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy of Cardiff University

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ABBREVIATIONS AND ACRONYMS

ABBREVIATION/ ACRONYM	FULL DESCRIPTION/TITLE
AEIGT	Aerospace Innovation and Growth Team
AIM	Advanced Institute of Management Research
ASEAN	Association of South-East Asian Nations
AWM	Advantage West Midlands
CAA	Civil Aviation Authority
CARBS	Cardiff Business School
CASIS	The Centre for Advanced Software and Intelligent Systems
CD(s)	Compact Disc(s)
CEO	Chief Executive Officer
CIPS	Chartered Institute of Purchasing and Supply
CMO(s)	Contract Manufacturing Organisation(s)
CRM	Customer Relationship Management
CRO(s)	Contract Research Organisation(s)
DBERR	Department for Business, Enterprise and Regulatory Reform
DBIS	Department for Business, Innovation and Skills
DCELLS	Department for Children, Education and Life Long Skills
DED	Department of Economic Development
DEFRA	Department of Environment, Food and Rural Affairs
DEIN	Department for the Economy, Innovation and Networks (WAG)
DE & T	Department for the Economy and Transport (WAG)
DfEE	Department for Education and Employment
DMU	Decision Making Unit
DTI	Department of Trade and Industry (UK)
EEDA	East of England Development Agency
EMEA	European Medicine Agency
EMDA	East Midlands Development Agency
ESRC	Economic & Social Research Council
EU	European Union
F1	Formula 1 (Motor Racing)
FDA	Food and Drugs Administration (USA)
FDI	Foreign Direct Investment
FSA	Financial Services Authority
FSS	Fixed Sample Size
FTE(s)	Full Time Employee(s) or Equivalent(s)
GCT	General Contingency Theory (of Management)
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
GVA	Gross Value Added
H & S	Health & Safety
HoC	House of Commons
HKG	The Hoshin Kanri Group
HRM	Human Resource Management

HQ	Head Quarters
IBW	International Business Wales (WAG)
ICIS	Integrated Client Information System (WAG IT system)
ICT	Information and Communications Technology
IP	Intellectual Property
ISO	International Organisation for Standardisation
IT	Information Technology
ITAR	International Traffic in Arms Regulations
IWA	Institute of Welsh Affairs
KB4B	Knowledge Bank for Business
LDA	London Development Agency
M & A	Merger and Acquisition
MAS	Manufacturing Advisory Service
MBO	Management By Objectives
MCILT	Member of the Chartered Institute of Logistics and Transport
MCIPS	Member of the Chartered Institute of Purchasing and Supply
MD	Managing Director
MEC	Manufacturing Engineering Centre
MHRA	Medicines and Healthcare products Regulatory Agency (UK)
MILs	Material Input Linkage(s)
MNE(s)	Multi National Enterprise(s)
MoD	Ministry of Defence
MSQA	Multi Sectoral Qualitative Analysis
N/A	Not Applicable
N/K	Not Known
NEAT	North European Aerospace Test (Range)
NESC	National Economic and Social Council
NHS	National Health Service
NICE	The National Institute for Health and Clinical Excellence
NIEC	Northern Ireland Economic Council
NIERC	Northern Ireland Economic Research Centre
No(s)	Number(s)
NWDA	North West Development Agency
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
ONS	Office of National Statistics
P & SCM	Purchasing and Supply Chain Management
p.a.	Per annum
PACEC	PA Cambridge Economic Consultants
PAUS	Parc Aberporth Unmanned Systems (Event)
PC(s)	Personal Computer(s)
PDCA	Plan Do Check Act
PESTEL	Political, Economic, Social, Technological, Environmental & Legal (Analysis)
PV(s)	Purchasing Value(s)

QA	Quality Assurance
QRM	Quarterly Review Meeting
R & D	Research & Development
RBV	Resource Based View
RDA(s)	Regional Development Agency (Agencies)
RoEU	Rest of the EU
RoI	Republic of Ireland
ROI	Return on Investment
RotW	Rest of the World
RoUK	Rest of the UK
RSA	Regional Selective Assistance
RSN(s)	Regional Supply Network(s)
SCM	Supply Chain Management
SCV(s)	Supply Chain Void(s)
SDI & AT	Sustainable Development Integration and Assessment Tool
SEEDA	South East England Development Agency
SIC	Standard Industry Code
SME(s)	Small and Medium Sized Enterprises
SWOT	Strengths Weaknesses Opportunities Threats (Analysis)
T/O	Turn Over (£)
TCA	Total Cost of Acquisition
TCE	Transaction Cost Economics
ToC	Table of Characteristics
TOWS	Threats Opportunities Weaknesses Strengths (Analysis)
UAS	Unmanned Air System
UAV	Unmanned Air Vehicle
UNCTAD	United Nations Conference on Trade and Development
USDoD	Unites States Department of Defense
USP(s)	Unique Selling Point(s)
UK	United Kingdom
USA	United States of America
UV	Unmanned Vehicle
WAF	Welsh Automotive Forum
WAG	Welsh Assembly Government
WAN	Wide Area Network
WAVE	Wales: A Vibrant Economy
WCED	World Commission on Environment and Development
WDA	Welsh Development Agency
WERU	Welsh Economy Research Unit
WWUAVC	West Wales UAV Centre

ABSTRACT

This study explores 'immediate' and 'potential' supply chain voids (SCVs) in capability within three Welsh priority sectors and is sponsored by the Welsh Assembly Government (WAG).

The research design employs a multiple case study strategy targeting Biosciences, Financial and Unmanned Systems utilising instruments such as secondary data, semi-structured and telephone interviews.

The findings from this study demonstrate that SCVs are contingent upon different sectors, supplier search and the behaviour of searchers, organisational size and structure, technology, markets and the nature of supply and demand at the macro level, the lack of suitable suppliers, poor quality standards and high prices.

The moderate development of Parc Aberporth and Unmanned Systems operations is impeding progress in the Welsh SME base owing to the lack of locally based customers with 'home base' capabilities, the early life-cycle position of the cluster, motivations of companies to move to the area, a deficiency of competition and the efficacy of economic development methods.

The key contribution is the development and pilot testing of a 'Hoshin Kanri' policy deployment framework for operation by the WAG (and Regional Development Agencies (RDAs)) whilst investigating 'immediate' and 'potential' SCVs across different sectors and firms.

The study was limited to the deployment of WAG strategies and companies operating in Wales therefore, in order to position it within a wider United Kingdom (UK) context, other RDAs were consulted. In addition, the literature was used to compare Wales to other regions in the UK and elsewhere.

Policy recommendations for the sponsors are identified and the findings are likely to be of interest to RDAs, the Department for Business, Innovation and Skills and UK Trade and Investment. The results have interest in relation to the framework and its application through aligning regional strategies to target SCVs using sustainable development and regional embeddedness criteria.

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Chapter 1

Introduction

CHAPTER 1 - INTRODUCTION

1.1 INTRODUCTION

This research, entitled 'An Investigatory Study into the Supply Chain Voids of Welsh Industrial Sectors', is sponsored by the Welsh Assembly Government (WAG) department previously known as the Welsh Development Agency (WDA), which merged into the WAG in April 2006. The research was funded for a four year period, based on the need to understand better gaps in the supply chains in Wales and how these may be addressed.

United Kingdom (UK) Government policy deployed through the Department for Trade and Industry (DTI), the Department for Business, Enterprise and Regulatory Reform (DBERR) and more recently the Department for Business Innovation and Skills (DBIS) has supported market intervention activities via the work of Regional Development Agencies, including the WAG. Supply chain interventions have included Regional Supply Networks (RSNs) (DTI, 1994) within regions in the UK and 'Source Wales' operated by the WDA. This study makes recommendations to better aid selection of those sectors and SCVs that should be investigated, as aligned to sector based strategy.

Supply chain voids may exist for a number of reasons for example, a low level of demand with a focal region or a lack of specialist technologies i.e. electronics (Welsh Economic Research Unit (WERU), 2004). In addition, it is difficult or unrealistic to develop all capabilities required to support specific sectors within a region (Alderman, 2005).

The research activity has been carried out within the governance of the Cardiff University Innovative Manufacturing Research Centre (CUIMRC), which consists of:

- the Lean Enterprise Research Centre (LERC) from Cardiff Business School (CARBS),
- the Logistics Systems Dynamics Group (LSDG) from CARBS,
- the Manufacturing Engineering Centre (MEC) from the School of Engineering.

The study aligns to the theme of sustainable change within the 'Sustainably Channelled Change at Every Scale and Situation' (SUCCESS) project by focusing on how to achieve more sustainable regions by addressing SCVs in manufacturing and service capability (CUIMRC, 2006).

1.1.1 DEFINITION OF 'SUPPLY CHAIN VOIDS' AND THE FOCUS ON WALES

In the absence of a definition within the existing body of literature, 'supply chain voids' (SCVs) are defined by the author as:

> *'Immediate and potential gaps in capability for products and/or services, within the business community. Identifying and satisfying these gaps will strengthen the economy and individual supply chains'.* (Refer to Figures 1.1 & 1.2 below).

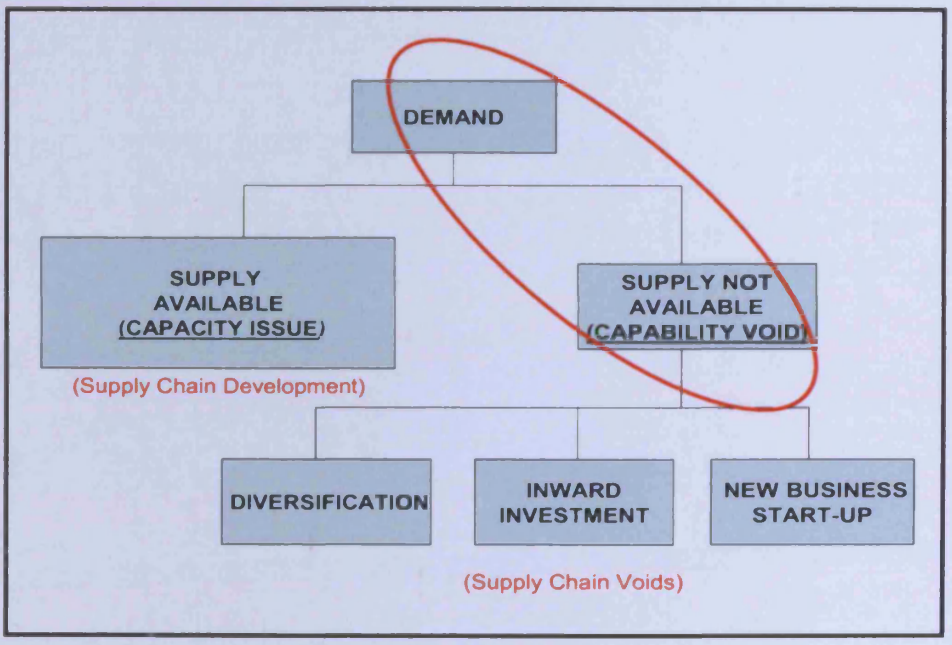

Figure 1.1 – Supply Chain Voids are Demand and Capability Driven (Source: The Author)

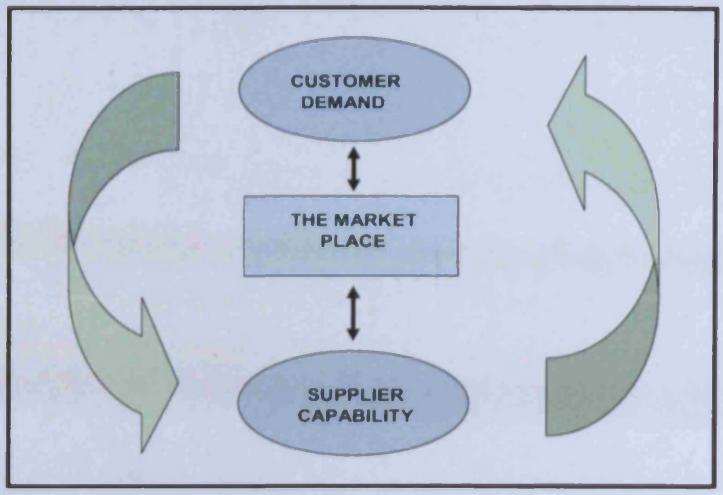

Figure 1.2 – Customer and Supplier Perspectives Related to Supply Chain Voids (Source: The Author)

These gaps exist where a geographic supply base is unable, unwilling or incapable of satisfying a local demand in the market place for a specific product or service, or where a business wishes to procure requirements from a local supplier but is unable to, owing to the lack of local supply options. Figure 1.2 shows that supplier capability is required to service demand within a region which Crone (1999) refers to as 'supply potential'.

The scope of this research is focussed on capability gaps whereas those relating to capacity were referred to the WAG for further investigation as part of their Supply Chain Development Programmes, as depicted in Figure 1.1. Possible solutions to SCVs could include recognised regional economic development tools such as diversification within an existing company, inward investment by a company from outside the region or a new business start-up.

As a result, such SCVs could either be 'immediate' and need to be addressed in a tactical or reactive manner, or are 'potential' voids which may exist in the short-medium term or longer, and are of a more strategic or proactive nature, and may relate to emerging industries or technologies.

The research aligns to a number of Welsh strategy documents (as identified in Chapter 2) and concentrates on the ten priority industry sectors within Wales (WAG, 2005, p 58). As the study commenced, these included the sectors shown in Figures 1.3 and 1.4.

Figure 1.3 - Priority Sectors in Wales (Source: WAG, 2005, p 58)

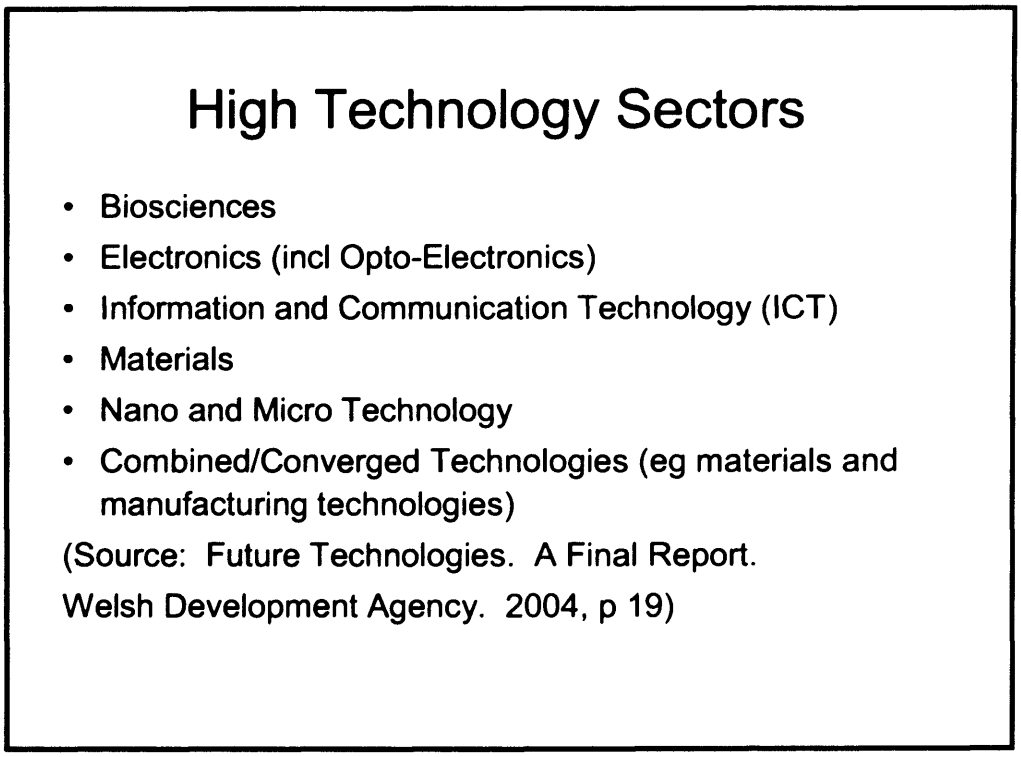

Figure 1.4 - High Technology Sectors in Wales (Source: WDA, 2004, p 19)

Chapter 2 provides the background to the study and summarises the investigation of the ten priority sectors by the author, leading to the selection of three within which to deploy a multiple case study strategy into specific SCVs, as guided by criteria recommended by the Institute of Welsh Affairs (IWA) (2005, p 9). These sectors are Biosciences, a new or latent sector in the region, Financial Intermediation and Insurance services which is seen as a current area of strength and Aerospace, focussing on Unmanned Systems including the development of Parc Aberporth. There is the potential for the sector in Wales to decline if it does not grasp the technological challenges relating to materials and structures (e.g. composites and Unmanned Systems development), skills and business development. Chapter 2 also reports on examples from the literature which demonstrate the difficulties associated with the identification and selection of 'priority sectors' (Bryan *et al.* 2005).

1.1.2 AIMS, OBJECTIVES AND THE RESEARCH QUESTIONS

The overall aim of the research was to investigate the occurrence of supplier voids within those sectors that have been identified as having considerable importance to the focal region. In addition the research aimed to provide a framework that could be employed to assist the WAG in addressing such voids.

Three Research Questions, theoretical objectives and a number of secondary objectives were defined in relation to the study and these have been informed by a comprehensive, multi-disciplinary literature review and the strategies employed by the sponsors. These have been aligned in Table 1.1.

The study commenced by targeting purchasing and supply chain management (P & SCM) literature and progressed through other themes such as make or buy strategies, capability and competences (core and non-core), economic linkages, clusters and cognitive theories including contingency, systems, the resource based view and theory of the firm, search and complexity. This approach is signposted at Chapter 3, resulting in the identification of the research gaps leading to the final selection of the background and foreground literature which forged the Research Questions, theoretical objectives that underpin the study.

Research Questions	Theoretical Research Objectives	Sponsors - Strategy Objectives
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	To identify and understand those contingency factors which indicate or explain the existence of supply chain voids.	Identify the supply chain voids in Wales within the ten priority sectors.
		Understand and collate evidence that identifies and validates these voids.
		Examine three or four highly targeted cases.
		Identify new business opportunities in Wales by fully researching the supply chain voids in capability.
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	To identify, understand and apply the theoretical and empirical paradigms that facilitates the deployment of regional economic development strategies and encompasses processes that enable the identification, investigation and resolution of supply chain voids.	Assess the opportunities that exist to fill these voids both internal and external to the designated industries, sectors, or regions.
		Understand how other regions have attempted to address the supplier void issue.
		Benchmark for the relevant performance required to fulfil these voids.
		Understand the economic impact of the voids.
		Provide and pilot test a framework that details the process of identifying and filling these voids
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?	To identify those theoretical paradigms that can be applied to underpin a framework that aims to address supply chain voids through sustainable development.	Provide and pilot test a framework that details the process of identifying and filling these voids.
		Expansion of the customer base to optimise capability created through filling supply chain voids in Wales.
		Shorten and integrate supply chains within Wales, thereby reducing costs and the environmental impacts relating to transportation, such as carbon emissions.

Table 1.1 – Alignment of the Research Questions and Objectives for the Study (Source: The Author)

The two predominant outputs targeted by the WDA (2004) and perpetuated within WAG are the 'number of jobs created' and the 'number of jobs safeguarded'. Therefore, any opportunities to address SCVs needed to take these into consideration.

Other measures are specified within a number of WAG strategies which are highlighted in Chapter 2.

1.2 BACKGROUND AND MOTIVATION FOR THE STUDY

The background and motivation for the interest in pursuance of this study falls into two categories:

- Academic
- Personal to the author

1.2.1 ACADEMIC INTEREST AND MOTIVATION

Supply chain, or supplier voids have concerned regional development and support agencies for some time although there is little reference to them in the supply chain literature. An early paper by Hines (1992) documented the role of 'intermediaries' in the supply network and focused on what was then a new initiative, 'Source Wales'. The catalytic role of such intermediaries was reported as assisting companies to source new and existing parts, bringing knowledge and experience from other sectors and providing specialist skills that are not available, particularly in smaller firms. Guinipero *et al.* (2008) identify a noticeable absence relating to the role of 'intermediaries' who may be able to assist in the identification of capability gaps within supply chains and the instigation of possible solutions.

This research aims to build upon these important facets of the 'Source Wales' initiative by identifying and investigating the SCVs that exist within Wales. Specifically, this research builds upon pilot studies that have been commissioned by WAG, identifying and documenting SCVs in automotive painting and forging in Wales (Supply Chain Management Development Centre (SCMDC), Swansea, 2004 and DMC Consulting, 2005).

From a review of the previous multi-disciplinary literature it would appear that no academic studies have focused on reporting the mechanisms or models employed to identify and respond to any specific SCVs that may exist. Much of the previous

research around the area of the supply network has focused on improving the performance of existing members in terms of key indicators such as quality, cost and delivery (e.g. Hines *et al.*., 2000). Many of the studies that have focused on supplier selection have assumed that a source exists and no links appear to have been made with external agencies such as 'Source Wales' formally to capture what these voids are (Hines, 1992). Therefore a need was identified to develop mechanisms that profile these voids and categorise potential actions for the development agencies.

The regional sourcing literature has largely focused on attracting out-sourced and/or off-shored activities and embedding overseas inward investors within their chosen locality (e.g. Brand *et al.*, 2000; Driffield *et al.*, 2004). Again, this research needs to be linked with identifying SCVs and formalising frameworks to support the execution of activities required to address any sourcing opportunities, with a combination of proactive and reactive measures.

Much of the empirical academic debate has focussed, almost in its entirety, on the manufacturing sector, Foreign Direct Investment (FDI) and multinational companies (e.g. PA Cambridge Economic Consultants (PACEC), 1995; Dunning, 1998; Hewitt-Dundas, 2005), with fewer studies including indigenous firms within specific regions (e.g. Crone, 1999). A number of locations globally and in the UK, including Wales, have been studied in relation to macro-economic measures such as the 'immediate' or current percentage levels of local sourcing, economic, supplier and material input linkages (e.g. Phelps, 1997). Limited interest has been employed in the research of firm level data (Scott-Kennel, 2007).

Recent debate is shy of studies relating to the service sector (Scott-Kennel, 2007) for both indigenous and FDI firms, firm level data regarding specific sourcing requirements and capabilities held in a region, and addressing 'potential' requirements (Guinipero *et al.*, 2008) based on new opportunities for regional development and external environmental changes. Finally, there is no framework available for RDA activities in Wales, UK or globally, to aid assessment of these issues in a sustainable manner that aims to introduce, develop and embed capabilities and companies within a region.

The literature review emphasises a multi-disciplinary study involving for example P & SCM, economics and economic geography. In addition, different sectors and their sourcing requirements are investigated, resulting in an often complex and challenging study.

1.2.2 PERSONAL INTEREST AND MOTIVATION

The author has been a business management practitioner for 22 years, prior to taking on the challenge of this study. Leading and operating within a cross-functional environment for the previous ten years enticed the author to take a four year career break to pursue a PhD research opportunity offered within the inter-disciplinary CUIMRC.

Having enjoyed the learning experience and successfully completed first degree level and masters academic qualifications whilst working full-time, the author was motivated to carry out a more focussed, rigorous and academically taxing study, whilst bringing a host of project, change, communications, and stakeholder management and supply chain operations experience to a research problem identified by Crone (1999) and experienced by the WAG.

1.3 MAIN FINDINGS, CONTRIBUTONS AND LIMITATIONS OF THE STUDY

The findings demonstrate that SCVs can exist for various reasons at the macro level, for example differences between sectors (e.g. Crone, 1999), the use of an appropriate search approach (e.g. Rothschild, 1974; Manning and Morgan, 1982), factors affecting the behaviour of searchers (e.g. Soelberg, 1967), organisational size (e.g. Blau, 1970), organisational structure, as determined by e.g. technology (Woodward, 1965), markets and the nature of supply and demand (e.g. Baily *et al.*, 2005; Hines, 1993; United Nations Conference on Trade and Development (UNCTAD), 2001; Crone, 1999; Woodward, 1965; Northern Ireland Economic Council (NIEC), 1999; Alderman, 2005, Rees, 2005).

Specific reasons for SCVs were identified by companies for example, the lack of suitable suppliers, quality standards not met and high costs (e.g. Hewitt-Dundas *et al.*, 2005).

The moderate development of Parc Aberporth as a cluster is impacting the potential for the development of supply chain support for Unmanned Systems owing to the lack of locally based companies with 'home base' capabilities (Porter, 1998b), issues relating to the location (Simmie and Sennett (1999), life-cycle position of the cluster (Porter, 1998a, Advanced Institute of Management (AIM) Research, 2005), the WDA 'push' strategy (Ahn and Kaminsky, 2005), the motivations of companies to move to Parc Aberporth (e.g. Chen *et al.*, 2004), the poor small and medium sized enterprise (SME) base (WAG, 2009), a lack of competition and the efficacy of development methods (Porter, 1998a) including maybe the branding of Parc Aberporth (UNCTAD, 2001).

McDonald *et al.* (2007) assert that cluster development in adherence to Porter (1998a; 1998b) does not work and that clusters or supply chains can include both local and global participants (e.g. Alderman, 2005, Rees, 2005; Kempainen and Vepsalainen, 2003; Zucchella, 2006).

Chapter 6 proposes a generic framework for use in a contingent manner, by the WAG (Alford and Hughes, 2008; Luthans, 1976), which has been pilot tested within the multiple case studies and includes sustainable development (World Commission on Environment and Development (WCED), 1987) and embeddedness (e.g. Polyani, 1944; Halinen and Tornroos, 1998; Hess, 2004; Giroud and Mirza, 2004) criteria. The investigation of SCVs based upon individual firms or markets often fail to achieve sustainable development (Carroll and Stanfield, 2001).

The main theoretical contribution is the development and pilot testing of a 'Hoshin Kanri' type framework to be operated by the WAG (and RDAs) as public sector 'intermediaries', whilst investigating manufacturing, service sector, indigenous and non-multinational company 'immediate' and 'potential' SCVs (e.g. Akao, 1991; Hacker *et al.*, 2001; Guinipero *et al.*, 2008; Crone,1999; Scott-Kennel, 2007). Other prominent theoretical contributions include the application of search theory to the study and the

identification of contingencies that determine supplier search activities by firms (Stigler, 1961; Perry and Widgerson, 1986; Proctor, 1978), the application of purchasing and supply chain contingencies to a service sector in the UK (Heriot, 1996), a detailed survey of purchasing requirements carried out at sector and SCV/micro level (Crone, 1999; Scott-Kennel, 2007), the investigation of multiple cases of backward linkages and indicative forward (sales) linkages (Scott-Kennel, 2007) and the development of measures based upon the embeddedness and sustainable development that extend regional economic development policies beyond 'job creation' and 'job numbers'.

The study was limited to the deployment of WAG strategies and those sectors and companies operating in Wales. Rosenzweig (2008) points out that by focussing on an 'absolute' target, such as Wales, the researcher can ignore the 'relative' performance of other targets or regions. However, to position the research within a wider UK context, other RDAs were contacted and their regional economic development strategies were compared to the Welsh equivalents. In addition, the literature was used to compare Wales to other regions in the UK and elsewhere, as appropriate to the study.

1.4 RESEARCH FRAMEWORK AND STUCTURE OF THE THESIS

A research framework has been developed by the author as depicted in Figure 1.5. The first column shows the key research phases deployed, whilst column two contains the process flow of the research activities. The third column sign posts the relevant chapters within this thesis for the key phases and research activities. The framework, as the main contribution is highlighted in gold.

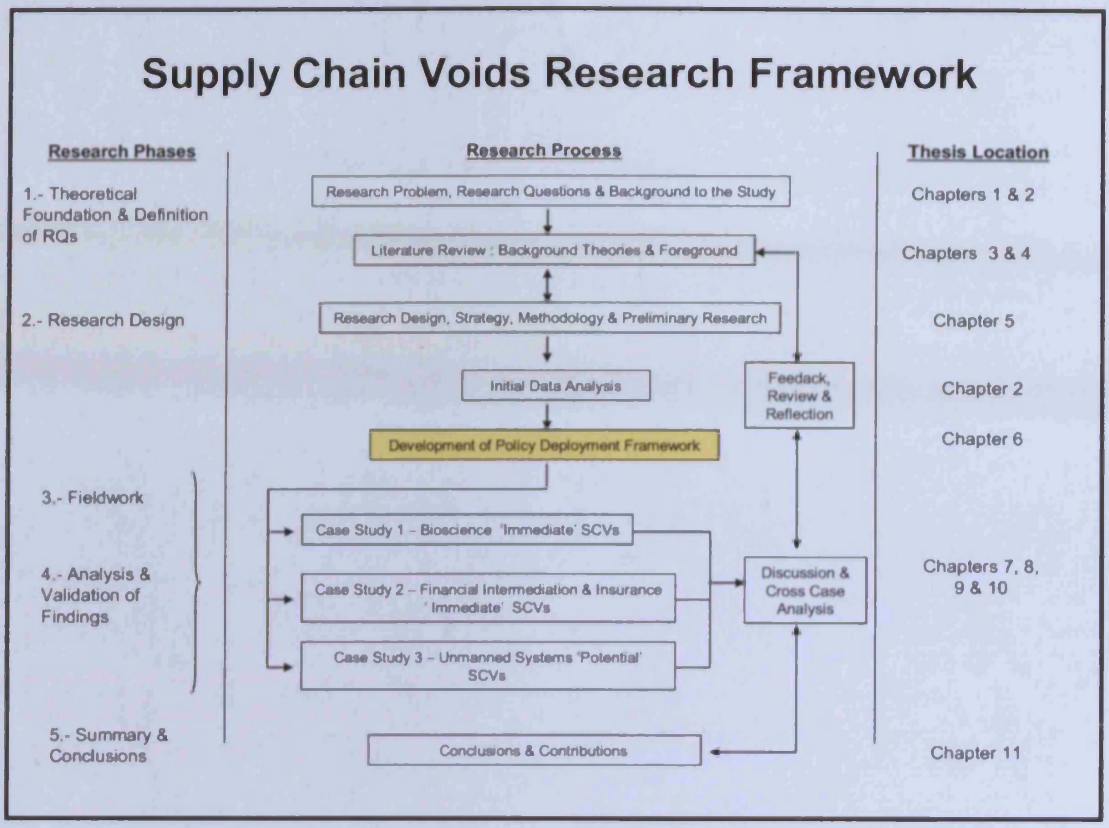

Figure 1.5 – Research Framework for the Study of Supply Chain Voids in Wales (Source: The Author)

The thesis has been structured as shown in Table 1.2, based on the research framework shown at Figure 1.5. This chapter has introduced the study of SCVs in Wales. Chapter 2 then provides the background context for the study and determines the three sectors in which the multiple case study research takes place. Chapter 3 reflects on the literature review, based on the retroductive and exploratory nature of the study and critiques the literature for cognitive theories (background) whilst the applied, foreground literature is reviewed in Chapter 4. Chapter 5 details the research methodology, design and instruments selected to investigate SCVs in Wales. Chapter 6 is significant in that it details the thought process, justification and development of the policy deployment framework, designed by the author, for use in the investigation of SCVs. Chapters 7, 8 and 9 detail the results of the multiple case studies in the sectors and SCVs selected for this study. Chapter 10 critiques the literature in relation to the results of the cases, leading to the derivation of the findings from the research. Finally, Chapter 11 concludes the study, identifying the contributions to knowledge and implications to

academics, the WAG, other agencies and managers, policy recommendations for the WAG, the limitations of the study and the directions for further research.

Chapter No	Title
Chapter 1	Introduction
Chapter 2	Regional Economic Development in Wales - The Background and Context of the Study
Chapter 3	Literature Review - Background Cognitive Theories
Chapter 4	Literature Review - Foreground Literature
Chapter 5	Research Methodology
Chapter 6	Development of the 'Supply Chain Voids Policy Deployment Framework'
Chapter 7	Case Studies – Biosciences – 'Immediate' Supply Chain Voids
Chapter 8	Case Studies - Financial Intermediation & Insurance - 'Immediate' Supply Chain Voids
Chapter 9	Case Study - Unmanned Systems – 'Potential' Supply Chain Voids – Parc Aberporth
Chapter 10	Discussion of Findings and Cross Case Comparisons
Chapter 11	Conclusions and Contributions

Table 1.2 – Structure of the Thesis (Source: The Author)

1.5 CONCLUSION

This chapter has introduced the study of SCVs in Wales, providing a definition and scope, summarised the Research Questions, aims and objectives derived for the research, introduced the background and outlined the motivations for the study. It has also introduced the research framework and summarised the structure of the thesis. Chapter 2 now provides the background to the study and identifies the three sectors in which the multiple case studies take place.

Chapter 2

Regional Economic Development in Wales

—

The Background and Context of the Study

CHAPTER 2 – REGIONAL ECONOMIC DEVELOPMENT IN WALES – THE BACKGROUND CONTEXT OF THE STUDY

2.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter provides the background and context of regional economic development in Wales. Firstly, a précis of the institutions associated with regional economic development is provided. Next, the historical context of the region's industrial past is signposted, prior to a synopsis of the key WAG strategies that inform this study. Then, a selection of relevant academic policy recommendations are included for comparison to the WAG strategies which is followed by a brief review of the 'Source Wales' programme, as it was the antecedent to the SCVs research. Finally, the priority sectors are investigated and analysed, resulting in three being selected for further research.

The sponsors had not defined specific sectors that the research into SCVs should target. Therefore, a pre-study phase was required to identify and select three sample sectors in which to carry out the case study research into SCVs, without bias. The aim was to pursue a variety of manufacturing and services sectors containing a diverse range of products and services, within the timescales of the study. This preliminary research took place between May to October 2006, prior to the full study and is reported at Appendix A and a review of the research methods used are summarised in Chapter 5, Section 5.11.

2.2 INSTITUTIONAL SUPPORT FOR REGIONAL ECONOMIC DEVELOPMENT IN WALES

When the Doctoral research commenced in October 2005, the WDA was the lead institution responsible for the implementation of regional economic development in Wales. With effect from 1 April 2006, it was merged into the WAG and the WDA ceased to exist. Roles and responsibilities were aligned to ministerial departments such as the Department for the Economy, Innovation and Networks (DEIN), later into the Department for the Economy and Transport (DE & T). The 1 April 2008 saw the commencement of a major transformation programme, where the WAG restructured its

organisation and business support processes and procedures. In relation to the study into SCVs in Wales, although the sponsoring department and personnel remained the same up until late 2008, key individual stakeholders and sector experts within WAG changed, significantly in some areas, along with their emphasis on the implementation of policies. Whilst this did not affect the research approach, the research programme was sometimes impacted, along with the direction of the investigation, owing to revised priorities and stakeholder views.

2.3 THE HISTORICAL CONTEXT OF REGIONAL ECONOMIC DEVELOPMENT IN WALES

A number of studies have focussed on the Welsh economy, a number of which are summarised within Appendix B which sets the historical context of regional economic development in Wales, leading up to the current sector based approach promoted not only in Wales, but by other RDAs across the UK.

2.4 'SOURCE WALES' AND THE SUPPLY CHAIN VOIDS RESEARCH

This section briefly summarises the 'Source Wales' programme and introduces the provenance of the SCVs research. It also provides academic commentary on the perceived benefits and issues associated with such programmes.

The WDA web site described 'Source Wales' as 'a buyer-driven initiative aimed at helping Welsh companies win more business by providing them with the support required to develop into first class suppliers and matching them with customers in the rest of the UK and Europe'. Morgan (1996) reports that 'Source Wales' has two basic objectives:

- to identify supply opportunities and encourage Welsh manufacturing firms to meet them;
- to establish a comprehensive performance improvement programme to help bring together supplier groups committed to improving efficiency through sharing expertise.

Hines (1993) advises that by increasing the quality and technological capacity of indigenous firms in line with 'Source Wales', it may benefit more than just the inward investor. Morgan (1996) asserts that developing local sourcing has a more traditional effect in that it can increase the size of the local multiplier by reducing leakages, arguing that any initiative that can reduce leakages is likely to be important to the Welsh economy. This relates directly to the rationale underpinning the research into SCVs, which aims to develop 'Source Wales' into a more strategic activity (Crone, 1999).

Taylor (2003) states that 'Lean' initiatives, supplier associations and cluster programmes fall into 'Source Wales'. He carries out an appraisal of its activities, finding it to be a parochial programme, in relation to the evolution of globalisation, global supply chain development and management activities. However, other authors including Crone (1999) and the Northern Ireland Economic Council (NIEC) (1999) consider the sourcing programme as best practice. Other regions in the UK introduced similar initiatives, for example, Regional Supply Networks (RSNs) (Department for Trade and Industry (DTI), 1994). These dealt with brokering activities, matching customers with suppliers, but not the supply chain development and improvement activities that 'Source Wales' carried out.

The DTZ Pieda Consulting Report (1997) commissioned by the DTI criticised sourcing programmes such as 'Source Wales' when it reviewed the RSNs in the UK. The report argues that sourcing is a 'market research' activity that should be undertaken by specialist private sector companies, rather than government organisations. Also, the report argues that the inherent problem of the 'free rider' associated with a public sector provided system would be eliminated by a private sector system. A 'free rider' is defined by DTZ Pieda (1997) as a client in need of a particular good or service but is not prepared to pay for it.

Taylor (2003) recommends that the supply chain development element of 'Source Wales' should continue because of the potential benefits to SMEs. However, he argues that the 'matching' or 'brokering' element should cease.

Crone (1999) questions the value of brokerage services, especially in his focal region of Yorkshire and Humberside, owing to the perceived highly skilled staff within the purchasing departments of the multinationals he was researching. However, he supports the supplier development activities. Crone, (1999) also questions whether the region is the most appropriate scale, for policy to address local sourcing. Based on his empirical research, he recommends that it may be better to implement sourcing initiatives across a larger geographical area, for example, Northern England in his case. He contends that this would be more realistic and cost effective because of economies of scale on staffing and other regional resources in the participating regions. However, he has doubts about the likelihood of the level of cooperation between RDAs as they are usually rivals for FDI. Whist DTI, DBERR and DBIS policies traditionally focus on regional development via RDAs, this study considers the option of addressing SCVs across regional boundaries.

Therefore, whilst 'Source Wales' is cited as best practice by some commentators (Crone, 1999; NIEC, 1999), such programmes are also questioned as to their value to regional economic development, particularly those restricted to brokering activities (DTZ Pieda, 1997)). Also, 'Source Wales' is seen to be parochial, ignoring the external environmental changes associated with globalisation (Taylor, 2003).

'Source Wales' precedes the SCVs research, which is seen by the WAG sponsors as a logical extension to the programme. Therefore, notwithstanding such criticisms levied by DTZ Pieda (1997) and Taylor (2003), WAG need to understand how SCVs in capability could be investigated and possibly, resolved within Wales. In pursuance of this, two pilot studies were commissioned by WAG:

- SCMDC Swansea (2004) – investigated SCVs for specialist coatings and paint finishes in the Automotive sector in Wales. The findings identified a potential supplier in Wales, owing to spare capacity and an opportunity to diversify.
- DMC Consulting (2005) – investigated forged parts for the Automotive and Aerospace sectors in Wales. Findings identified that it was cost prohibitive to introduce supplier capability in Wales.

Both of these pilots relied mainly on statistical data and analysis and confirmed a need for more qualitative research into SCVs, resulting in the requirement for a sponsored PhD.

2.5 REGIONAL ECONOMIC DEVELOPMENT STRATEGIES AND POLICIES IN WALES

This section looks at those strategies and policies that help to target and deliver regional economic development for Wales. It includes WDA and WAG strategy and policy deployment documents, along with an illustrative selection of academic commentaries and recommendations to aid development of the Welsh economy.

2.5.1 WELSH DEVELOPMENT AGENCY (WDA) AND WELSH ASSEMBLY GOVERNMENT (WAG) STRATEGIES AND POLICIES

There are a number of WDA and WAG strategies and policy deployment documents that inform this study. The most relevant have been identified and summarised here, based on their alignment to general or sector specific development. Other regions have a similar suite of documents.

Extant policies from the WDA era include 'Future Technologies - A Final Report' (WDA, 2004a) which covers the identification of future technologies and their implications on Wales, the aspiration to transform to a sustainable knowledge based region and opportunities to target for the region and specific sectors. WDA (2004b) is the 'WDA Business Plan 2005 – 2008 - Creating Success Together' which focuses on creating business success through the merger of the WDA with the WAG in April 2005. It sets out sector based priorities e.g. energy, automotive, aerospace and the creative industries and emphasises the importance of links between Techniums (R & D), business incubators, linkages between universities and industry partners and the KB4B in relation to innovation and entrepreneurship. The 'WDA Output Measures and Monitoring - Guidance and Definitions', Issue dated July 2004 (WDA, 2004c) identifies key output measures promoted within the WDA which include e.g. the number of jobs created or safeguarded, number of new business start-ups and number of new businesses

attracted to Wales. There are 33 output measures in total, with targets set by the WDA or UK Trade & Investment (UKTI) and these were still being adhered to for the majority of the study, until revised within the 'Enterprise Spending Profile Area Plan' (WAG, 2008).

'A Winning Wales' is the 'National Economic Development Strategy of the Welsh Assembly Government' dated January 2002 and sets out policies for a number of areas including the improvement of skills and infrastructure, encourages and supports R & D and innovation and provides an environment which is business friendly. It also deals with the introduction of business incubators or Techniums, the encouragement of entrepreneurship, promotion of ICT, improvement of transport links, the importance of Regional Selective Assistance (RSA), sustainable development, and EU structural funding. Moreover, it introduces the initial ten priority sectors for development. Some of these elements are superseded or reinforced by 'Wales: A Vibrant Economy' ('WAVE', WAG, 2005).

'WAVE' is the 'Welsh Assembly Government's Framework for Economic Development, a Consultation Document' dated 23 November 2005. It leads on the identification of the ten 'priority sectors' and sets out the development priorities to increase employment and raise the quality of jobs. It introduces the creation of the Knowledge Bank for Business (KB4B) and improved account management for Welsh businesses whilst linking to or bringing together a number of other strategy documents for example, 'Wales: A Better Country' which is the 'The Strategic Agenda of the Welsh Assembly Government' dated September 2003. This contains the key aims of the WAG in relation to the economic inactivity agenda including helping people into jobs, creating better jobs and skills. There is recognition that Wales has few Head Quarter (HQ) companies with R & D and marketing functions. The 'Top ten' commitments and implementation plans include the creation of the KB4B and additional Techniums.

'Wales for Innovation' is the 'Welsh Assembly Government's Action Plan for Innovation' dated March 2003 and it implements the innovation element of 'A Winning Wales' to make the region more competitive through innovation. The five action areas

include development of potential high growth businesses, better equipping people to enable innovation and maximising the economic development of universities and colleges. It also emphasises the importance of Techniums, skills development and R & D to regional innovation.

WAG (International Business Wales (IBW) (2007)) is the 'IBW Operations Plans 2006 – 2008 of the Cardiff Based Sector Teams' dated 1 May 2007 and sets the sector development priorities for IBW for Bioscience & Healthcare, Financial Services, Automotive & Engineering, IT, Software & Communications, Sustainable Technologies, Business & Manufacturing Processes and Food Services..

The 'Business and Environment Action Plan for Wales' dated February 2002, aims to balance economic growth with community development and environmental performance. It also seeks to clarify the sustainable business and environment agenda from 'A Winning Wales', also referred to as 'Greening Wales'. Further, 'The Sustainable Development Action Plan 2004 – 2007' dated 22 March 2004 supplements 'Wales: A Better Country' and aims to address the social, environmental and economic challenges of the region. It includes a new set of 'top ten' commitments to support sustainable development. Additionally, 'People, Places, Futures' is the WAG 'Wales Spatial Plan' dated November 2004 details the promotion of a sustainable economy and valuing the environment, collaboration and linkages with other regions including South West England, West Midlands, North West England and Ireland whilst identifying specific opportunities and actions for Wales whereas the 'Environment Strategy for Wales' (WAG, 2006b) introduces the environmental vision and anticipated outcomes for 2026.

'One Wales' is promoted as a progressive agenda for the government of Wales and an agreement between the Labour and Plaid Cymru Groups in the National Assembly dated 27 June 2007. This introduces the policy and key priorities for the WAG for four years from 2007, targeting e.g. the NHS, social services, economy, quality of jobs, communities, life long learning and education and sustainable development (i.e. social, economic and environmental).

The 'Draft Aerospace and Defence Strategic Plan' dated November 2006 (WAG, 2006a, Updated Feb 2009, Revision 1, Draft 3, see Chapter 9) outlines the WAG plan for the regional economic development of the aerospace and defence sector in Wales and is relevant to the Unmanned Systems case study.

The 'e-Wales Policy Objectives' (WAG, 2007) set out the WAG policy for e-connectivity across the region for both social and business use which underpins all sectors and furthers some work from the 'Broadband Wales Strategy' dated January 2005 which outlines how WAG intends to fully exploit the benefits of broadband for consumers and business customers (WAG, 2005a).

Finally, the 'Enterprise Spending Profile Area Plan - Business Planning 2008/9 and Future Years' (WAG, 2008) commissions 'One Wales' in the newly created 'Enterprise' function within WAG DE & T. Key outputs on legacy projects are the numbers of jobs created or safeguarded, the number of new business starts and businesses supported whilst on new projects, outputs are numbers of jobs created or safeguarded, enterprises assisted and started. This is relevant to all sector development activities.

With reference to these strategies and policies, it can be seen that the key themes throughout these documents include sustainable development, targeted sector development, improved employment and skills development, transformation to a knowledge-based economy with highly skilled jobs in value adding activities, working with new technologies and collaboration between universities and industry, the introduction of specific 'Techniums' or technology focused business incubators (e.g. opto-electronics) to aid the development of technologies and small businesses. The merger of the WDA into the WAG is also reflected throughout the evolving priorities with the introduction of account management for businesses and dedicated KB4B managers for those top 50 businesses that have demonstrated the potential for high growth.

Output measures remain fairly constant in the number of jobs either created, or safeguarded. These do not however differentiate between the quality of jobs but recent

developments in the implementation of 'One Wales' have seen the development and introduction of a 'Return on Investment' (ROI) test (WAG, 14 Mar 08) to assess potential projects. This considers the quality of jobs based on the location of the jobs and the annual salary proposed. NIEC (1986) identifies that the impact of industrial development goes well beyond the effect of direct employment (i.e. jobs). Also, IBW (2007) for example, are not necessarily pursuing those priority sectors identified within WAG (2005) in their operations plan for 2006 – 2008. Figures 1.3 and 1.4 in Chapter 1 show those sectors identified as priority to economic development in Wales and whilst there is some overlap, they are not exactly the same.

To put the Welsh regional economic development approach for priority sectors into context, Appendix C identifies the priorities of other UK RDAs in comparison to Wales, along with the background on how such strategies emerged.

This section has summarised those WAG strategies and policies that are of most relevance to this study.

2.5.2 POLICY RECOMMENDATIONS MADE IN THE ACADEMIC LITERATURE

This sub-section identifies an illustrative selection of policy recommendations from academic literature relating to the Welsh economy, which bear most relevance to this study and can be compared to the government strategies and policies summarised in Table 2.1. Literature relating to regional economic development in general terms is reviewed in Chapter 4.

Conflicts are understood to exist within regional development policies in relation to attracting FDI or encouraging the prosperity of indigenous industries in Wales (Jones, 2000). The long term opportunities for benefits accruing from the diversification and improvement of indigenous industries may be greater than those perceived from large FDI. Such issues may stem from the pursuance of measures relating to the number of 'jobs created' or 'jobs safe guarded' (WDA, 2004c; WAG, 2008).

Reference	Key Policy Recommendations	Relevant WDA & WAG Strategy & Policy Documents
Institute of Welsh Affairs (IWA) (2005)	Industry clusters can potentially provide, for example: • Productivity gains through the use of specialised inputs and services, and the potential for local sourcing • Innovation gains through enhanced supplier-customer interaction, proximity to knowledge centres and easier exchange of tacit information	*Wales for Innovation* (WAG, 2003); '*WAVE*' (WAG, 2005).
IWA (2005)	Porter's (1990) view of industrial policy is that to be effective, it needs to be directed at the level of the regional cluster. IWA (2005) highlight the precarious nature of this strategy, as increased regional specialisation leads to increased regional inequalities and risks.	
IWA (2005)	DTI (2001) states that clusters should be self sustaining and deep. To achieve this, the IWA suggest that a link is required between private business services, government support systems and the higher education sector. By doing this, a wide range of firms, institutions and linkages are incorporated into the 'triple helix' of successful regional innovation systems (e.g. Cooke, 2001).	'*WAVE*' (WAG, 2005).
IWA (2005)	'Network' arrangements in an economy are now often believed to form the foundation for economic growth (IWA).	'*WAVE*' (WAG, 2005).
Taylor (2003, p 161)	'The mainstay of Wales's manufacturing sector is its ability to manufacture differentiated products using some sophisticated technology, skilled and flexible labour and a degree of R & D to accomplish product development'.	'*WAVE*' (WAG, 2005).

Hill (2000)	For Wales to be more prosperous in the 21st century, the following qualities would be required, for example: • High levels of value-added within products and processes • Some resources devoted to generating new knowledge, but more to the dissemination and application of existing knowledge • An attractive physical and business environment for the (relatively few) creative and enterprising people who will drive economic growth • A Wales-wide network of ICT infrastructure • Physical infrastructure that carries development and growth across Wales.	*A Winning Wales* (WAG, 2002); *Wales: A Better* Country (WAG, 2003); *'WAVE'* (WAG, 2005); *Broadband Wales Strategy* (WAG, 2005a); O*ne Wales* (WAG, 2007).
Jones (2000)	WAG policy should pursue opportunities for higher value occupations in industries yielding the greatest return to Wales.	*Wales for Innovation* (WAG, 2003); *Future Technologies* (WDA, 2004); 'WAVE' (WAG, 2005); *One Wales* (WAG, 2007).
Munday, (2000).	Large scale development of clusters along the Porter (1990) model is a distant possibility for Wales. Whilst firms benefit from a locally based components supply infrastructure, this is low priority when compared to keeping other production costs as low as possible.	
Munday, (2000).	Concerns relating to longer term trends in FDI outflows, together with increasing competition to host FDI have led some to conclude that resources in Wales (and UK) may be better used in improving the embeddedness of existing FDI companies rather than encouraging new ones.	
Morgan, (1997).	As real resources for development in Wales have fallen, they should be directed towards indigenous companies, supporting the development of supply clusters and promoting regional economic growth within a framework of a more innovative and learning region.	*Wales: A Better Country* (WAG, 2003); *Wales for Innovation* (WDA, 2004); '*WAVE*' (WAG, 2005).
Morgan (1996)	A policy with technology transfer and learning at its core has two issues: • supply problems • demand problems.	*Wales for Innovation* (WDA, 2004).

Lipietz (1992); Morgan (1996)	Lipietz (1992) argues that there is a division between regions related to whether to compete on low wages and a competitive environment (defensive restructuring) or on a high wage, high skill, high productivity, partnership approach (offensive restructuring) maintaining that most successful European regions have followed the latter. Morgan (1996) agrees and believes that whilst Wales has followed a dual track approach in the past, it has begun to develop a coherent offensive approach.	'WAVE' (WAG, 2005).

Table 2.1 – Policy Recommendations from Academic Literature and a Comparison to Relevant Welsh Assembly Government Strategies and Policies (Source: The Author)

It can be seen from Table 2.1 that the majority of policy implications or recommendations for Wales, identified by academic commentators, are being addressed, to some degree, by existing strategies and policies. Of the three that do not clearly align, two relate to industrial cluster development (Munday, 2000; IWA, 2005) and one relates to the need to embed existing FDI companies, rather than encourage new FDI inflows (Munday, 2000). Whilst WAG (2005) encourages the development of clusters, there is no mention of the potential implications of cluster development or FDI. As Lipietz (1992) and Morgan (1996) point out, Wales is now adopting a more offensive approach to regional economic development.

2.6 THE WELSH ASSEMBLY GOVERNMENT'S STRATEGIC FRAMEWORK FOR REGIONAL ECONOMIC DEVELOPMENT – 'PRIORITY SECTORS' – PRELIMINARY RESEARCH INTO SUPPLY CHAIN VOIDS

This section reports on the preliminary research required to select three priority sectors in which to investigate SCVs during the full study, as the WAG had not determined these previously. The work took four months between June and October 2006 and consisted of a literature review, collection and analysis of secondary data relating to the sectors, where available, and 30 interviews with sector experts. Figures 1.3 and 1.4 in Chapter 1 identify those sectors originally highlighted by WAG (2005) and WDA (2004) as priorities for regional economic development.

It became apparent quickly that it was difficult to obtain data on all sectors owing to Standard Industry Code (SIC) code problems, availability of data and resource issues. Therefore, a process of review and elimination was carried out, the results of which are summarised in Table 2.2, showing those sectors eliminated from further research and the reasons why.

Sector	Reference/Agreement	Reason for Elimination
Energy & Environment	19 July 2006, Supervisory Meeting; Formalised on 22 November 2006, Quarterly Review Meeting (QRM) with Sponsors and Supervisors	Scale and scope of the research, lack of data in preliminary research time scales
Social Care	18 July 2006, Tony Mizen, WAG; Formalised on 22 November 2006, QRM with Sponsors and Supervisors	Avoid duplication with 'Value Wales' public sector procurement work
Nano & Micro technology, Information and ICT, Materials and Combined and Converged Technologies	30 August, 2006, Supervisory Meeting; Formalised on 22 November 2006, QRM with Sponsors and Supervisors	Resource constraints, non-availability of stakeholder expertise in timescales, lack of available data

Table 2.2 – Review of the Research Scope and Elimination of Key Sectors (The Author)

However, all of the high technologies identified in Figure 1.4 were researched during meetings with key sector stakeholders to see if and how they were enablers to the other priority sectors. The results of this analysis are summarised at Table 2.3, where the horizontal headings represent Welsh priority sectors and the vertical axis shows high technology, enabling sectors. This shows that all high-technology sectors underpin the priority sectors through a variety of products, services and infrastructure, ergo their supply chains, for example, Bioscience technologies are seen to support the Automotive sector through the development of bio-fuels.

This section has introduced the preliminary research phase. The next section provides the results of these initial investigations into Welsh priority sectors and SCVs.

Sector/High Tech Enabler	Automotive	Aerospace	Electronics	Optronics	ICT Hardware	ICT Content/Software	Agri-Food	Biosciences	Pharmaceuticals/ Bio-chemicals	Financial Services
Biosciences	Bio-fuels	Bio-fuels	Bio sensors.	Biosensors	Visioning hardware and software	Visioning hardware and software	Development of healthy foods/crops		Development of biofuels and biochemicals.	Equity/funding services for Bioscience companies, Biometric ID systems
Electronics	Systems	Unmanned systems		Laser systems	Various systems	Various systems	Manufacturing systems	Laboratory equipment	Manufacturing and test equipment	Systems
Optronics	Assisted robotic assembly and vehicular night vision	Various sensors	Various sensors		Systems	Systems	Sensors etc in large food processing plants	Micro optical fluidic systems.	Various sensors	Systems
Information & Communication Technology (ICT) Hardware	Satellite systems	Satellite systems	Systems	Systems		ICT infrastructure and systems	Various systems	Visioning hardware and software	ICT infrastructure	Contact Centre systems
ICT Content/Software	Satellite systems	Satellite systems	Various systems	Various systems	IT Infrastructure		IT Infrastructure	Visioning hardware and software	ICT infrastructure	Contact Centre systems
Telecomms	Communication systems	Communication systems	Communication systems	Communication systems	Communication systems	Communication systems	Communication systems	Communication systems	Communication systems	Contact Centre systems
Materials	Composites, joining of eg composites and metals.	Composites, joining of eg composites and metals.	Light weight materials	Various materials	Greener materials	Data storage materials	Various packaging materials	Materials with chemistry fixed to the surface	Varicus packaging materials greener materials	Recycled materials/paper
Nano & Micro Technology	Various systems	Various systems	Devices - transisters and other devices etc, Processes including ultra precision engineering, other micro-opto electronics based precision processes	Micro-optics, processes such as ultra precision engineering	Various systems	Various systems	Micro-sensor technologies	Surgical/Treat-ment probes, processes such as ultra precision engineering	Delivery of non-invasive medication	In support of ICT and Contact Centre systems
Combined/Converged technologies (ie materials and manufacturing technologies)	To deal with noise pollution and environmental pollution, production line technologies and processes.	To deal with noise pollution and environmental pollution	Data processing and anufacturing applications	Various systems	Data management processing systems	ICT infrastructure and systems	In large food processing companies (process and technology)	Various manufacturing and processing	Varicus manufacturing and processing	Various systems

Table 2.3 – Matrix of Priority Sectors and Enabling High Technologies (Source: The Author)

2.6.1 SUMMARY OF RESULTS FROM THE TABLE OF CHARACTERISTICS AND THE PURCHASING DATA FROM THE DOMESTIC USE MATRIX AND SELECTION OF THE THREE PRIORITY SECTORS FOR THE CASE STUDIES

This section presents the results of the analysis of the 'Table of Characteristics' (ToC) that was created by the author using secondary data, purchasing 'linkage' data from the Welsh Input-Output Tables for 2000 (Welsh Economic Research Unit (WERU), 2004) and the anecdotal views of sector experts in Wales, relating to the existence of SCVs. Detailed analysis can be found at Appendix A.

The ToC was structured to contain statistics and qualitative information relating to the Welsh priority sectors, where available, with the aim of providing a strategic picture of these industries. Qualitative information relating to competences, risks and trade opportunities were obtained from relatively recent research carried out by WERU (2002) and the IWA (2005) which had used Multi Sector Qualitative Analysis (MSQA). Purchasing data are encapsulated within the 'Domestic Use Matrix' within the Welsh Input-Output Tables for 2000.

The detailed analysis of the ToC is at Appendix A with the summary results shown at Table 2.4. Considering the values associated with full time employees (FTEs), Gross Value Added (GVA), GVA per head/employee, Purchasing in Wales, rest of the UK (RoUK) and the rest of the world (RotW), the sectors have been assigned a rank position. Ranked positions 1 – 5 have been colour coded as shown with Table 2.4. Trends in FTEs and GVA are also colour coded. In addition to the quantitative analysis, the anecdotal SCVs identified during stakeholder meetings with sector informants have also been included as a starting point for further investigation in the case studies. These are varied and are summarised in Table 2.5.

Priority Sectors	FTE (2004)	FTE (Rank)	FTE Trend	GVA (2003)	GVA Rank	GVA Trend	GVA per Head	GVA Per Head Rank	Purchasing Value (PV) in Wales £m	PV in Wales Rank	PV in UK £m	PV in UK Rank	PV in RotW £m	PV in RotW Rank
Aerospace	9996	9		848	6		0.084	1	309.3m	7	213.1m	8	351.4m	2
Agri-Food	22907	5		897	5		0.039	6	747.0m	5	522.0m	5	227.3m	6
Automotive	13224	7		848	6		0.064	3	408.3m	6	368.4m	6	298.5m	4
Biosciences/ Pharmaceuticals	5176	10		N/K	10	N/K	N/K	N/K	N/K	10	N/K	10	N/K	10
Chemical/ Pharmaceuticals	10331	8		817	8		0.079	2	290.1m	8	307.9m	7	275.2m	5
Construction	51742	3		2404	1		0.046	4	1186.5m	2	683.5m	3	176.1m	7
Creative	17411	6		N/K	10	N/K	N/K	N/K	181.9m	9	212.2m	9	111.9m	9
Electronics (Optronics)	23425	4		997	4		0.042	5	778.9m	4	589.5m	4	913.2m	1
Financial & Professional Business Services	62216	2		1434	2		0.023	7	898.6m	3	728.8m	2	174.2m	8
Hospitality Leisure & Tourism	121201	1		1322	3		0.01	8	1692.6m	1	819.2m	1	328.5m	3

Key:	
Rank Position 1	
Rank Position 2	
Rank Position 3	
Rank Position 4	
Rank Position 5	
Increasing Trend in FTEs	
Decreasing Trend in FTEs	
Increasing Trend in GVA	
Decreasing Trend in GVA	

Table 2.4 – Summary of Analysis of the Priority Sectors (Source: The Author)

Sector	SCVs Identified
Aerospace	Composites - companies and skills to carry out techniques/processes for making composite materials for components and structures.
	Surface treatments for components etc.
	Clean rooms.
Agri-Food	Abatoirs in the right location.
	No coherent meat supply chains in Wales.
	Peanuts etc. that cannot be grown in Wales/UK and have to be sourced from elsewhere.
Auto, Aero, Electronics	Road Infrastructure in Wales/M4!
Automotive	Motor Sport Companies have SCVs - no details
	Capability to produce products in volume – this would require collaboration by a number of companies in Wales.
	R & D and Testing facilities for Welsh companies to develop and test prototype products.
	Finance e.g. a company wants to borrow less than £10 m to invest in the business and has to go to a bank in Bristol!
	Collaborative purchasing and supply chain opportunities, including sharing of capacity with logistics providers.
	Cheap energy prices.
	The biggest issue is facing companies lower in the supply chain in finding bigger companies to supply goods/services to in Tier 1 and Original Equipment Manufacturers (OEMs).
	Material capability issues associated with e.g. technologies to enable the joining of different materials i.e. composites parts to steel chassis etc.
Biosciences	Specialist testing facilities e.g. clean rooms/laboratories, animals for use in testing, people for use in testing, equivalent facilities/capabilities of e.g. Huntingdon Life Sciences.
	Specialist equipment to carry out Phase 1 Clinical Trials.
	Specialist logistics companies who manage/transport molecules for testing etc.
	Sterile facilities and cleaning fluids.
	Basic infrastructure
Construction	Paints (Sikkens & others from Devon and Canada bought via a distributor in Ludlow) & Oils (German Company) etc. used on wood.
	Laser equipment used to optimise wood and cut to size for jobs - bought from Germany - specialist equipment.
	Labour & Skills
Creative Industries	In film/TV: Skills: Electricians, Carpenters, Set designers.
	In film/TV: TV/Film Studios (only 3 in Wales: 2 in Cardiff and 1 in N Wales), therefore Wales does not have capacity for another 'Dr Who'.
	Effective and capable communications (e-infrastructure).

Electronics	Skills
	Professional Services to aid with the protection of intellectual property etc.
	OEM
	Obsolescence management
	Waste electrical and electronic equipment (WEEE) services
	Intellectual Property (global)
Financial and Insurance Services	ICT Hardware & Software
	Telephone Systems i.e. 'SWITCH'
	HR services including Training and Recruitment services.
	Legal services

Table 2.5 – Summary of 'Anecdotal' Supply Chain Voids Identified by Industry Informants between June and October 2006 (Source: The Author)

Owing to the vast scope of the research project, the aim at this stage was to identify three of the priority sectors to pursue to the next stage of the research via semi-structured interviews with individual companies, to identify and quantify SCVs in capability.

In pursuance of the academic need for a diversity of sectors in which to study SCVs, reference was made to previous research by the IWA (2005, p 9) into regional development and the identification of priority sectors. The IWA concluded that it may be worth selecting three priority sectors for further research based on the following criteria:

- *To support where necessary, current areas of strength.* Here, this could relate to the Financial Services sector as it underpins so many of the other priority sectors in Wales through their purchasing activities as depicted in Appendix A, Table A1.5 and Figure A1.11. It also ranks highly in FTEs in second position, the employment trend is increasing, overall GVA is ranked in second position although GVA per employee is very low, purchasing in Wales is ranked third with purchasing from the RoUK ranked second. Figure 2.1 shows the breakdown of the purchasing activities in Wales by the individual Industry/Product Groups within the Financial and Professional Business Services grouping. When added together, it can be seen that Financial Intermediation and Insurance Services account for in excess of £700m of purchases in Wales. The percentage comparison of purchases for Financial

Intermediation and Insurance are shown in Figures 2.2 and 2.3. In total, £134.3m (15%) is bought from the RotW for Financial Intermediation and Insurance. Anecdotal SCVs identified by industry informants include ICT hardware and software, specific telecommunications systems such as 'SWITCH', human resource and legal services. These need to be validated; therefore this is a suitable sector to pursue to the next stage.

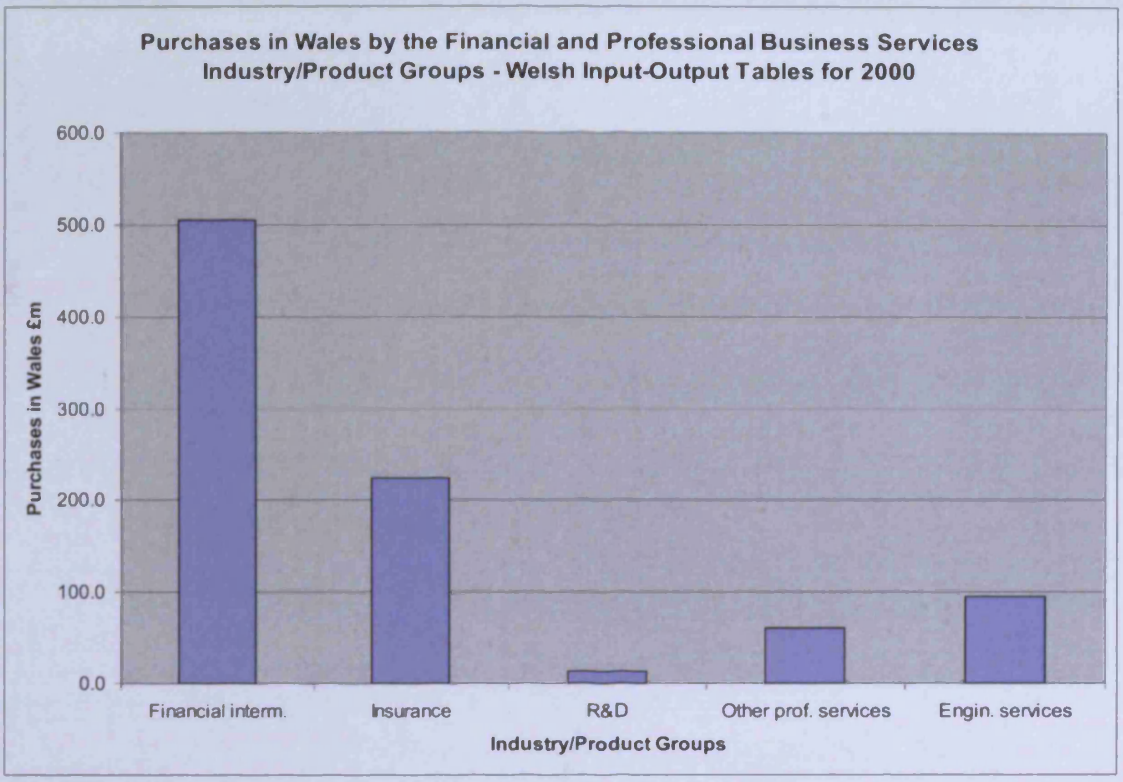

Figure 2.1 – Purchases in Wales by the Financial and Professional Business Services Individual Industry/Product Groups (Source: The Author, based on the Welsh Input-Output Tables for 2000)

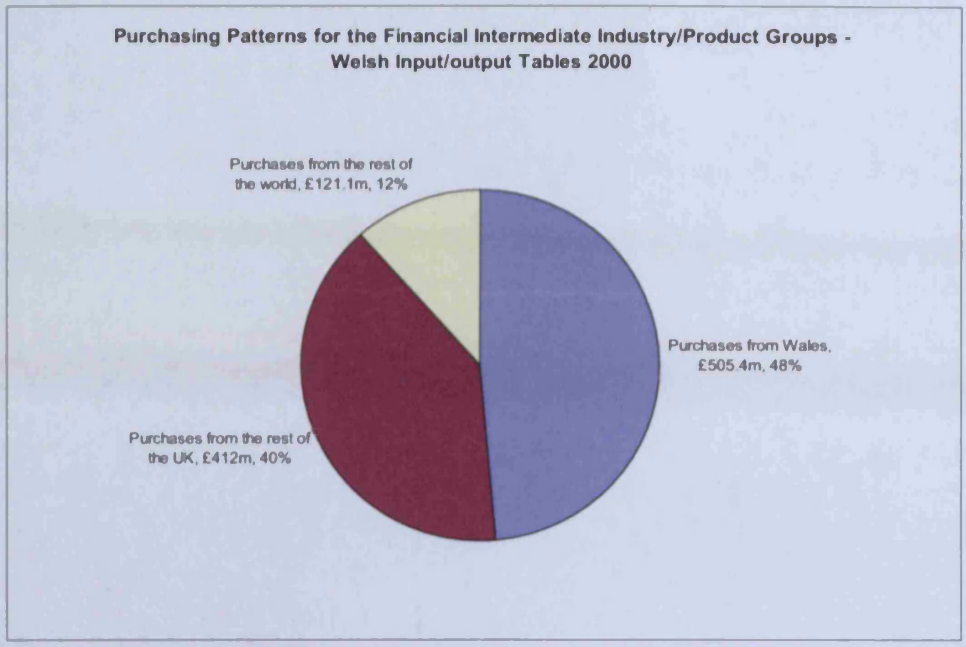

Figure 2.2 – Percentage Comparison of Purchases Made by the Financial Intermediation Industry/Product Group (Source: The Author, based on the Welsh Input-Output Tables for 2000)

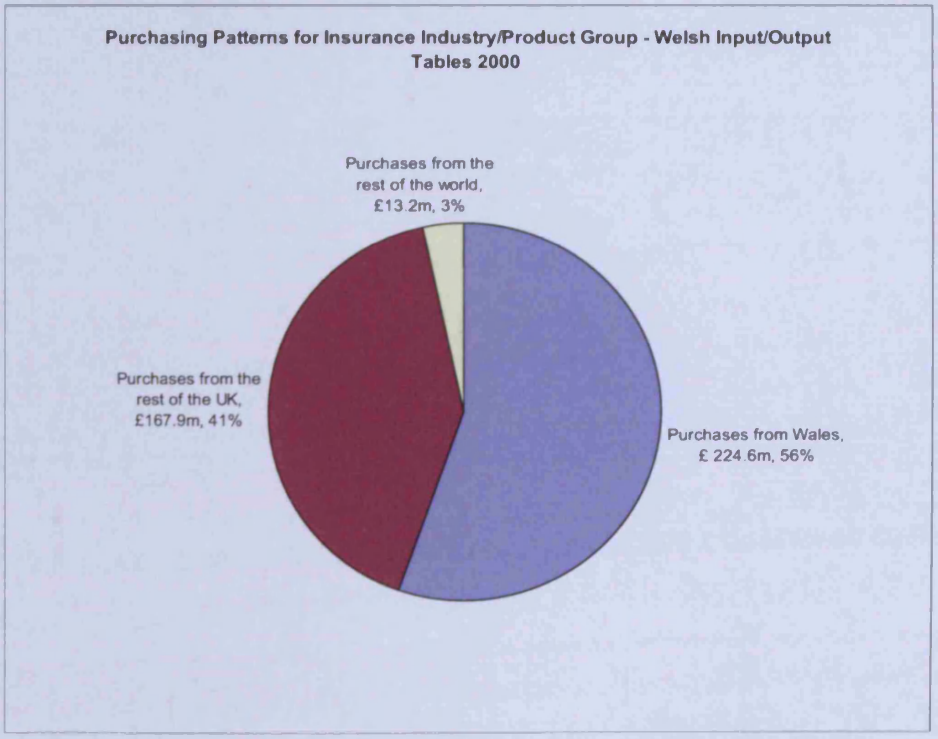

Figure 2.3 – Percentage Comparison of Purchases Made by the Insurance Industry/Product Group (Source: The Author, based on the Welsh Input-Output Tables for 2000)

- *To develop new/latent sectors.* In this study, this could relate to Biosciences. Although not all statistics were available from WAG, resulting in a partial picture of the sector, it is a sector under development and a focus is required to aid such activities. Not withstanding this lack of data, the Biosciences report commissioned by the WDA (Deloitte & Touche, 2006) provides the background to the sector and based on the data that was available, the trend in FTEs is believed to be increasing with jobs being of a high value owing to the 'ideas generation' element. Anecdotal SCVs identified by industry informants include highly specialised testing facilities, equipment, logistics companies, sterile facilities and basic infrastructure. These require further investigation; therefore this sector is appropriate for the case study stage. The fact that this sector is under researched in Wales is another reason for further investigation.
- *To ameliorate problems in sectors likely to decline further.* In the case of SCVs this could be Aerospace. Whilst there are strengths as the GVA per employee is ranked at position one, the FTE numbers are low but the trend is increasing. It is also forecasted that both passenger and cargo requirements are increasing (WAG, 2006). Whilst the total GVA is the lowest in Wales, alongside the Automotive sector, the GVA trend is increasing. However, there is the potential for the sector in Wales to decline if it does not grasp the technological challenges relating to materials and structures (e.g. composites and Unmanned Systems development), skills and business development in Wales. The purchasing data for Aerospace is not wholly reliable as it is based on the SIC code for 'Other Transport Equipment'. Anecdotally, a number of SCVs have been identified by the Aerospace Wales Forum (2 Oct 06). These include materials technologies for structures and components, surface treatments and clean room facilities. However, opportunities exist to investigate this sector to identify and quantify SCVs, particularly in relation to developing technologies such as Unmanned Systems.

The reasons for excluding the other sectors from further research are as follows:

- The Agri-Food sector in Wales has a low level of FTEs when compared to the other sectors. The total GVA is low to medium and the GVA per employee is

medium. Purchasing activities in Wales are low for individual Industry/Product groups but when aggregated in to an Agri-Food grouping they are the fifth highest in Wales. Figure 2.4 demonstrates the purchasing split between Wales, RoUK and the RotW for the Agri-Food grouping. Whilst 85% of purchases are made in Wales and the RoUK, only 15% of goods and services are imported from the RotW and this includes such items as peanuts which cannot be grown in the UK climate but are processed in Wales for wider use within the Agri-Food sector (Griffiths, 6 Jul 06). Therefore opportunities to identify and pursue SCVs are believed to be low so the Agri-Food sector is to be eliminated from the research.

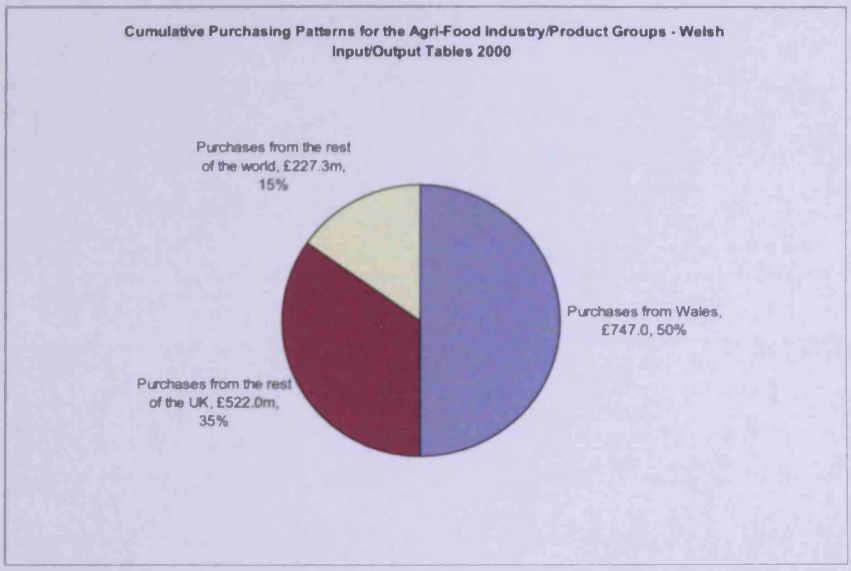

Figure 2.4 – Percentage Split and Value in £m for the Total Agri-Food Grouping Purchases split by Wales, Rest of the UK and the Rest of the World (Source: The Author, based on the Welsh Input-Output Tables for 2000)

- The Automotive sector in Wales is an interesting case with much support devoted to it from the WAG (e.g. 'Accelerate Wales' Clusters) and the Welsh Automotive Forum. Whilst the sector is one of the lowest in terms of FTEs, it has a medium total GVA value and is third highest in GVA per employee value. With reference to purchasing activity in Wales, Automotive is the fourth highest individual Industry/Product Group. However, when other individual

Industry/Product groupings are aggregated into the priority sector groupings for example, such as Agri-Food and Hospitality, Automotive slips to sixth position. Figure 2.5 summarises the purchasing values (PVs) from Wales, the RoUK and the RotW. Whilst this graph shows that up to 72% was bought in Wales or the RoUK in 2000, discussions with the Chief Executive Officer (CEO) of the Wales Automotive Forum (9 Oct 06) advised that manufacturing jobs and activities have been transferring from Wales to the RotW and along with it, the purchasing activity in Wales and the RoUK is believed to have reduced, leading to increased imports from the Far East and Eastern Europe, for example. On a positive note, he also stated that the companies in Wales are becoming more collaborative in research, design and manufacture activities of assemblies rather than parts. With ownership of many Welsh companies residing outside of Wales, the UK or even Europe, there is little influence that can be applied to increase purchasing activity in Wales. As the previous SCV pilot study into forging confirmed, to re-introduce such a capability in Wales was cost prohibitive (DMC Consulting, 2005). Therefore with the intense support already in existence and the lack of realistic opportunities for resolving SCVs in Wales, Automotive has been removed from the scope for the next phase.

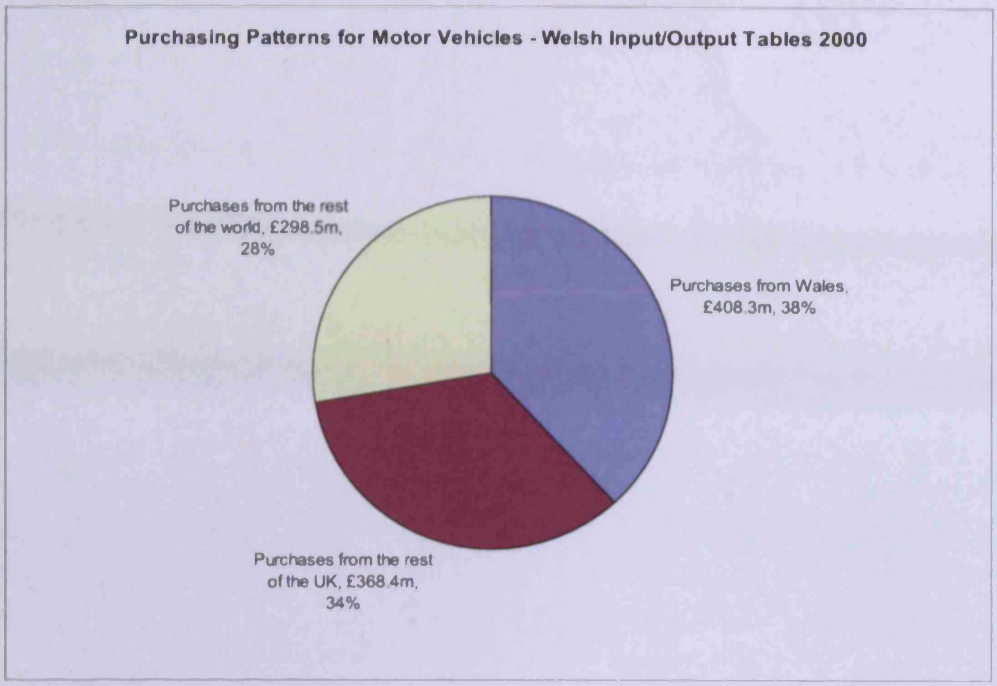

Figure 2.5 – Percentage Split and Value in £m for Motor Vehicles Purchases split by Wales, Rest of the UK and the Rest of the World (Source: The Author, based on the Welsh Input-Output Tables for 2000)

- The Construction sector is the fourth highest for FTEs in Wales and the highest for total GVA. However, GVA per employee is medium and could be reduced significantly if the total number of employees, including the self employed and the grey economy were included. Whilst the employment trend shows a decrease in FTEs in 2004, compared to 1998, the situation as at 2006 was very healthy for Construction in Wales and employee numbers were disputed by industry informants, owing to the nature of the sector i.e. self employment and the grey economy. Purchasing activities in Wales are the highest amongst all individual Industry/Product Groups, with purchases from the RoUK being high with only 9% of goods and services being imported from the RotW, as shown in Appendix A, Table A1.4. As with the Agri-Food sector, there appears to be a low opportunity for identifying significant SCVs in Wales.
- The Creative Industries team within WAG formed in the summer of 2006. During a meeting that the author had with the team, it was clear that they were still establishing themselves and it appeared that the SCVs study had come a little early for this sector. In addition, there was little data available on the

sector. Other issues include the intangible aspects of the activities within the supply chains and the need to deal with individual companies in both Welsh and English. The author does not speak Welsh and would be reliant on the services of translators within the WAG to progress with interviews in some cases. It was therefore decided to forego the opportunity to work with this sector as the timescales and resources preclude it.

- The Electronics sector is similar to Automotive only there is not as much dedicated support from WAG. There is however, a Welsh Electronics Forum that supports the sector. When compared to the other priority sectors, the number of FTEs in this sector in Wales is low. The total GVA is medium as is the GVA per employee. Individual Industry/Product Groups have reasonably low to medium levels of purchasing in Wales. However, when they are grouped within an Electronics grouping, Electronics is the fourth highest purchasing sector in Wales. Purchasing activity is summarised in Appendix A, Table A1.3 where it can be seen that 34% is bought in Wales, 26% in the RoUK and 40% from the RotW. This is the highest value of imports when compared to the other sectors and in 2006, it was believed to be larger (Young, 3 Oct 06). Also, Appendix A, Table A1.5 shows that 'Wholesale' is the biggest supplier to the individual Industry/Product Groups within Electronics and it is expected that these distributors are in Wales but are providing goods from outside of the UK. During a meeting with the Managing Director (MD) of the Welsh Electronics Forum (Young, 3 Oct 06) it was confirmed that increasing manufacturing activities are leaving Wales and transferring to the Far East, for example. Therefore the sector in Wales is trying to move up the value chain into research, design and manufacture of assemblies, rather than piece parts. Based on the fact that OEMs are located in the RotW, parent companies are also based outside of Wales, and there is a migrating manufacturing base, Electronics has been eliminated from the study.
- The Hospitality grouping has the highest number of FTEs in Wales, an increasing trend in employment numbers, the third highest GVA value, but the lowest GVA per employee. However, it has the highest purchasing activities by value within Wales and the RoUK as shown in Appendix A, Table A1.3. Only 12% of goods and services are imported from the RotW. Therefore, there is

little opportunity to identify SCVs in Wales. As the GVA per employee is the lowest in Wales, the jobs are understood to be poorly paid and low quality. As the WAG is pursuing a strategy to develop high quality jobs in Wales it has been decided to eliminate this sector from the study.

In summary, based on the findings of the preliminary research phase, the author has decided to select the following sectors to pursue to the case study stage, based on the IWA (2005) recommendations:

- Biosciences – a developing sector
- Financial and Professional Business Services, with a focus on Financial Intermediation and Insurance Services in Wales – an established sector still growing in Wales and referred to within the thesis as 'Financial'
- Aerospace – a mature sector with challenges, focussing on Unmanned Systems.

Whilst these sectors were agreed by the WAG and academic supervisors during the QRM held 22 November, 2006, it is recognised that they are from the scope of priority sectors in Wales and ignore other sectors within the economy. As this is an investigatory study into SCVs, findings should identify differing contingencies between sectors that may also relate to non-priority sectors and help to develop and pilot test a generic framework to address such problems.

Interestingly, the ongoing literature search identified that the sectors selected for further research into SCVs are the three sectors reported as the most important to the UK economy (DTI, 2005).

This section has provided the results of the preliminary research phase, resulting in the selection of three sectors in which to carry out further research into SCVs. The next section concludes this chapter and summarises its relevance to the thesis.

2.7 CONCLUSION AND RELEVANCE TO THE THESIS

This chapter has provided the background and historical context of regional economic development in Wales. It has summarised the key WAG strategies that inform this study prior to a comparison with a representative selection of academic policy

recommendations. This was followed by a brief summary of the 'Source Wales' programme, as it was the forerunner to the SCVs research. Finally, the priority sectors were investigated and analysed, before three were selected by the author for further research into SCVs.

The main points of relevance to the thesis, contained in this chapter are:

- The research into SCVs builds upon the regional economic development of the past, including the 'Source Wales' programme and takes Wales into the 21st century.
- The policies and strategies being developed and deployed by the WAG build upon previous research and recommendations of Welsh commentators; hence this study extends such work.
- The priority sectors have been investigated and three have been selected for further research into SCVs.

Chapter 3 now commences with a summary of how the literature and Research Questions evolved before reviewing the cognitive theory literature.

Chapter 3

Literature Review

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Background Cognitive Theories

CHAPTER 3 – LITERATURE REVIEW – BACKGROUND LITERATURE - COGNITIVE THEORIES

3.1 INTRODUCTION, DEFINITION AND STRUCTURE OF THE CHAPTER

This chapter initially explains how the Research Questions were forged during a reflective and retroductive approach to the study. It then moves on to review the background (Williams, 2004) or foundation (Phillips and Pugh, 2005) literature, which relates to cognitive theories. In contrast, the foreground (Williams, 2004) or focal (Phillips and Pugh, 2005) literature aligns to the specific area of enquiry, often drawing upon empirical research and this is reviewed in Chapter 4.

The Research Questions relating to the study have been affirmed through reference to the literature and are shown in Table 3.1. They were originally derived through a review of purely P & SCM literature but were further developed to address research gaps in more relevant work from search and contingency theories, material input, supplier or local linkages, regional embeddedness and sustainable development.

Research Questions	**Final Literature Review**
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	e.g. search and contingency theories, P & SCM, economic linkages (see Chapters 3 and 4 for detailed literature)
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	e.g. Hoshin Kanri (Akao, 1991), material input, supplier or local linkages (Crone, 1999). See Chapter 4.
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?	e.g. sustainable development (WCED, 1987), regional embeddedness (Granovetter, 1985). See Chapter 4.

Table 3.1 – Research Questions (Source: The Author)

Saunders *et al.* (2003) advise that the main purpose of a literature review is to help develop a good understanding and insight into the relevant, previous research and the trends that have emerged from it.

As SCM is seen to be a concept, rather than a theory (e.g. Croom *et al.*, 2000; Burgess *et al.*, 2006), a number of management theories have been reviewed to identify their suitability for this study. Appendix D reflects upon the review and selection of cognitive theories, resulting in two for review:

- Search Theory – this is relevant to the study owing to the behaviours of individuals carrying out the search activities or process by sourcing/purchasing companies to identify suitable suppliers and how for example the WAG may search to identify options to address SCVs.
- Contingency Theory – this is relevant as contingency factors affect decision making and organisational (i.e. P & SCM) structures. Sourcing decisions by companies are contingent upon a number of factors as are possible solutions to address SCVs.

An illustrative selection of the literature has been reviewed and gaps are identified where this research may make contributions to academic knowledge. The focus of this review is highlighted in Figure 3.1 which demonstrates how the background literature links to the foreground and other literature and translates as shown in Table 3.2.

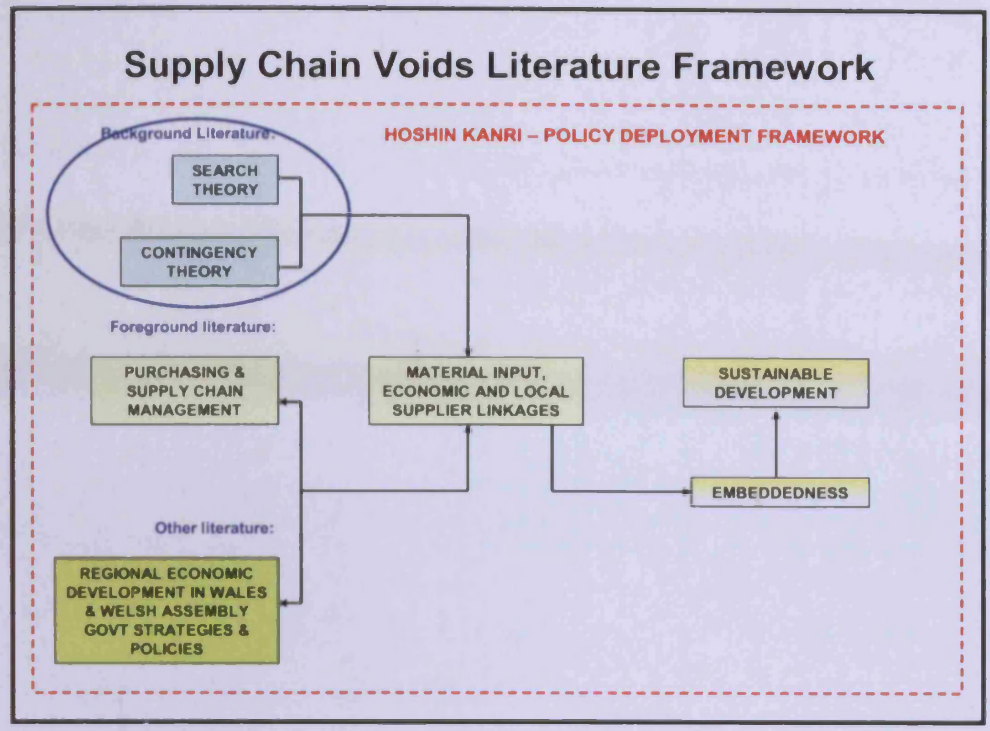


Figure 3.1 – The Focus of the Literature Review Framework for the Study of Supply Chain Voids in Wales (Source: The Author)

Type of Literature	Colour Code	Explanation of Literature Type	Location within the Thesis
Background	Blue	Key cognitive theories in which to ground the study and guide the SCVs framework development.	Chapter 3
Foreground	Red	Empirical or applied concepts used to guide the SCVs framework development.	Chapter 4
Foreground	Pale Yellow	Empirical or applied concepts	Chapter 4
Foreground	Pale Yellow/White	Empirical or applied concepts used in the SCVs framework development.	Chapter 4
Other	Green	WAG strategies and policies	Chapter 2

Table 3.2 – Explanation of Figure 3.1 and the Location of the Literature in the Thesis (Source: The Author)

Criticism has been directed towards the study of SCM for adopting a principally empirical and descriptive approach, rather than something more theoretical, hence the lack of an accepted cognitive theory in this discipline. Such criticisms and concerns are summarised below.

Croom *et al.* (2000) state that SCM is not theoretically or conceptually well researched asserting that 'whilst supply chain management as a concept is a recent development, much of the literature is predicated on the adoption and extension of older, established theoretical concepts' such as Transaction Cost Economics (TCE) and competitive strategy (p 68). Svensson (2003) on the other hand identifies deficiencies in theory generation within SCM research. Concerns relate to the need to move from atomistic theory generation towards something more holistic and cross-disciplinary, beyond the traditional boundaries of SCM which include economics, engineering, operations management, production management, and logistics.

Burgess *et al.* (2006) highlight theoretical concerns in relation to the lack of evidence aligned to the theoretical underpinning of SCM research and identify that of the literature reviewed, 20% has no discernable theory and 52% rely on TCE or competitive advantage as a theoretical perspective. In addition, Harland *et al.* (2006) principally address the Research Question as to whether or not SCM may be called a discipline and carry out a structured literature review, concluding that there is insufficient evidence to suggest SCM is an independent discipline, mainly owing to the limit of debate relating to the SCM discipline within the literature and a limited theoretical foundation. However, they propose that SCM is an emerging discipline in need of strong academic leaders to expand both the theoretical base and paradigmatic position. Finally, Storey *et al.* (2006) assert that 'Supply management can be viewed as both an emergent field of practice and an emerging academic domain' (p 754). The authors argue that for SCM to develop, the gap between theory and practice must close by redefining the boundaries of SCM theory, leading practice into new domains.

Further to these theoretical concerns, previous SCM studies have acknowledged the multi-disciplinary nature of such research. Zokaei (2009) adopted contingency and

process theories, Mason (2009) reviewed systems, the Resource Based View (RBV), principle agency, network and relational contract theories amongst others. James (2003) elected for organisational theory whilst Williams (2004) chose TCE and the theory of the firm in concert with institutional sociology, network and contingency theories. TCE and organisational theory have also been used by Croom (1996), Hines (1995) and Lamming (1993). This study uses the theoretical foundation of both search and contingency theories.

This section has introduced the background theories for review in this chapter, highlighted concerns relating to SCM and its role as a concept, rather than an academic discipline and provided examples of theoretical foundations adopted for use in previous SCM studies. The following sections define and review search and contingency theories whilst identifying the research gaps to be addressed by this study.

3.2 DEFINITION OF SEARCH THEORY

Bothamley (1993, p 477) states that search theory has its provenance in the field of economics. She defines it as 'the analysis of how buyers and sellers acquire information about market conditions and how potential market participants are brought together'. Search theory purports to explain how individuals behave when they have imperfect or incomplete information relating to the market (Rothschild, 1974). The concept of bounded rationality plays its part here (Williamson, 1975). Stigler is seen to be largely responsible for introducing this theory to the field of economics, suggesting that an individual should visit *n* stores, obtain price quotations and then buy from the cheapest store (Rothschild, 1974). In contemporary parlance, this could relate to the number of suppliers' web sites or on-line stores or resources accessed on the internet by potential buyers.

The application of the theory to labour markets in the USA was pioneered by Stigler (1962). In this instance, it was recognised that for search theory to be applied, both employers and workers need to invest time and other resources to meet, if mobility within the labour market is to continue. Therefore, in relation to sourcing activities, both buyers and suppliers need to invest time and other resources to meet to explore

opportunities. More recent investigations into the labour market have been made by Pissarides (2000; 2001). Whilst reference to buyer and seller information search activities can be located within the literature (e.g. Stigler, 1961; Perry and Widgerson, 1986; Proctor, 1978), no empirical studies have been found applying or relating search theory to P & SCM activities within a business setting, or relating to regional economic development, hence these gaps are to be addressed within the study.

3.2.1 SEARCH THEORY - BACKGROUND

The development of search theory began during the Second World War and has evolved through four eras as depicted in Table 3.3. It has grown into a major discipline within the field of operations research (Richardson, 1989).

Era	Type of Search Theory	Description/Key Elements	Key Authors
1942 – 1965	Classical	Optimal allocation of a fixed amount of search effort to detect a stationary target. Known as optimal detection search.	Koopman, 1946, 1956a & b, 1957.
1965 – 1975	Mathematical	Stationary and moving target problems.	Stone, 1975
1975 – 1985	Algorithmic	The use of cheap and powerful computers to solve moving target problems resulting in the 'theory of optimal search'. Modelling of both 1-sided and 2-sided search problems. Simple feedback mechanisms advising that a target has been detected.	e.g. Rothschild, 1974
1985 onwards	Dynamic	Dynamic search plan systems, updated based on all available information relating to e.g. changing location. Development of computer assisted search systems (e.g. submarine surveillance).	e.g. Haley, 1981

Table 3.3 – The Evolution of Search Theory (Source: The Author, based on Stone, 1989)

3.2.2 LITERATURE REVIEW FOR SEARCH THEORY

There is some evidence within the consumer buyer and consumer choice literature (e.g. Zhang *et al.*, 2006) of the application of search theory. The use of complex mathematical models in search of 'electronic' information is prevalent. This section of the thesis concentrates on the qualitative, descriptive aspects of search theory and search models, not the technicalities of the mathematical models. The study seeks to understand what is happening and why, therefore descriptions and explanations are important, not how the models are technically constructed and operate.

The critical features of a search problem are concerned with the nature of a specific target in space and time, along with the method and efficiency of the search (Haley, 1981). Much of the literature has reported in theoretical mode owing to the confidentiality of the military orientated cases under investigation (Haley, 1981; Haley and Stone, 1979) i.e. submarine surveillance or search and rescue of crashed aircraft or personnel. More contemporary applications of search models identified by Haley (1981) include those used for coastguard services, mineral exploration, tracking of animals or escaped convicts.

The methodology of search demands a number of processes, decisions and assumptions to be adopted (Stone, 1975). The theory of consumer search was introduced by Stigler (1961) to explain the observed dispersion of prices in markets, with search being seen as a basic feature of economic markets. Complex decisions require extensive forethought in the search for alternative courses of action to be taken within organisational decision making (Proctor, 1978).

Theories which are more closely associated with individual search to market dispersion have been developed by Hey (1974), Manning (1976) and Wilde (1977). Much of the literature concentrates on the elaboration of the search problem whilst Stigler (1962) furthers his original contribution with an application of search to finding a well paid job. Hvidding (1979) draws parallels between both the search for jobs and prices within

their respective markets. Complex analyses of search for low prices have been carried out by many, including Rothschild (1974).

Stigler (1961) contends that the searcher selects the number of quotations to obtain, and that this number is not revised in light of experience. This can be called a fixed-sample size (FSS) strategy (Manning and Morgan, 1982). (In a business example, sometimes purchasing departments will ask for three quotes). Some authors have subsequently refuted this in support of sequential search where the searcher decides, after each quotation is received, whether or not to get another quotation (e.g. Rothschild, 1974). Manning and Morgan (1982) assert that both FSS and sequential search are special cases of a general search strategy in which the searcher obtains a number of quotations, before deciding on how many more to obtain before making a final decision. This general search theory was first introduced by Morgan (1977) and elaborated further in Morgan (1979).

Economic theory literature (Weitzman, 1979; Stahl, 1989) models consumers' search behaviour as a compromise of the anticipated utility gain, through price reduction and the additional search cost. Another way of phrasing this is that consumers search for information as long as the gains from that search are higher than the marginal costs (Sen *et al.*, 2006). TCE theory (Williamson, 1975) identifies that search and information costs, such as those incurred in determining that the required good is available in the market whilst assessing options for the lowest price, for example, are of important economic consideration.

Owing to the limited amount of literature found relating to search approaches for consumer and industrial or organisational buyers and general search for information, an illustrative selection has been reviewed identifying the main elements aligning to the study.

Foster and Ford (2003) report that serendipity is important across disciplinary areas, for its role in connection building, discovery and creativity relating to the search and retrieval of academic information. They also find that the literature presents serendipity as being both passive and yet capable of 'efficiency', or techniques by which hidden

knowledge may be retrieved and that researchers have an idea of the type of information required but may be uncertain as to whether it exists or may be located.

There is more literature relating to consumer search approaches. Axell (1974) describes a model where the distribution of supply is given and consumers search sequentially were there are three types of information relating to consumer search for goods/services. These are price, quality grades and properties and the usefulness of such properties. The consumer must weigh the cost of improving the basis of decision making against the expected benefit of continued search activity and seeks out price data sequentially, estimating after each new observation, the expected benefit from continued searching, comparing that to the cost of the search. This gives an 'adaptive search model'.

Stigler (1961) finds that wealthy consumers search less than poor consumers whereas Schmidt and Spreng (1996) assert that the search for information depends on the individual's ability and motivation, which are both required to acquire information via effortful search. The four variables are ability, motivation, cost and benefit. Dellaert and Haubl (2004) add that at each stage of the search process, the consumer makes two related micro decisions: whether the current product is the most attractive thus far or whether to terminate the search and buy the best of the options identified, or continue the search. They also report the searcher's tendency to optimise locally i.e. to over-rely on recently encountered product information.

Johnson *et al.* (2004) advise that on average, consumers search 1.2 sites/stores for books, 1.3 for Compact Discs (CDs) and 1.8 for air travel services compared to Zhang *et al.* (2006) who report an average of 2.1 sites/stores for CDs and 3.3 for air tickets and computer hardware products.

For general search activities, Rothschild (1974) identifies that search is based on the lowest price and that if the costs of the search increase, the amount of search decreases indicating that the optimal search rule is sequential (i.e. after receiving each price quotation, the searcher decides whether to continue searching or not) and is characterised by a reservation price, where the searcher will accept any price </= the

reservation price and will reject higher prices. The reservation price is a function of the searcher's beliefs and it changes as their beliefs are revised through experience. Those who fail to find low prices in initial searches despair of ever finding them and become willing to accept higher prices as they become less finicky!

In relation to information search, Manning (1976) reports the actions of non-specialist traders selling to a known demand, finding that specialist traders will endeavour to find out whatever information is in their interest to know. However, many markets are characterised by non-specialist traders who will not, with a reasonable expenditure of effort, be able to discover facts which a specialist would be able to exploit.

Job search features prominently within the search literature. Soelberg (1967) finds that as long as people are involved in corporate decision making, the choice processes of individuals will remain a key feature of management decision making whilst Salop (1973) asserts that searchers' standards fall as they first explore the most attractive possibilities. If these prove unsatisfactory, they demand less from what remains. Moreover, Gronau (1971) asserts that the cost of search increases as time goes on, echoing some of the consumer search findings. More recently, Ioannides and Loury (2004) identify that access to job information is heavily influenced by social structure and social networks.

The search process within an organisational context has been studied. Proctor (1978) identifies that when exercising choice between alternative courses of action, firms set minimum values to be obtained on each objective, selecting the strategy that reaches or exceeds the required levels for all objectives (e.g. supply chain objectives such as Quality/Cost/Delivery). In addition, Belich and Dubinsky (1995) find that internal, small firm specific factors such as managerial processes, organisational structures and capabilities can impact successful information search. In relation to entrepreneurial activities, Palich and Bagby (1995) report that individuals' search behaviours are bounded by the decision maker's knowledge of how to gather and process an appropriate amount of information, hence people with limited experience may simplify the search process whilst those with considerable experience may better target sources of information. Finally, Yeoh (2005) finds that an individual's ability and motivation to

search for information are important identifying that larger firms have the resources to obtain and process greater amounts of information, smaller firms may need to make trade-offs in the efficiency in which information is processed and acted upon.

The main themes and findings from this review summarised in Table 3.4.

Author(s)	Key Themes/Findings Relating to Search Theory Literature
Zhang *et al.* (2006); Johnson *et al.* (2004)	The average number of sites searched before consumer selection is made
Yeoh (2005); Schmidt and Spreng (1996); Palich and Bagby (1995)	The ability and motivation of the searcher
Delleart and Haubl (2004)	Sequential search and the consumer's tendency to over-rely on most recently encountered information
Ioannides and Loury (2004)	The influence of social structures and networks in relationship to access to information
Foster and Ford (2003)	The role of serendipity in the search for information
e.g. Zanchi (2000); Rothschild (1974); Salop (1971)	A variety of search models exist
e.g. Belich and Dubinsky (1995); Manning and Morgan (1982); Proctor (1978)	The importance and variety of contingencies or factors to consider during the search
Manning, 1976; Palich and Bagby, 1995	The behaviour of specialist traders and entrepreneurs in search activities
Rothschild (1974); Gronau (1973)	Cost of search resources versus the length of the search
Soelberg (1967)	The choice processes of individuals will remain a key feature of management decision making.

Table 3.4 – Key Themes and Findings Relating to the Search Theory Literature (Source: The Author)

The selected search theory literature is mainly descriptive, to inform the discussion in Chapter 10 as guided by the 'what' (descriptive) and 'why' (explanation) Research Questions. Whilst a number of criticisms of search theory or its mathematical models have also been identified, they relate specifically to the mathematical models so have been excluded from this section.

The main contributions of search theory to the study are summarised in Table 3.5.

Research Questions	Author(s)	Research Issue/Gap
1 - What supply chain voids in capability exist in three of the priority sectors in Wales and why?	Axell, 1974; Rothschild, 1974; Manning and Morgan, 1982.	Model(s) suitable for supplier search.
	Stigler, 1961; Perry and Widgerson, 1986; Proctor, 1978.	No empirical studies applying or relating search theory to P & SCM within a business setting, or to regional economic development.
	Axell, 1974; Rothschild, 1974; Proctor, 1978; Dellaert and Haubl; 2004, Heriot, 1996).	Application of search models in relation to achieving supply chain priorities (see Heriot, 1996).
2 - Can a generic framework be developed to address supply chain voids in capability within the sectors?	Search theory. (Various – see Table 6.6).	Application of search theory in the proposed framework.

Table 3.5 – The Main Contributions to Search Theory from the Supply Chain Voids Study (Source: The Author)

This section has reviewed an illustrative selection of literature relating to search theory, summarising the key themes and highlighting the main contributions relating to this study. The next section does the same for contingency theory.

3.3 DEFINITION OF CONTINGENCY THEORY

Bothamley (1993, p 116) defines contingency theory as 'a sceptical theory of politics and history' elaborating that 'any historical situation or set of political events are likely to be shaped by particular circumstances' or contingencies e.g. general structures, rules or frameworks. Therefore, understanding a particular situation relies upon looking at the specifics of a case and at the general conditions in which it occurs.

In addition to contingency theory, the 'situational' approach is also referred to (e.g. Luthans, 1976; Luthans and Stewart, 1977; Hershey *et al.*, 2009) in relation to management and leadership. Bothamley (1993, p 488) identifies that 'situationalism'

derives from the school of philosophy and defines it as an 'ethical doctrine that our moral duty cannot be rigorously subjected to general rules, but must take account of each situation as it arises'.

Whilst this section concentrates on contingency theory, the author recognises the comparison to 'situations' which are also be referred to as 'contingencies' by some authors.

Reference to the selected literature indicates a number of possible gaps that this study could address. Environmental contingencies are understood to affect decision making within organisations (e.g. Groff and Muth, 1972; Perrow, 1967; Luthans, 1976). Numerous studies have been identified were contingency theory has been applied to P & SCM decision making (e.g. Kraljic, 1983; Elliott-Shircore and Steele, 1985; Gonzalez-Benito and Suarez-Gonzalez, 2001; Rozemeijer *et al.*, 2003; Stonebreaker and Afifi, 2004). Empirical studies are scarce applying or relating contingency theory to public sector activities (Alford and Hughes, 2008) or regional economic development assistance (Perry, 2007).

The identification of specific contingencies, which may determine or affect sourcing decisions at the company, sector or regional economic development level, along with the reasons for these, may be discovered throughout the study. Also, the identification and understanding of contingencies that may affect strategy development and policy deployment in a public sector organisation such as the WAG, for example, in relation to addressing SCVs may also be addressed.

3.3.1 CONTINGENCY THEORY - BACKGROUND

Stinchcombe's (1959) paper on the construction industry, along with Chandler's (1962) contribution on strategy and structure are often regarded as the causal agent for the rise of contingency theory (see Padgett, 1992). During the 1960s, the influential contributions by Burns and Stalker (1961) and Lawrence and Lorsch (1967) argue that the efficiency and effectiveness of an organisation rely upon the fit between the

characteristics of that organisation and the contingencies that reflect the particular situation of the organisation and its environment.

Contingency theorists stress that there is no 'one best way' for managing organisations and that no single management model is essentially more effective than any other (Donaldson, 1996; 2001). These ideas conflict with the classical schools of management theory such as Taylor's scientific management (Taylor, 1947) and Fayol's administrative theory (Fayol, 1949), which state there are universal principles for best management practice, where the 'one best way' of dealing with a given problem could be found. Gulick's (1937) POSDCORB (planning, organising, staffing, directing, coordinating, reporting and budgeting) along with Taylor's scientific management were 'popular manifestations of this 'one best way' theorising', that is, a methodology by which few simple nostrums (ineffective remedies) were followed in all circumstances (Stillman, 1991, p 9).

However, Kast and Rosenzweig (1985) argue that contingency theory is a middle ground between the universal principles of management and that each organisation is unique and therefore must be analysed separately depending on specific circumstances.

The broad aim of contingency theory is to establish the fit-performance commonalities amongst organisations based on the pattern of relationships and compatibilities between sub-systems and the wider environment (Kast and Rosenzweig, 1985), resulting in the appropriate managerial actions for specific situations. On reaching the achievement of best fit and high performance, organisations are encouraged to maintain levels of adaptability to avoid misalignment, as and when contingencies change (Donaldson, 2001).

3.3.2 LITERATURE REVIEW FOR CONTINGENCY THEORY

Contingency theory 'has become the dominant paradigm in the field of organisational design' (Child, 1977, p 165). Structural contingency theory plays a prominent role within this theoretical paradigm. The relationship between contingency and structure has dominated discussions within academic works whilst the association between these

variables also aligns the size contingency with aspects of the bureaucratic structure (Child, 1973). The causal relationship denotes that a change in contingency leads to a change in structure (Burns and Stalker, 1961).

Whilst organisational design and structure is important, other contingencies are more relevant to the study of SCVs as shown in Table 3.6.

Contingency	Author(s)	Relevance to SCVs Study
Environment	e.g. Burns and Stalker (1961)	PESTEL type environmental factors affect P & SCM decisions in organisations. The framework developed in Chapter 6 incorporates PESTEL, SWOT and TOWS analyses to aid decision making throughout the investigation of SCVs.
Organisation size	e.g. Child (1975)	Of relevance to the size of the companies engaged in the case studies, along with the size of WAG in relation to the proposed operation of the framework.
Organisational strategy	Chandler (1962)	Contingencies affecting the strategy development and deployment within the framework.
Technology	e.g. Woodward (1965)	Technologies used in different sectors influences the P & SCM decision making within companies and how WAG operate the framework.
A general contingency theory of management	Luthans (1976)	Contingencies affecting P & SCM and decision making within WAG.

Table 3.6 – Contingencies Seen to be of Relevance to the Supply Chain Voids Study (Source: The Author)

In addition to the themes identified in Table 3.6, theoretical models of contingency have been developed for application in the public sector (Alford and Hughes, 2008), P &

SCM activities (Stonebraker and Afifi, 2004; Rozemeijer *et al.*, 2003; Heriot, 1996; Wilson *et al.*, 1989 and 1991) and management (Luthans, 1976).

Therefore, the main themes and findings from the existing literature relating to contingency theory are summarised below and these are not exhaustive but represent a number of selected studies.

A number of generic studies into contingency theory in organisations are reviewed. Lawrence and Lorsch (1967) discover that the appropriate degree of structural adaptation (organicism) alternates at the departmental level. The degree of environmental uncertainty is strongly related to the internal balance established between differentiation and integration. Furthermore, Child (1984) reports that structured design includes the allocation of roles and responsibilities, the grouping of functions, decision-making, coordination, control and reward, all of which are fundamental to the continued operation of an organisation. In relation to decision making, learning processes and performance, the importance of management planning ('management choice') and policy deployment activities has been repeatedly identified as critical to high organisational performance by contingency theorists.

In relation to environmental contingency, Burns and Stalker (1961) and Pennings (1992) find that environmental stability affects organisational structure. Mechanistic structure relates to stable, routine environments whereas organic structure relates to a more volatile, innovative culture. Moreover, Duncan (1972) asserts that environmental uncertainty is the most influential external contingency and is a function of environmental complexity and dynamism. In addition, Groff and Muth (1972, p 4) stress that 'The capabilities developed within the operations area should match the requirements of the firm. These requirements are determined primarily by the characteristics of the environment in which the firm operates'. Finally, Kast and Rosenzweig, 1985, pp 116 - 119) state that contingency views recognise the environment and internal sub systems of each organisation are somewhat unique and provide a basis for designing and managing specific organisations whereas Pennings (1992) determines that the environment is a contingency factor that affects organisational structure.

Size contingency is referred to in the literature by a number of authors. Blau (1970), Child (1973, 1975) and Pugh and Hickson (1976) all report that the size of an organisation affects the structure. Organisational size relates to the number of employees within an organisation and how this affects the extent to which an organisation's structure is bureaucratic or decentralised. Large organisations are seen to be bureaucratic, governed by rules/regulations whereas small organisations are of a simpler centralised structure to aid decision making. In contrast, Robbins (1990) asserts that bureaucracies can be efficient in large organisations.

With reference to the strategy contingency, Chandler (1962) and Galbraith (1973) find that organisational strategy affects structure in that a diversified strategy equals a divisional structure whereas an un-diversified strategy allies to a functional structure.

Technological contingency is prominent within the literature. Woodward (1965) discovers 'technological determinism' whereby technology does not correlate to organisational size but influences operational methods and organisational structure. 'It was possible to trace a cause and effect relationship between a system of production and its associated organisational pattern and, as a result, to predict what the organisational requirements were likely to be, given its production system' (p 12). Schein (1965) recognises the importance of the impact of technology as a contingent factor stating that in relation to the primacy of management planning 'technology can tell us much'. Perrow (1967 and 1970) supports Woodward's findings stating that technology determines a number of factors within an organisation, including decision making. He proposes that the diagnostic capability ('specialist buffer') required to support productive assets including problem solving, corrective actions and maintenance requirements etc. stem from technology asserting that structure is a function of the predictability of technology. Finally, Hayes and Wheelwright (1984) and Hill (1985) find that technological determinism is implicit and broadly supported in operations management literature, in relation to organisational structures.

Studies into the application of contingency theory within the public sector are rare, for example, Alford and Hughes (2008) state that 'public value pragmatism' recognises that

different circumstances demand different management tools. Management depends upon the nature of the task, the context, the available technologies and resources. Through the application of their decision support framework, traditional notions of strategy development and deployment may be challenged.

There are a number of studies relating to P & SCM within the contingency theory literature. Stonebraker and Afifi (2004) state that as supply chain technology evolves, it creates greater differentiation (decentralisation and specialisation), which, for organisational success necessitates greater levels of integration (formality and collaboration). A contingency theory model is developed and tested and findings reiterate that technology drives organisational structure (of supply chains). In addition, Rozemeijer *et al.* (2003) report that following merger and acquisition activities, a number of actions are required to implement synergistic corporate purchasing strategies that cater for a number of dispersed business units. Having tested a contingency model, the results indicate that synergistic initiatives within purchasing were weak within sample companies in the Netherlands.

Heriot (1996) proposes a contingency theory for use in the decision making of sourcing activities. Changes in the external environment, such as the globalisation of businesses and supply chains, determine the use of different sourcing approaches or types of decision making and contingency theory is evident in the selection of sourcing methods (i.e. quality, price, service and relationships). Finally, Wilson *et al.* (1989) state that organisational buying decisions are diverse and it is unlikely that one group choice model will be the best fit in all circumstances. Contingency factors will have a significant influence on the adopted model. Wilson *et al.* set four attributes for products which include price, quality, delivery, service/maintenance. Sheth's (1974) model of family decision making has a significant commonality with these contingency factors used in organisational buying. Wilson *et al.* (1991) furthers the work of Wilson *et al.* (1989), testing two situational factors i.e. the buying task, as adopted within Wilson *et al.* (1989) and perceived risk, using financial commitment and technical uncertainty as indicators of risk. Results indicate that both situational factors affect the types of choice models used by buying groups in their decision making.

Lastly in this section, the general contingency theory of management (GCT) is proposed by Luthans (1976) who asserts that management is not universal but depends upon the situation, stating that an approach is applicable, in a contingent manner, to all organisations in modern society, not just those within a business environment. Contingency management means that there is no 'one best way' to manage.

The key findings that arise from this literature review are summarised below, along with any criticisms identified:

- Environmental stability, uncertainty or factors affect organisational structures (Burns and Stalker, 1961; Pennings, 1992; Lawrence and Lorsch, 1967; Duncan, 1972; Kast and Rosenzweig, 1985). However, organisations may be unable to adapt to the environment (Aldrich, 1979; Hannan and Freeman, 1977; Morgan, 1986).
- Multiple contingencies exist (Pugh *et al.*, 1968; 1969).
- The size of an organisation affects its structure and the way it operates (Child, 1973; 1975; Pugh and Hickson, 1976) although Child (1972; 1977) also asserts that organisations are shaped by human choices where perceptions, values and beliefs are relevant i.e. 'strategic choice'.
- Strategy affects structure (Chandler, 1962; Galbraith, 1973).
- Technology affects structure, operational methods and decision making (Woodward, 1965; Schein, 1965; Perrow, 1967 and 1970). However, technological variables are only related to structure in certain circumstances (Child and Mansfield, 1972).
- Public value pragmatism for the public sector recognises that different circumstances demand different management tools (Alford and Hughes, 2008).
- Supply chain technologies determine supply chain structures (Stonebraker and Afifi, 2004).
- Contingencies are evident in sourcing decision making (Heriot, 1996; Wilson *et al.*, 1989 and 1991).
- Management is not universal but depends upon the situation (Luthans, 1976; Luthans and Stewart, 1977). However, Longnecker and Pringle (1978) are critical of the GCT of management proposed by Luthans and Stewart (1977).

The main contributions from this study to the body of knowledge for contingency theory (and associated foreground literature in Chapter 4) are listed in Table 3.7 and address Research Question 1:

'What supply chain voids in capability exist in three of the priority sectors in Wales and why?'

Author(s)	Research Issue/Gap
Contingency theory and the public sector (Alford and Hughes, 2008) and regional economic development assistance (Perry, 2007).	Few empirical studies applying or relating contingency theory to public sector activities or regional economic development assistance.
Contingency theory and P & SCM. (Rozemeijer *et al.*, 2003)	Sectors that use synergistic purchasing.
Contingency theory and P & SCM priorities. (Heriot, 1996).	Contingency factors not applied in the service sector or UK.
Contingency theory, P & SCM (e.g. Heriot, 1996) and material input, supplier or local linkages (e.g. Crone, 1999).	Contingency factors that determine SCVs.
Contingency theory and material input, supplier or local linkages. (Groff and Muth, 1972; Crone, 1999; NIEC, 1991).	Capabilities should be developed based on their fit with the requirements of the firm, as determined by the environment they operate in and FDI/indigenous firms should be targeted based on regional requirements.

Table 3.7 – The Main Contributions to Contingency Theory from the Supply Chain Voids Study (Source: The Author)

This section has reviewed an illustrative selection of literature relating to contingency theory, summarising the key themes and criticisms, highlighting the main contributions relating to this study. The next section concludes the chapter and summarises its relevance to the overall thesis.

3.4 CONCLUSION AND RELEVANCE TO THE THESIS

This chapter has critically reviewed the background literature relating to the cognitive theories deemed appropriate to this study. In compliance with Saunders *et al.* (2003), this literature review has provided an insight for both search and contingency theories. Trends within the literature for both indicate the complexity of the external environment in relation to information search, using electronic resources for example, and the volatility and complexities of contingencies.

Search theory is relevant to this to this study for three reasons:

- owing to the nature of the search carried out by customers to find suitable suppliers and by the WAG to investigate SCVs,
- the strategic enhancement of the 'Source Wales' programme as developed within the framework in Chapter 6, including the embeddedness and sustainable development criteria tool,
- the inter play with contingency theory as search models or processes are reliant upon contingency factors used in decision making.

Contingency theory is relevant to this study:

- it is applicable to studies relating to P & SCM because it highlights the importance, contingent nature and context of the study and the environment in which supply chains operate,
- the need to understand the contingencies that influence SCVs in Wales,
- owing to the contingent or situational nature of decision making of customers looking to secure sources of supply, or the WAG attempting to address SCVs,
- the need to understand specific requirements of customers, e.g. priorities required from a supply chain including quality, cost and delivery,
- it offers important guidelines for managerial actions in specific situations,
- it complements search theory in that search activities depend upon contingencies including the embeddedness and sustainable development criteria in the framework detailed at Chapter 6.

Chapter 4 now reviews the foreground literature selected for this study.

Chapter 4

Literature Review

–

Foreground Literature

CHAPTER 4 – LITERATURE REVIEW – FOREGROUND LITERATURE

4.1 INTRODUCTION, DEFINITION AND STRUCTURE OF THE CHAPTER

This chapter consists of the foreground literature relating to the applied concepts associated with the study. Figure 4.1 highlights the focus for this chapter in the blue 'box' within the research framework which links the background, foreground and other literature themes. The Research Questions identified in Table 3.1 have also been derived from the gaps in this literature which emphasises a multi-disciplinary study.

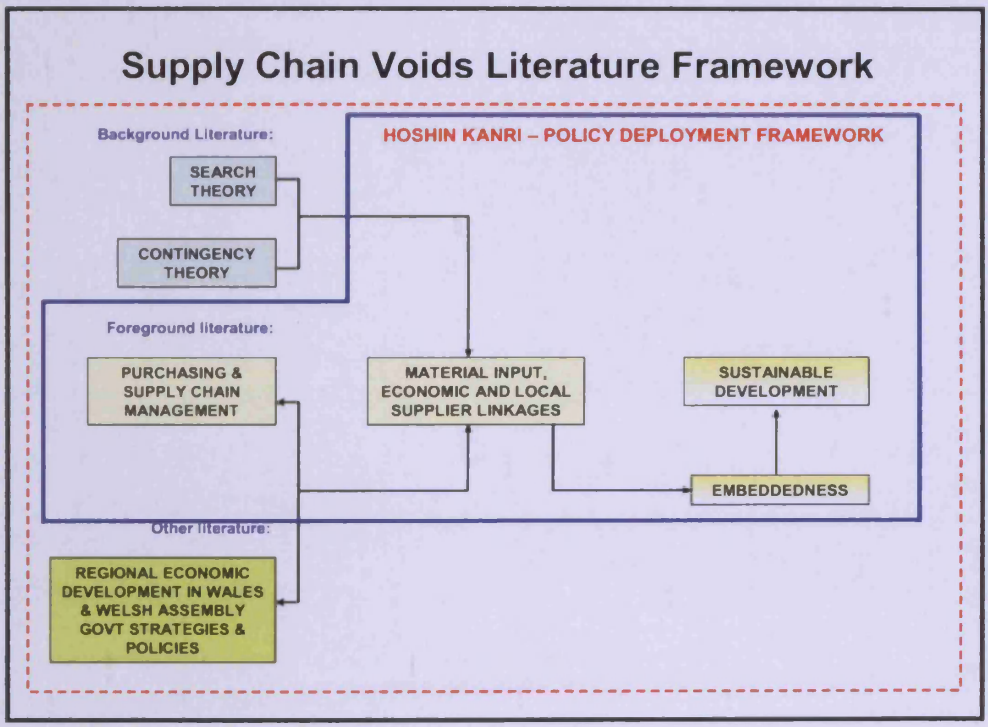


Figure 4.1 – The Focus of the Literature Review Framework for the Study of Supply Chain Voids in Wales (Source: The Author)

Appendix D summarises the foreground literature themes originally considered as having relevance to the study and these were reduced and justified as five for detailed review:

- Hoshin Kanri/policy deployment – this underpins the design of the framework developed for use by the sponsors and was preferred to other approaches such as classical and rational planning, 'logical incrementalism', emergent, processual and systemic strategy models (Sloan,1965; Mintzberg, 1994; Sloan, 1965; Quinn 1978; Whittington, 2001) as it relates specifically to strategy and policy deployment and is more contingent to an organisation, based on the Plan, Do, Check, Act feedback model (Deming, 1986).
- Material input, economic and local supplier linkages – helps to explain the findings and links to the cognitive theories.
- Regional Embeddedness – significant in relation to how to address SCVs. This is integrated with the linkage literature.
- P & SCM – specific elements that help to explain the case study findings and links to the cognitive theories.
- Sustainable development – helps to address SCVs in a sustainable manner.

An illustrative selection of this literature is reviewed in the following sections and gaps are identified where the study contributes to academic knowledge.

4.2 DEFINITIONS OF HOSHIN KANRI/POLICY DEPLOYMENT

Akao (1991) asserts that Hoshin Kanri is a system for quality control and continuous improvement activities which is prominent within Japanese companies. There are a variety of definitions based upon the contingent application of Hoshin Kanri within different organisations. Nayatani (1984) states it is a systematic control activity for the achievement of annual management policy where all job levels perform Plan Do Check Act (PDCA) to harmonise each policy. Meanwhile, Mizuno (1984) insists it is used to improve performance continuously by disseminating and deploying the direction, targets, and management plans to top management and all employees so that all job levels can act on the plans, evaluate, study, and feedback results while continually performing PDCA by analyzing current problems and deploying in response to environmental conditions.

Miura (1985) stipulates that Hoshon Kanri relates to all activity within an organization for the systematic achievement of the medium/long-term management plan or annual management policy whereas Sugimoto (1986) refers to it as a system for effective achievement of targets by banding all capabilities of the total organisation of a company. Akao's (1991, p 174) definition states it is '.... a means to pull together the forces within a company and to unite the minds internally, to perpetually improve its performance by adjusting quickly to change'.

More recently, Western commentators have studied the approach. Womack and Jones (1996) define it as a strategic decision-making tool that focuses resources on the (few) critical initiatives to accomplish the business objectives of the firm which are translated into specific projects and deployed down to the implementation level in the firm. Hoshin Kanri unifies and aligns resources, establishes clearly measurable targets to progress toward the key objectives and is measured on a regular basis. Furthermore Hines and Taylor (2000) state it is a strategic decision making tool that focuses resources on the critical initiatives necessary to accomplish the firm's critical success factors. It also encompasses the cascading of this by 'key business processes' together with the control, measurement and feedback of results.

Witcher and Butterworth (2001) find it to be a form of corporate-wide management combining strategic and operational management by linking the achievement of top management goals with daily management at an operation level whereas later, Witcher (2003) summarises this as a top level management system for mobilising a company-wide effort to realise the strategy. Finally, Babich (2005) asserts that Hoshin is a system of 'forms' and 'rules' that provide structure for the planning process.

These definitions refer to Hoshin Kanri as either an 'activity' (Nayatani, 1984; Miura, 1985), a 'system' (Sugimoto, 1986), 'alignment' of activities (Akao, 1991), a 'strategic decision making tool' (Womack and Jones, 1996; Hines and Taylor, 2000), 'corporate or company wide management' (Witcher and Butterworth, 2001; Witcher, 2003) or tactical 'forms' and 'rules' (Babich, 2005). Most acknowledge a need to coordinate activities across an organisation whilst focusing on a vital few priorities, operating a

PDCA type approach. This study utilises a combination of these when addressing Research Question 2 within the contingency based framework at Chapter 6.

Akao (1991) advises that Hoshin Kanri is also known as hoshin planning, management by policy or policy deployment, utilising Deming's (1986) PDCA control cycle which has a 'closed loop' feedback system focussing on the 'vital few' priorities. The cycle is continually planning, evaluating results and refining activity, creating cycles of learning that can allow plans to self-correct (Babich, 2005). It is emphasised that the process rather than the results is important, to improve the process and achieve better results.

4.2.1 HOSHIN KANRI/POLICY DEPLOYMENT – BACKGROUND AND SCOPE OF THE STUDY

This study relates to the deployment of those WAG strategies aligned to regional economic development and the focus on specific sectors (see Chapter 2). The framework developed by the author is underpinned by the Hoshin Kanri and policy deployment literature.

There are a number of Hoshin Kanri type strategy development and policy deployment models. To define the scope for this study, a useful example is that of Soin (1992), a simplified PDCA model shown in Figure 4.2. The PDCA or Shewhart model was promoted by Deming (1986) in relation to quality management. During the 'plan', users need to establish the objectives and processes necessary to deliver results in accordance with the expected output. By making the expected output the focus, it differs from other techniques in that the completeness and accuracy of the specification is also part of the improvement. The 'do' phase includes the implementation of the new processes. The 'check' phase measures the new processes and compares the results against the expected results to ascertain any differences. Finally, during the 'act' phase, any differences are subjected to analysis to determine their cause and identify where to apply changes or improvements. If a pass through these four steps does not result in the need to improve, refine the scope to which PDCA is applied until there is a plan that involves improvement.

All of these elements are appropriate as through the investigation of SCVs, directed by regional economic strategies, the author has elected to develop and implement activities within a framework driven by PDCA, identifying 'what' needs to be done and 'how' to achieve results. Examples of its use are shown in blue text in Figure 4.2.

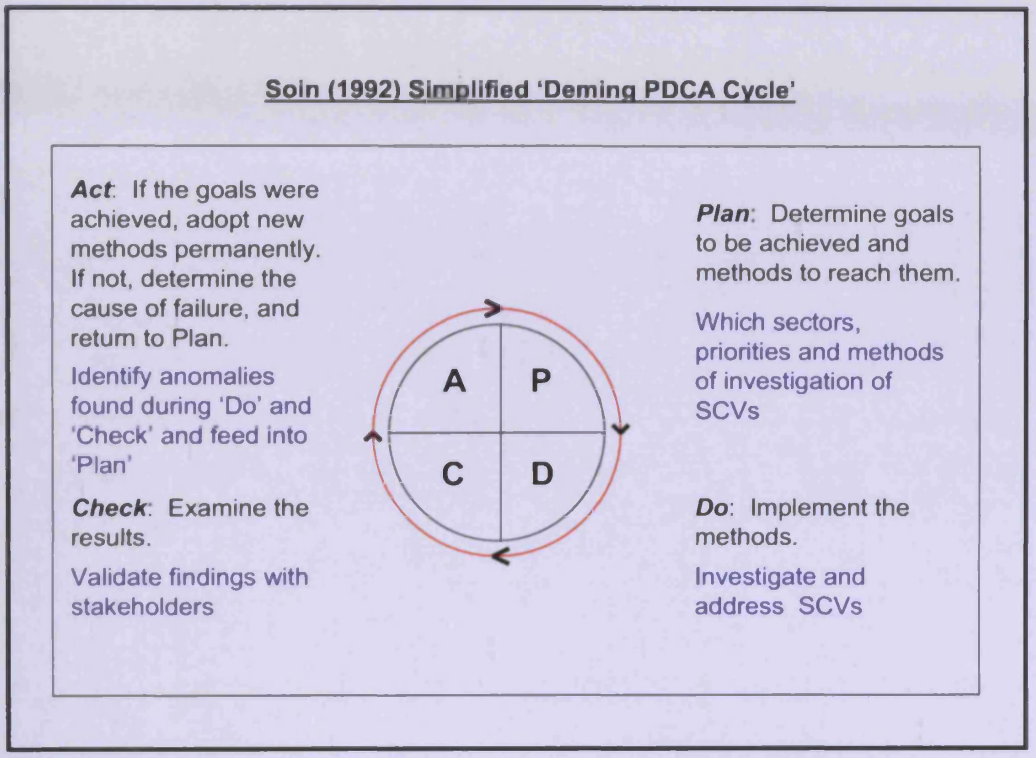


Figure 4.2 - Simplified PDCA Cycle (Source: Soin, 1992)

Witcher (2003) identifies that in practice, the stages within this model can overlap considerably and cites Akao (1991) along with Wood and Munshi (1991) in their recommended application of this model as APDC.

4.2.2 LITERATURE REVIEW FOR HOSHIN KANRI/POLICY DEPLOYMENT

This section covers the literature review of an illustrative selection of Hoshin Kanri or policy deployment narratives. Much of this is descriptive in that it identifies examples of models and processes, theoretical and empirical investigations of its application in

organisations within the UK and elsewhere and a brief appraisal of the benefits and issues associated with the use of such models.

Many authors have identified manufacturing companies such as Hewlett Packard (Babich, 2005) and Bridgestone (Akao, 1991) that have adopted Hoshin Kanri. However, the literature is weak in relation to empirical evidence of service (Marsden, 1998) and public sector application (Hacker *et al.*, 2001). Therefore this study makes contributions through the investigation of SCVs in both the manufacturing and service sectors whilst addressing Research Questions 1 and 3 through the use of a public sector based Hoshin Kanri policy deployment framework designed to answer Research Question 2.

4.2.2.1 HOSHIN KANRI AS A MODEL OR PROCESS OF STRATEGY DEVELOPMENT AND POLICY DEPLOYMENT

There are a number of Hoshin Kanri or policy deployment models within the literature e.g. Cowley and Associates (1995), cited by Cowley and Domb, 1997; the Hoshin Kanri System at the Bridgestone Tire Company adapted from Akao, 1991 by Hines, 2006; Witcher *et al.*, 2007 and Wood and Munshi, 1991.

Hines *et al.* (1998) use the terminology of 'whats' and 'hows' when referring to customer requirements and how a supplier plans to meet them whereas Cowley and Domb (1997) state that hoshin planning includes both 'doing' tasks and the 'review' of how these are progressing, aligning to Deming's PDCA 'closed loop' model (1986).

Whilst elements from a variety of models have been reviewed, two examples have been considered and adapted when addressing Research Question 2. A simplified hoshin planning process is shown at Figure 4.3 with those elements relevant to this study depicted within a blue box and the 'catchball' in red. As the 'whats' of the various WAG strategies have been reported in Chapter 2 the study commences from 'how' to investigate SCVs. An empirical example of a policy deployment framework set in a university is shown at Figure 4.4.

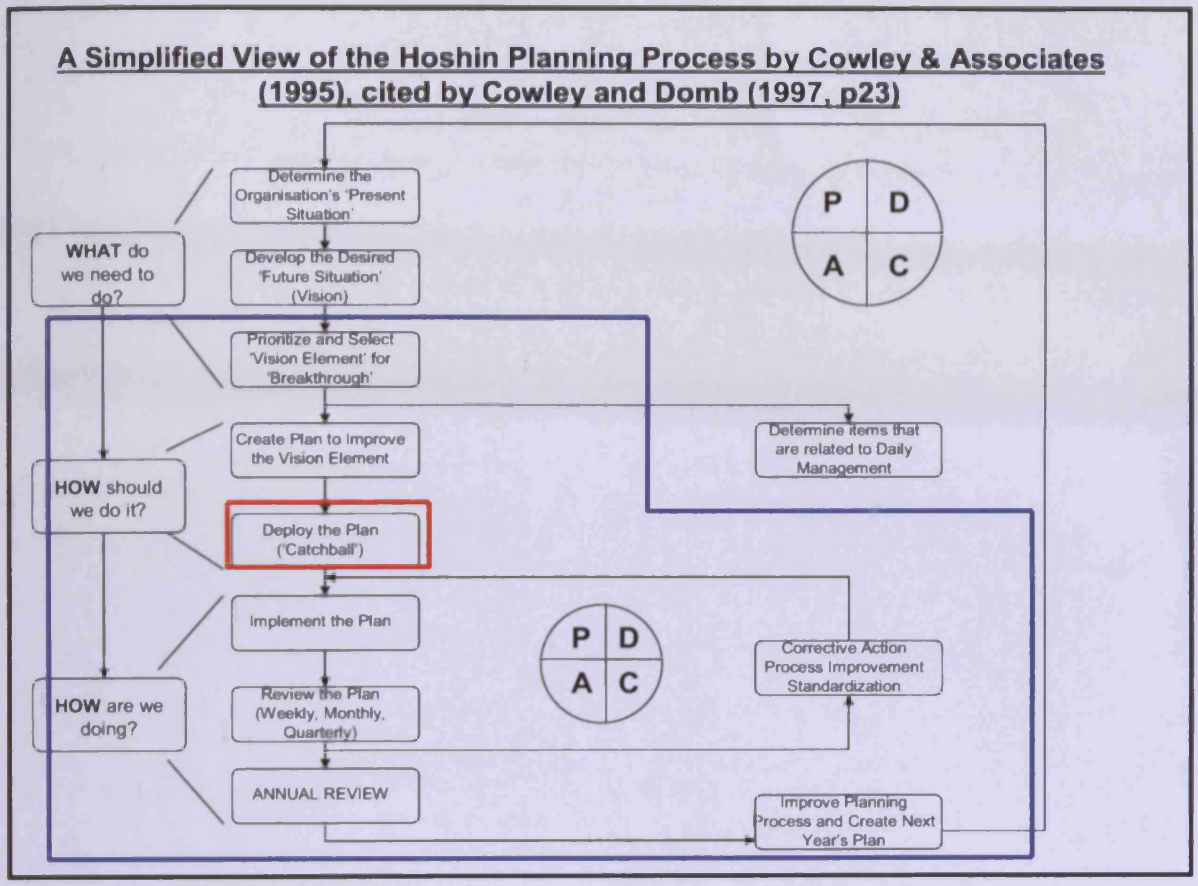


Figure 4.3 - A Simplified Hoshin Planning Model (Source: Cowley and Associates, 1995, cited in Cowley and Domb, 1997)

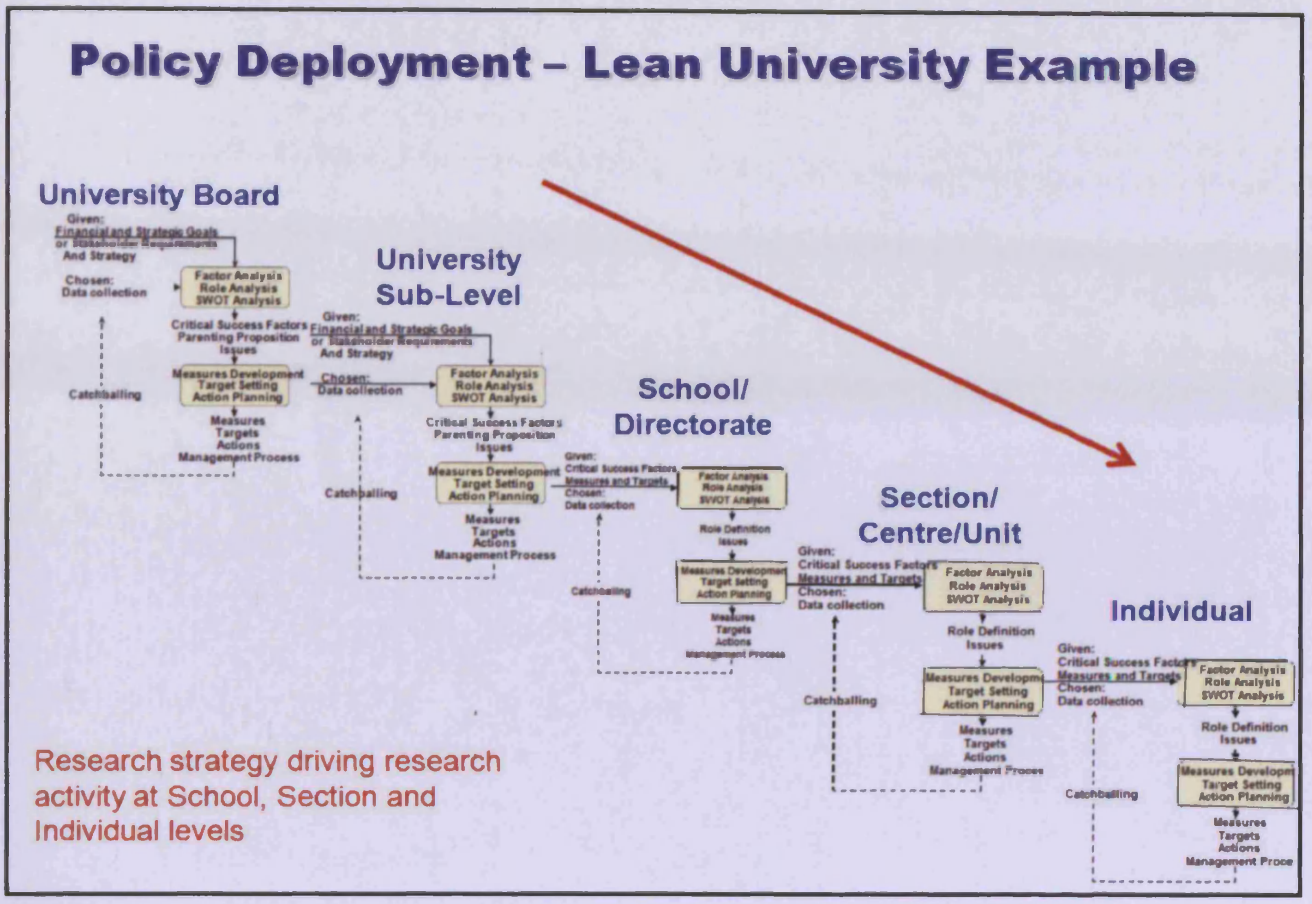


Figure 4.4 – An Empirical Policy Deployment Model (Source: Lethbridge *et al.*, 2007)

The term 'catchball' features prominently within the Hoshin Kanri literature. Akao (1991) defines 'catchball' as the reiterative up, down, and horizontal communications across an organisation necessary for effective determination of target and means of achievement, whereas Cowley and Domb (1997) state it is the process of selecting strategies to meet objectives at any level of planning, involving dialogue between managers and their teams to reach agreement and ownership on strategies and goals, also known as 'collaborative goal setting'. Finally, Babich (2005) likens it to the back and forth discussion carried out within an organisation until a consensus is reached in relation to e.g. the mission. It is therefore about consultation, communication, agreement and ownership relating to strategy, goal setting and alignment of implementation, or policy deployment, which is important in addressing Research Question 2.

To visualise a total hoshin deployment process, Domb (2005) creates the 'Big W' diagram, as demonstrated at Figure 4.5. The elements within the blue oval shape are those targeted by this study in that they involve the deployment of policies through the investigation of SCVs, whilst reviewing the progress and process. The diagram also shows multiple applications of the 'catchball' process.

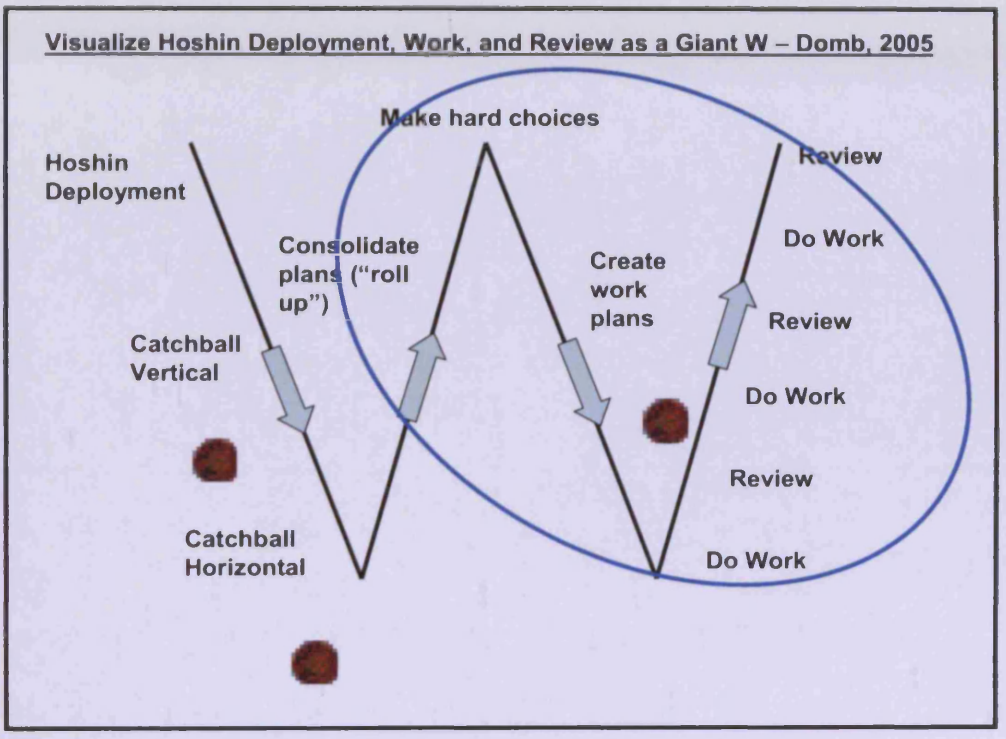


Figure 4.5 – The Big 'W' Diagram of Policy Deployment (Source: Domb, 2005)

Watson (1991) warns that there are many differences between Japanese companies and cultures and those in the West hence the adoption of Hoshin Kanri is not prescriptive, but contingent. He cites Deming (1986) who argues that companies should adapt Hoshin Kanri principles that apply to their context. Moreover,Akao (1991) advises that as policy deployment has become popular, many companies have published their own terminology and methods. Adopting a facsimile of those practices operated by other companies will often lead to failure as each company has its own reasons for the way it operates. Therefore, the way in which the WAG operates has been considered during framework development.

4.2.2.2 THEORETICAL AND EMPIRICAL STUDIES OF HOSHIN KANRI AND POLICY DEPLOYMENT

This section summarises a selection of theoretical and empirical studies of Hoshin Kanri or policy deployment, both within the UK and elsewhere. Much of the literature relates to manufacturing and Japanese companies (e.g. Dimancescu *et al.*, 1997; Collins and Huge, 1993; Rich and Hines, 2000). However, other studies have been carried out relating to service and public sectors.

Daneke (1980) focuses on policy and programme implementation in the public sector in the USA where findings identify that implementation should be a vital consideration from the beginning of the policy formulation and selection process, but that the logical point for improving implementation procedures is at the juncture with programme reviews and evaluation. Evaluation should be designed to provide vital feedback on implementation processes to facilitate strategic renegotiation. Later, Marsden (1998) investigates manufacturing and service sector organisations within the UK, reporting that four defining features of Hoshin Kanri systems that align to the PDCA model are piloted in the UK within eight manufacturing and ten service organisations (public and private). Findings show that different organisations use different policy deployment systems, as they vary by contingencies such as:

- Market sector
- Size
- Corporate culture
- Organisational structure
- Systems

Despite the acknowledged benefits of Hoshin Kanri within manufacturing-based studies, participant service organisations were not using it. The service sector appears to be behind manufacturing in its use of policy deployment systems.

More recently, Hacker *et al.* (2001) study the application of formal strategy deployment processes used to link strategic plans to actions within three government departments in the USA and conclude that the success of strategic management activity within USA government departments varies. Four 'critical deployment processes' are identified for

implementation, based on the PDCA cycle. Organisations should tighten the link between strategic planning and daily activities. The key issue is the hand-off between these two activities - this hand-off is referred to as the deployment component of strategic management. Additionally, Radnor *et al.* (2006) evaluate the application of 'Lean' in the public sector in Scotland and find that a more sustained and effective application of 'lean' would link strategy and operational improvement in a whole systems approach. (Also see Dimancescu *et al.*, 1997, for example). They summarise that policy deployment brings cohesion to the implementation plan for the roll-out of 'lean'.

Finally, Barber (2007) reports upon his experience of the public sector and service reform under the Blair Government 2001 – 2005. Whilst Hoshin Kanri or policy deployment is not specifically mentioned, the methodology is clearly inferred throughout. This deals not so much with the 'what' of public service improvement, but the 'how'. The overall system is referred to as 'deliverology' and the 'discipline of delivery' (p 283).

Marsden's (1998) research is a rare 'service' sector example. He states that little research into the application of Hoshin Kanri in the service sector (including public sector), has been carried out, citing some use in the US medical profession (Kennedy, 1994). He reports an awareness of unpublished studies, but nothing in the UK. Hacker *et al.* (2001) is an uncommon study of the public sector whilst Barber (2007) describes and commentates upon the government and public sector application of such approaches through the implementation of public service reforms. Discussions with leading researchers in the sphere of Hoshin Kanri at The Hoshin Kanri Group (HKG), Norwich Business School, University of East Anglia confirmed that the public sector is an under-researched area for the application of Hoshin Kanri (Witcher, 6 Apr 2008). Therefore, this study contributes to academic knowledge whilst addressing Research Question 2.

Seddon (2008, pp 108 - 120) significantly criticises Barber (2007) asserting that public services should be designed around the customer following the Toyota model, stating that targets should be derived from the work not commanded top-down. Barber (2007)

concedes that Government departments tend to see policy from their 'producer' stance, rather than from that of the 'customer'. Seddon criticises 'deliverology' stating that for it to work, it depends upon the method adopted and arguing that there was no method. Interestingly, Barber (2007) appears to have adopted some Toyota practices, for example, the importance of going to visit front line service delivery to understand the issues and gather data.

By way of a summary, Table 4.1 shows the main elements of Hoshin Kanri as identified by Tennant and Roberts (2001).

Element	**Hoshin Kanri**
Vision	Long term
Focus	Processes
Implementation	Prioritise
Measures	Realistic
Review	Improvement
Communication	Deployment of targets
Feedback	Top-down and bottom-up

Table 4.1 - The Key Elements of Hoshin Kanri (Source: Tennant and Roberts, 2001, Table 2)

This section has summarised a selection of theoretical and empirical literature relating to Hoshin Kanri and policy deployment, both in the UK and elsewhere. The next section indicates some advantages and disadvantages on the application of such processes.

4.2.2.3 ADVANTAGES AND DISADVANTAGES OF HOSHIN KANRI AND POLICY DEPLOYMENT

A limited number of empirical studies have identified advantages, disadvantages or issues associated with the implementation of Hoshin Kanri or policy deployment. Advantages identified within manufacturing organisations, rather than service or public sector organisations are summarised below.

Babich (2005) states that the approach is applied successfully by many global companies by focussing effort on the critical few things necessary to succeed, it encourages employees to analyse situations, create plans for improvement, conduct performance checks and to take appropriate action, it is a powerful communication tool that helps everyone in the organisation understand how their efforts contribute to overall success. It is driven by data and fact, not by anecdotal views and organisations become more effective through the implementation of Hoshin Kanri.

Marsden (1998) concludes that significant improvements in organisational performance can be witnessed, by aligning work activities of individuals behind company strategic goals. The approach increases employee commitment to achieving strategic goals through involvement in planning, it distinguishes critical business processes and focuses discretionary resources on improving them and it builds a flexible business structure, able to respond swiftly to changes in the external environment. Furthermore, Hoshin Kanri derives annual plans and targets from long and medium-term strategies, helping to communicate and clarify the organisation's vision and mission. It supports the move towards process management and management by fact and provides the guidance needed to allow the full benefits of empowered workers operating in cross-functional teams to be realised.

Tennant and Roberts (2001) assert that Hoshin Kanri ensures the integration of strategic objectives with tactical daily management, applies the quality orientated PDCA to business process management. Moreover, it facilitates parallel planning and execution methodology and is a company wide approach ensuring improvements in communication.

Additionally, Witcher and Butterworth (2001) find that it provides focus, alignment and integration of policy into operations, achieved using TQM and in an environment conditioned by the demands of lean working and supports the participatory involvement of personnel across an organisation in determining, deploying and managing objectives.

Witcher (2002) identifies that top management goals were made visible in terms of daily management, enabling other people in the organisation to manage their own

targets effectively and that policy had been built into work, enhancing commitment to top level goals. Finally, Witcher (2003) finds that policy management is seen to be a coherent and distinctive organisation-wide management system, there is evidence of strategic transparency where management knows at any one time where operations are in relation to the achievement of strategic objectives and policy is integrated into daily work, enabling pan-organisational commitment to strategic goals.

The perceived disadvantages or issues associated with Hoshin Kanri are now reported. Babich (2005) acknowledges that implementation is not easy and that it takes management discipline to overcome the barriers to adoption and avoid common mistakes. In addition Witcher and Butterworth (2000) identify the management style of senior managers can impede effective policy deployment, the management of the review process can be lacking, there is a requirement for discipline in limiting objectives to a 'vital few' and there are questions about how much to involve the work force in the 'catchball' activities.

Finally, Witcher (2002) reports that top managers have high expectations of Hoshin Kanri, resulting in promoting too many policies. Moreover, some companies do not involve all levels of staff in 'catchball' activities or 'catchball' can become a prescriptive deployment activity about detailing responsibilities and making action plans at the operational level. Linking targets and means of achievement need to link to each individual through the performance appraisal system and there is no audit of how the process of Hoshin Kanri has been used in some organisations.

Criticisms of the Hoshin Kanri approach are rare within the literature and on discussing this anomaly with the HKG (Witcher, 13 Nov 08), this appears to be the case. However, the Hoshin Kanri approach can be criticised for the following:

- Management By Objectives (MBO) (Drucker, 1982) orientated, sometimes with too many objectives or targets (e.g. Witcher, 2002)
- Top-down approach (see Seddon, 2008, for example)
- Japanese orientated (Various examples e.g. Akao, 1991; Witcher, 2003)
- Not as good as the balanced scorecard by Kaplan and Norton (Witcher, 13 Nov 08)

- Poor review process (e.g. Witcher and Butterworth, 2000; Witcher, 2002)
- Whilst it is essential to manage the process, this can become too bureaucratic (Witcher, 13 Nov 08)
- A top-down planned approach can result in negative unintended consequences especially in uncertain and rapidly changing times although Hoshin Kanri can be appropriate and effective within a dominant paradigm of relative stability where norms, expectations and situations are generally characterised by linearity and incrementalism (Chia and Holt, 2009).

In summary, Hoshin Kanri or policy deployment has its origins in Japan, along side 'lean' management processes and can be defined in a number of ways (see Section 4.2) deemed contingent upon the organisation adopting the approach. Hoshin methodology has been tested empirically, predominantly in manufacturing (e.g. Babich, 2005; Tennant and Roberts, 2001; Witcher and Butterworth, 2001) and such literature identifies advantages and some concerns relating to the introduction of such systems and records that service organisations are behind manufacturing in their adoption of it (Marsden, 1998). Significantly less research has addressed the service sector and in particular, public sector organisations, specifically in the UK (e.g. Marsden, 1998; Hacker *et al.*, 2001). However, there is emerging evidence of similar models being adopted within UK Government departments (Barber, 2007). Whilst there is limited evidence of criticisms of Hoshin Kanri approaches, examples have been identified from Seddon (2008), Chia and Holt (2009) and Witcher (2002). This study embraces a synthesis of the definitions of Hoshin Kanri and learns from the empirical studies to address Research Question 2 in Chapter 6.

4.3 DEFINITIONS OF ECONOMIC TRANSACTION, MATERIAL INPUT AND LOCAL SUPPLIER LINKAGES AND EMBEDDEDNESS

This section introduces and defines the economic transaction, material input and local supplier linkages, which are synonymous with SCVs. It is understood that linkages can result in spillovers leading to the potential embeddedness of firms within a region. Therefore, embeddedness is also included in this section.

The concept of industrial linkages can be traced back to the regional economic growth theories of Hirschman (1958) who defines them as 'transaction linkages' falling into two categories: 'backward' linkages including the purchase of inputs and other services from the local economy or 'forward' linkages i.e. the domestic use of the output of the plant. This study focuses on 'backward linkages'.

Markusen and Venables (1997) state that the creation of 'backward linkages' is critical to an economy and should be a priority. If inputs are purchased from within the host region, this will provide a boost to the regional economy by stimulating increases in output and employment among the local supply industries (Hirschman, 1958). Purchases made from outside a region result in 'leakages' of expenditure. Therefore, from the perspective of the host region, though not necessarily the purchasing organisation, it is advantageous if a high proportion of inputs are purchased locally. The general consensus in the literature is that linkages can benefit domestic firms' technical, managerial and organisational capabilities (Dunning, 1993; United Nations Conference on Trade and Development (UNCTAD), 2001).

Crone (1999) defines 'backward linkages' as material input linkages (MILs) and states that they have a significant impact on regional economic multipliers as expenditure may 'trickle down' successive tiers of the regional supply chain, resulting in a regional multiplier effect.

Crone (1999) goes on to define local MILs as linkages with suppliers located within a specific study region. These have also been described as 'upstream linkages' (Dunning, 1993), 'supply linkages' (Crone and Watts, 2000), 'local linkages' (Crone, 2002), 'sourcing patterns' (Hewitt-Dundas *et al.*, 2005) and 'material linkages' by Phelps (1993a and 1993b) within academic studies relating to economic geography. Crone (1999) also states that manufacturing linkages are classed as 'backward (or input) linkages', which could provide new business opportunities for suppliers in the locality, and forward (or output) linkages, which could stimulate additional business activities in industries using the outputs produced by a manufacturing plant. A recent study by Kay *et al.* (2007) recommends that as services are becoming more important within regional economies, the traditional view and measurement of linkages may require updating.

Polanyi (1944) is referred to as the 'father of embeddedness' and asserts that 'instead of the economy being embedded in social relations, social relations are embedded in the economic system' (Polanyi, 1944, p 57). Polanyi also talks about economic exchange in systems based on reciprocity, where 'acts of barter are embedded in long-range relations, implying trust and confidence' (Polanyi, 1944, p 61).

Embeddedness has been defined in a number of ways, a selection of which is depicted here. Granovetter (1985, p 490) is the seminal definition which states that embeddedness is 'the role of concrete personal relations and structures (or 'networks') of such relations in generating trust and discouraging malfeasance'. Later, Halinen and Tornroos (1998, p 196) state that there are six types of embeddedness including social, political, market, technological, temporal and spatial and that firms are dependent upon particular technologies. 'Each business actor is embedded in a specific market defined in the terms of products and services offered, the clientele served, the functions performed and the time and territory encompassed by the company's operations. Actors are connected with their customers, suppliers and distributors, and in some cases also with competitors (e.g. through strategic alliances)'.

More recently, Jessop (2001, p 224) is concerned at the variety of definitions of embeddedness, concluding that it is conceptual, at different levels. The central issue is the 'institutionalization' of economic processes, or 'the 'societal' embeddedness of functionally differentiated institutional orders in a complex, de-centred society'. Finally, Hess (2004) states that having considered the various definitions and develops a framework consisting three types of embeddedness: Social, Network and Territorial.

From these definitions, it can be seen that relationships, networks and spatial or territorial factors are prevalent for embeddedness, hence supply chains and clusters link to this theme. This study is interested in how companies can be sustainably embedded in Wales whilst addressing Research Questions 2 and 3.

Amin and Thrift (1994) propose that 'institutional thickness' emphasises the social and cultural factors underlying the economic success of regions. Factors contributing to

institutional thickness are: 'a strong institutional presence; high levels of interaction; defined structures of domination and/or patterns of coalition; a mutual awareness of being involved in a common (regional) enterprise' (Amin and Thrift, 1994, p 14). A strong and positive combination of these factors helps to consolidate the local embeddedness of industry, which in turn is closely linked to particular regional cultures.

4.3.1 ECONOMIC TRANSACTION, MATERIAL INPUT AND LOCAL SUPPLIER LINKAGES AND EMBEDDEDNESS – BACKGROUND AND SCOPE OF THE STUDY

The study of linkages and embeddedness has a considerable literature within economics, economic geography and business studies. This study relates to a very small element concerning 'backward linkages', which is depicted within Figure 4.6. Therefore, the literature review for linkages is limited to the scope of the dyadic, customer-supplier relationship identified under P & SCM. This approach has been selected in preference to local and global sourcing, as justified in Appendix D. The scope of the literature relating to embeddedness is confined to its benefits and concerns relating to linkages, to develop the framework. However, the author does not underestimate the value of the eliminated literature to this study.

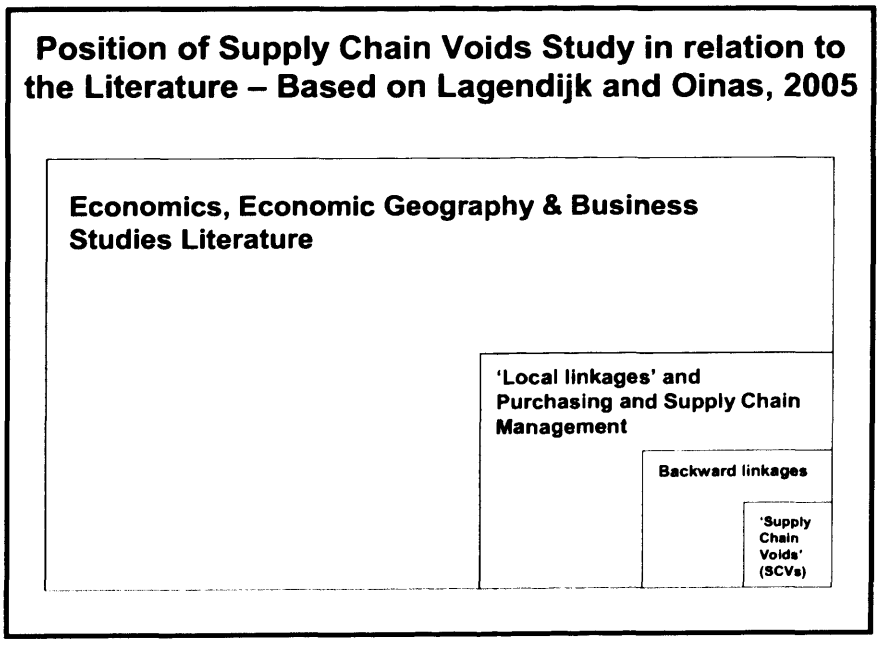


Figure 4.6 - The Position of the Supply Chain Voids Study in Relation to the Literature on 'Linkages' (Source: The Author, based on Lagendijk and Oinas, 2005)

4.3.2 LITERATURE REVIEW FOR ECONOMIC TRANSACTION, MATERIAL INPUT AND LOCAL SUPPLIER LINKAGES AND EMBEDDEDNESS

This section reviews a selection of the literature relating to linkages and embeddedness. The purpose is to summarise examples used to inform the semi-structured interview questions derived to address Research Question 1, the development of the framework which answers Research Questions 2 and 3, to aid description and explanation of the case study findings and to identify gaps in the literature where contributions may be made by this study.

Scott-Kennel (2007) completes a comprehensive review of the linkage literature, relating to the types of studies carried out, identifying that:

- the majority of linkage studies in developed countries have focussed on manufacturing, e.g. Hewett-Dundas *et al.* (2005).
- much of the research is at the macro or meso level, identifying the percentage levels of local linkages and not the micro or firm level detail (See Table 4.2 for examples).
- empirical research into firm level linkage patterns usually limits itself to the use of econometric studies, panel data and input-output tables (e.g. Girma *et al.*, 2004).
- backward and in some cases, forward linkages (UNCTAD, 2001) and single case study firms have been investigated (e.g. Ivarsson and Alvstam, 2004).

4.3.2.1 PREVIOUS STUDIES TO ESTABLISH PERCENTAGE LINKAGE LEVELS IN REGIONS

With the exception of a few studies in the service sector (e.g. O'Gorman *et al.*, 1997; Clancy *et al.*, 1998; Scott-Kennel, 2007) previous research has focused on current linkages within the manufacturing sector and has compared both foreign owned and indigenous activities. Hewitt-Dundas *et al.* (2005) investigate the sourcing patterns of foreign owned multinational plants in Ireland and the reasons why they do not source

locally. Crone (1999) identifies local supply linkages in Yorkshire and Humberside within multinational plants owned by both UK and foreign companies and compares the results to previous research carried out in other UK regions, including Wales. Table 4.2 summarises the previous studies into the extent of local sourcing by multinational plants in various UK and foreign regions.

The comparison concludes that generally, supply linkages are weak across the UK, averaging less than 25%. In the Repubic of Ireland (RoI), linkages are strong for food related supplies but weak for non-food supplies (McAleese and McDonald, 1978). Girood and Mirza (2006) identify mixed linkage levels between the Association of South-East Asian Nations (ASEAN). Whilst these studies focus on total or material expenditure, the SCVs research has targeted a sub-set of high (and low) value purchases sourced from outside of Wales. Although the precise characteristics of the samples used in these studies and the statistical methods of analyses differ from each other, and from the qualitative methods used in the SCVs research, they are broadly comparable and consistent with previous evidence on local sourcing by multinational plants.

Author(s)	Context	Manufacturing/ Service	Research Methods/Sample	Mean/ Local Sourcing %	Misc Relating to Linkages/Embeddedness
McAleese and McDonald (1978)	Ireland, FDI	Manufacturing	Secondary data from previous surveys/research, materials expenditure	Food - Domestic firms 95.5%; Non-Domestic Firms 96.3%. Non Food - Domestic Firms 22.2%; Non Domestic Firms 11.2%	Local sourcing linkages **increase over time as FDI companies become more embedded.**
Collis and Roberts (1992)	West Midlands	Manufacturing	Survey, (99 companies) and interviews (15 companies). FDI plants; no size restrictions; all sectors	c20%	
Phelps (1993a)	Northern Region, FDI	Manufacturing	Survey, 28 foreign multinational enterprise (MNE) plants; 100 + employees; all sectors	13%	
Turok (1993)	Scottish electronics industry, FDI.	Manufacturing	Secondary data, Survey and Interviews. 31 foreign MNE plants, no size restrictions, electronics only	12%	
Phelps (1997)	Wales	Manufacturing	Survey, 38 UK-owned and 98 foreign MNE plants; 100 + employees; all sectors	14%	

Turok (1997)	Scottish electronics industry, FDI, other sectors in Scotland.	Manufacturing	Secondary data, update and extenson of Turok (1993)	17% Electronics; Between 35% and 73% average for other sectors including Chemicals (45%), Finance and Business Services (54%), Distribution (73%).	'Developmental' and 'Dependancy' nature of relationships between customers and suppliers within a region. **'Developmental' for example includes collaboration and the mutual sharing of technology and knowledge between plants, suppliers and distributors.**
Crone (1999)	Yorkshire and The Humber, FDI, multinational plants.	Manufacturing	Case Study, face to face interviews, 26 UK-owned and 24 foreign multinational plants; 200 + employees; all sectors	23%	The **extent of linkages** are **primarily determined** by the **specific nature** of a **plant's demand for inputs** and the '**supply potential**' of the **regional economy**. **External ownership** and **control** impact local sourcing. **Different sectors vary in their demand/local sourcing.**
Crone (1999)	Yorkshire and The Humber/Humberside as Case Study region, FDI, multinational plants.	Manufacturing	Case Study, face to face interviews, 26 UK-owned and 24 foreign multinational plants; 200 + employees; all sectors	23%	MNE **plant attributes** can affect levels of MILs i.e. **Age, Size, Method of establishment** (in region), **Nature of products** (i.e. complex, standard etc.), **Method of production** and **R & D** function.

Crone (1999)	Yorkshire and The Humber/Humberside as Case Study region, FDI, multinational plants.	Manufacturing	Case Study, face to face interviews, 26 UK-owned and 24 foreign multinational plants; 200 + employees; all sectors	23%	**Corporate context** e.g. **purchasing/sourcing strategies** determine if local or global suppliers are to be used.
Crone and Roper (1999)	Northern Ireland, FDI.	Manufacturing	Interviews, 33 multinational plants; 200 + employees; all sectors	11%	
Taylor (2003)	Wales, FDI. Automotive and Electronics sectors.	Manufacturing	Case Study	Automotive: 14% from Wales; Electronics: 6% from Wales.	**Very little local sourcing from both sectors**. For Electronics, many OEMs **purchase** from **associate companies**, **procurement strategies** were **influenced by parent companies** and very **little R & D carried out in Wales**.
Giroud and Mirza (2004)	Association of South-East Asian Nations (ASEAN) including Cambodia, Malaysia, Thailand & Vietnam, FDI	Manufacturing in Electrical/Electronics and Textile/Garment industries	Survey of semi-structured questions carried out using face to face interviews with MDs or top managers, statistical analysis using multi linear regressions, dataset from 85 FDI companies.	Malaysia (35%), Thailand (35%), Vietnam (20%), Cambodia (0%)	**Local linkage is highest** when the **FDI company** performs a **strategic role and are embedded** in the host country. The **specific industry** and the **existence of a supply base** are important determinants in the level of local input linkage.

Giroud and Mirza (2004)	ASEAN countries	Manufacturing in Electrical/Electronics and Textile/Garment industries	Survey/Interviews	Malaysia (35%), Thailand (35%), Vietnam (20%), Cambodia (0%)	Local sourcing linkages **increase over time as FDI companies become more embedded.**

Table 4.2 - Summary of Previous 'Linkage' Studies and Identification of Percentage Local Linkages (Source: The Author, based on the literature)

Table 4.3 shows the comparison of results between two UK regions compared by Crone (1999). These relate to the reasons why companies carry out limited sourcing from local suppliers, with the main reason in both regions being that inputs required are not available from local suppliers. In Scotland, 70% state that local suppliers are relatively expensive whilst poor quality and a lack of capacity are also reported for both regions.

Reason for not sourcing more from local suppliers	Yorkshire and The Humber %	Scotland %
Inputs are not available from local suppliers	94%	70%
Local suppliers are relatively high priced	30%	59%
Local suppliers' products are of inadequate quality	12%	37%
Local suppliers have insufficient capacity	20%	15%

Table 4.3 - Summary of the Reasons cited by Multinational Plants in Yorkshire and The Humber and Scotland for Not Sourcing More Material Inputs from Local Suppliers (Sources: Data for Yorkshire and The Humber from Crone's own research (2002) and for Scotland from Turok, 1993, Figure 8 – in Turok's paper, cited by Crone, 2002).

In addition, Hewitt-Dundas *et al.* (2005) investigate northern and southern Ireland to compare the extent to which multinational plants are integrated into their host economies through local sourcing. Companies were asked for the reasons why they did not source locally. The southern Ireland sample consisted of senior managers from 61 multinational plants whereas the northern Ireland sample included 33. The results are shown in Table 4.4.

Reasons for not sourcing locally	Southern Ireland (% of Multinational Plants)	Northern Ireland (% of Multinational Plants
Prefer Group Supplier	21	Nil
Technical Competence	25	10
Delivery Times	10	2
Quality Issues	15	14
Too Expensive	38	29
Supplier Capacity	31	Nil
Local Availability	86	96
Unreliable Suppliers	Nil	5

Table 4.4 - Summary of the Reasons for Not Local Sourcing by Multinational Plants in southern and northern Ireland (Source: The Author, based on Hewitt-Dundas *et al.*, 2005)

Hewitt-Dundas *et al.* (2005) identify that 86% of multinational plants in southern Ireland compared to 96% in northern Ireland have a lack of local availability of sourcing. The results relate to the number of plants interviewed and their perception of why purchasing is not carried out locally, whereas the SCVs research relates to the identification of suppliers of specific, high and low-value goods and services perceived to be lacking in the region. Coincidently, Crone (1999) shows a similar order of magnitude, confirming that lack of availability is a significant problem resulting in weak local linkages. The author utilised the Hewitt-Dundas *et al.* study and the perceived reasons for not sourcing locally to pose the semi-structured interview questions used to address Research Question 1. In relation to the Financial and Business Services sector in Wales, Gripaios and Munday (2000) report the poor state of linkages between inward investors and locally based companies. Also, the objective of low cost competitive advantage has resulted in companies locating contact centre operations in Wales in preference to other regions (Bristow *et al.*, 2000) to benefit from lower property costs, for example.

Most of the available empirical evidence indicates that foreign investors have rarely developed significant input linkages with their host economy. In fact, considerable evidence supports the assertion that the sourcing patterns of multinational companies have become increasingly internationalised (see for example, Phelps, 1993a and 1997; Hudson, 1997; Rees, 2005; Alderman, 2005). Twomey and Tomkins (1996) also

demonstrate that smaller regions have greater deficiencies within their supply chains in relation to local availability.

4.3.2.2 BENEFITS OF LINKAGES AND EMBEDDEDNESS

Linkages are understood to deliver benefits to the focal region, leading to the potential embeddedness of firms within the region. This can result from linkages between indigenous and FDI companies. Caves (1974) identifies that competitive (i.e. horizontal) linkages can prompt innovation, efficiency and technical improvements in domestic firms whilst Lall (1980) reports that FDI may contribute to improve the capabilities of domestic suppliers or customers by raising quality standards and efficiency of production, as well as providing assistance relating to procurement, design, quality control, training or market information.

In addition, Blomstrom (1989) finds that FDI can contribute to increased productivity of host country resources, skills, knowledge accumulation by domestic firms as well as production, exporting and technological capability whereas a study relating to Northern Ireland by the Department of Economic Development (DED) (1995) discover that the quality and benefits of inward investments go beyond job creation by extending to more intangible knowledge-based variables, providing the basis for investments to become embedded in the local economy. The PACEC (1995, p 154) study into FDI and UK manufacturing reports that 'Direct trading with inward investors resulted in significant improvements in the business performance of suppliers in areas such as quality, costs, product development, production organisation/technology and delivery which resulted in increased sales and employment and improvements to investment behaviour, productivity and profitability'. Other improvements were identified including local labour supply and skills, technological base, training facilities and services, local infrastructure, supply chains and networks and the number and quality of jobs arising directly from inward investors and indirectly from local linkages.

Later, a focus on Wales concludes that FDI acts as a spur for Welsh indigenous firms to continuously improve in terms of performance, quality, price and delivery reliability and that there is some evidence of Welsh suppliers being encouraged to improve

products and to innovate (Cooke, Boekholt and Todtling, 2000). In relation to generic FDI, UNCTAD (2001) report that linkages can contribute to the upgrading of domestic enterprises and embed foreign firms more firmly in host economies.

By looking at the investors' perspective of potential embeddedness, Chen *et al.* (2004) investigate Taiwanese companies investing abroad and ask what they look for in target locations or economies. They report that the use of skilled as opposed to unskilled labour could entail some relational capital (i.e. develop embeddedness through relationships with skilled labour). This also relates to the other linkages investigated i.e. sales to local firms, R & D, local labour used, subcontracting, financial resources supplied by local institutions.

Finally, Scott-Kennel (2007) identifies that transactional linkages generate demand for and add to the supply of locally produced goods and services in New Zealand.

In summary, the main benefits relate to improved technologies (e.g. Caves, 1974; PACEC, 1995), skills (e.g., Blomstrom, 1989) efficiencies and quality (e.g Lall, 1980), with productivity, knowledge transfer, products, embeddedness, employment and costs also rating highly (e.g. PACEC, 1995; Lall, 1980, Chen *et al.*, 2004; Cooke *et al.*, 2000).

4.3.2.3 DISADVANTAGES, CRITICISMS OR ISSUES TO CONSIDER REGARDING LINKAGES AND EMBEDDEDNESS

There are a number of disadvantages or issues relating to linkage development or potential embeddedness in a region. Granovetter (1985) and Zucchella (2006) study FDI in Italian industrial districts and clusters and identify that 'lock-in' or over-embeddedness can be a weakness leading to the dis-embeddedness of firms. The risk of over-embeddedness appears to be a convincing argument in explaining the decline of local clusters, as local members can no longer find competitive enhancement in embedded ties, and fail to develop new ones (locally or non-locally).

In Northern Ireland, Fothergill and Guy (1990) report that many FDI plants are selected for closure based on their role in relation to the parent organisation, hence any linkages can be lost. In addition, they find that a number of plants were found to be 'relatively small, production-only units making products that were nearing the end of their life-cycle' (p 18), indicating limited linkage opportunities. Harrison and Brady (1992) assert that there will be no predisposition on the part of FDI companies towards local sourcing unless quality, price, delivery, reliability and technical competence can be guaranteed to be at least as favourable as the best elsewhere. Looking at 'competitiveness' within Northern Ireland, Dunning, Bannerman, and Lundan (1998) find that FDI companies can be attracted by financial inducements, therefore investment and linkages are likely to be quite shallow, hence transient. Furthermore, NIEC (1999) report that short term investment of some FDI projects in Northern Ireland can limit linkage and embeddedness opportunities owing to the establishment of plants with products nearing the end of their product life cycles and the lack of corporate functions such as R & D.

Focussing on industrial districts in, for example, the Ruhr in Germany, Grabher (1993) finds that cluster decline occurs mainly due to its falling into the 'trap of rigid specialisation'.

In general FDI terms, Harrison (1994) reports that the entry of multinationals can impact embeddedness and lead to the decline of industrial districts whereas Blomstrom and Kokko (1998), Gorg and Strobl (2001) and Gunther (2005) find that a number of studies provide evidence of both positive and negative spillovers in different contexts, using different research methods, however, results are mixed and inconclusive. Aitken and Harrison (1999), Bosco (2001) and Gunther (2005) also find that Inward investment does not necessarily result in beneficial spillovers. UNCTAD (2001) elaborate that not all linkages are equally beneficial for host countries. The extent to which domestic firms benefit from linkages with foreign affiliates also depends on the nature of their relationship and the 'power' position within that.

More recently, in relation to clusters and capital projects, Alderman (2005) discovers that owing to the transitory nature of capital projects and the transient nature of supply

chains, local embeddedness within a region is not a normal outcome. Although the acquisition of knowledge, for example, is fundamental to capital projects, implying a need for face to face communications and the transfer of tacit knowledge between project team members, this tends to demand the mobility of people, knowledge and other project resources, rather than embedding them in the local regional economy. Companies should therefore be embedded within a capital project but not necessarily in a region. Embedding in these cases relates to the need to embed knowledge on the project.

Finally, Zucchella (2006) concludes that there are both local and global ties between firms of differing types. The focus on local alone cannot be perpetuated. there is a form of 'multiple embeddedness' where innovation is favoured, and the home structure and culture of firms are subject to renewal and the risks of lock-in and district sterilisation are reduced. The time of the self-sufficient local systems is over and that specialised clusters need to establish forms of cooperation, reciprocal knowledge sharing and transfer on a global scale, to fend against the risk of over embeddedness, cognitive sterilisation and decline.

In summary, the main disadvantages or issues relating to linkage development or potential embeddedness include the potential for 'lock-in' or dis-embeddedness (e.g. Granovetter, 1985; Zucchella, 2006), role and life-cycle position of products (Fothergill and Guy, 1990), specialised clusters need to establish forms of cooperation, reciprocal knowledge sharing and transfer on a global scale, to fend against the risk of over embeddedness, cognitive sterilisation and decline (e.g. Alderman, 2005; Zucchella, 2006) and that spillovers are not always evident or found to be positive for a region (e.g. Gunther, 2005). Section 4.4.4 on clusters also identifies examples where local supply is not appropriate or feasible in a local versus non-local discussion.

4.3.2.4 REASONS WHY LINKAGES CAN OR CANNOT BE DEVELOPED OR ENABLED

There are a number of reasons identified within the literature relating to the possible reasons why linkages can or cannot be developed in a region. Marshall (1979) asserts

that company ownership is not a significant determinant of material linkage patterns. However, findings show that production technologies, environmental certainty and the size of firms do relate to the level of linkage patterns whereas Dicken (1992, p 397 – 398) finds that the nature and characteristics of the host economy is one of the four main influences on the establishment of linkages with local suppliers, by multinational firms. However, other authors do not consider this and progress on the basis that other reasons exist for the lack of capability within local supply chains (e.g. Marshall, 1979).

A number of authors underpin those reasons identified by Hewitt-Dundas *et al.* (2005) that relate to weak linkages. Harrison and Brady (1992) for example conclude that there will be no predisposition on the part of FDI companies towards local sourcing unless quality, price, delivery, reliability and technical competence can be guaranteed to be at least as favourable as the best elsewhere. Moreover, Hines (1993) asserts that one of the major issues facing both inward investors and indigenous companies in Wales is the quality of local sources of supply. If (Welsh) suppliers are to take advantage of the establishment of foreign plants established in Wales, then the goods and services supplied must match the best offered elsewhere in terms of quality, cost and delivery. Morgan (1996) reports that local suppliers must have the technological capacity to adapt to accelerating technological advances and shortening product life cycles whilst Blomstrom and Kokko (2001) find that availability, geographic proximity and competency of local suppliers also increases the likelihood of local sourcing and inter-firm linkages. Crone finds that the availability problem in Yorkshire and Humberside is linked to competitiveness and capacity (i.e. volumes required by large MNEs are not available in region).

Also under-pinning Hewitt-Dundas *et al.* (2005), UNCTAD (2001) make a number of observations relating to linkage development. The linkage formation process is affected by a host country's overall policy environment, its economic and institutional framework, the availability of human resources, the quality of infrastructure and macroeconomic stability. However, the most important factor is the availability, costs and quality of domestic suppliers. The technological and managerial capabilities of domestic firms also determine to a large extent the ability of a host economy to absorb and benefit from the knowledge that linkages can transfer. Weak capabilities of

domestic firms increase the chances that foreign firms source the most sophisticated and complex parts and components either internally or from a preferred (foreign-owned) supplier within or outside a host country. The extent to which foreign firms forge links with domestic suppliers is determined by the balance of costs and benefits, as well as differences in firm level perceptions and strategies. Whilst cost and benefits reflect a large number of industry-specific factors, the most important concerns the local availability of qualified suppliers. Foreign firms producing primarily for the domestic market generally procure a larger share of inputs locally than export orientated ones, or those that are part of integrated international production systems. In the case of the latter, cost and quality considerations are particularly stringent, and firms tend to be guided by corporate global sourcing strategies. The lack of efficient domestic suppliers is often a key obstacle to the creation of local linkages. In many demanding activities, multinational firms therefore actively encourage foreign suppliers to establish local facilities or prefer to produce in-house.

Phelps (1993a) identifies that where purchasing is organised globally there is a reduction in opportunities for local suppliers whereas Williams (1997), UNCTAD (1998) and Giroud and Mirza (2004) find that greater autonomy of FDI companies is associated with higher levels of backward linkages.

In Yorkshire and Humberside, Crone (1999) finds that 'lean' initiatives are determining levels of local sourcing by older multinational companies. Also, the extent of MILs are primarily determined by the specific nature of a plant's demand for inputs and the 'supply potential' of the regional economy. External ownership and control also impact MILs and different sectors vary in their demand levels and MILs. Multinational plant attributes can affect levels of MILs i.e. age, size, method of establishment (in region), nature of products (i.e. complex, standard etc), method(s) of production and R & D function. In addition, corporate context for example, purchasing/sourcing strategies determine if local or global suppliers are to be used. Crone (1999) identifies a number of barriers to local sourcing:

- Strong integration in group wide production systems means that there is little scope for policy intervention

- Centralised/pooled procurement and knowledge sharing initiatives between sites results in a difficult for policy intervention
- Single sourcing strategies for key inputs mean that local suppliers need to improve their competitiveness, otherwise they are unlikely to become preferred suppliers.

NIEC (1999) conclude that regional 'supply potential' boils down to the internal dynamics and capabilities of individual firms. Large FDI companies and multinationals are demanding of suppliers in terms of quality, cost and price, therefore suppliers must be capable of expanding from concept to high volume production rapidly.

In more recent times, Baily *et al.* (2005) identify that there are three main reasons why locating suppliers may be difficult:

- Technological advances – The buyer's needs are becoming more complex and difficult to achieve and fewer suppliers are willing or capable of meeting such needs.
- Increasing concentration in supply markets – The continuing process of mergers and acquisitions is leading, in many sectors, to a situation where there are very few, very large suppliers who have less motivation to pursue business that will eventually come their way.
- Increased specialisation – Specialisation amongst manufacturing concerns tends to lead to more 'buy' than 'make' decisions. This in turn means that a greater proportion of their needs are acquired from outside sources. Such sources may not be aware of the developing needs and will not be actively sought out by the buyer organisation.

Finally, Scott-Kennel (2007) reports on the competitiveness of the host country's domestic industry should be considered. The smaller the gap in technologies between the domestic and foreign firms increases the likelihood of linkages and spillovers occurring due to better absorptive capacity.

In summary, the main reasons relate to the lack of 'supply potential' or capabilities within a region (e.g. Dicken, 1992; Hines, 1993; NIEC, 1999; Blomstrom and Kokku, 2001).

Conversely, in their study of manufacturing FDI companies from Taiwan investing abroad, Chen *et al.* (2004) find that the intensity of local linkages differs by FDI location or country, firm size, entry mode or nature of the production network in which the FDI investor is embedded. In addition to supply linkages, Chen *et al.* also investigate sales to local firms, R & D, local labour used, subcontracting and financial resources supplied by local institutions. They identify that more local linkages are pursued by the investor if they are in search of distinctive and inimitable resources. Findings from this paper were used to scope the semi-structures interviews used in relation to Research Question 1 for 'potential' SCVs.

4.3.2.5 POLICY IMPLICATIONS RELATING TO LINKAGES

It is worth considering how SCVs in Wales may be addressed, based on policy recommendations from within the literature. In an early study, NIEC (1991) cautions against offers of assistance for limited activities such as assembly or branch plant type operations, arguing for a more selective approach to FDI. The priority should be to attract projects that would introduce new products and technology, offering scope to develop high order corporate functions (e.g sales and marketing, R & D, purchasing etc.). The short term investment of some FDI projects lead to a lack of embeddedness in a region. Moreover, the OECD (1993) report that most regional authorities are trying to embed mobile capital, ensuring its contribution beyond simple job creation, to the formation and development of mutually reinforcing linkages in the local economy. Three waves of regional policy are recommended: FDI, indigenous and a mix of the two by supporting local/indigenous potential whilst exploiting opportunities from FDI or external resources.

Munday (1995) and Crone and Watts (2002) both recognise that policies directed at encouraging second round inward investments and the development of linkages

between larger firms would probably offer greater potential for successful cluster development in less favoured regions.

Whilst focussing on Wales, Morgan (1996) asserts that major policy areas include the concept of technology with the capacity to innovate and upgrade, particularly for products and processes in support of the knowledge based economy. A policy with technology transfer and learning at its core has two issues:

- supply problems relate to the lack of capacity in Wales to innovate and diffuse technology;
- demand problems are about the receptiveness of local business, especially SMEs, in their failure to generate a demand for output of research and technological development in the form of new products and processes (supporting the European Commission, 1995).

In a more strategic approach, Twomey and Tomkins (1996) advise that local sourcing might be increased by designing policies to 'fill gaps' in a region which is addressed within the SCVs framework in Chapter 6.

Crone's (1999) thesis on linkage development in Yorkshire and Humberside makes a number of policy recommendations. Local sourcing initiatives are required to improve local MILs where, for example, there is a need for world class accreditations and standards to be achieved and complied with, therefore, RDAs should establish supplier development initiatives for such things. Further, Crone (p 375) asserts that in relation to the availability problem, 'questions must be raised about the viability of creating local supply capability in areas where none exist'. There is limited funding for development in UK and it is therefore unlikely that sufficient resources could be made available to support development of new indigenous suppliers.

Crone also identifies that an option may be to target inward investors who have the specific capabilities required by a region. (This approach may be more appropriate if building on existing strengths i.e. Scotland and Republic of Ireland (RoI) clusters). He continues by suggesting that 'A detailed survey of purchasing requirements of locally based multinational plants and the capabilities of suppliers would help RDAs to identify specific gaps, to assess the scope for attracting suppliers and therefore target inward

investment more accurately' (p 376). (This gap is addressed by research Question 2). In addition RDAs should re-consider the development of new local supply capability in low technology or low value adding sectors owing to the increasing threat of competition from low cost countries. RDA effort should be spent on high technology industries/high-value adding suppliers where a sustainable competitive advantage may be achieved.

Crone also asserts that coalitions of SMEs in a region should be created in order to deal with volume and other activities i.e. main assembly design/development/manufacture, rather than simple manufacture of spare parts. More importantly, Crone asks if a single region is the most appropriate scale for policy to address local sourcing? He suggests it may be better to implement sourcing initiatives across a larger geographical area e.g. Northern England and states that this may be more realistic and cost effective because of economies of scale on staffing and other resources in the regions. However, he has doubts about the likelihood of the level of cooperation between RDAs as they are usually rivals for e.g. FDI. Therefore, central Government may need to take the lead to develop a strategic vision (Crone, 1999 pp 380 – 381; Crone, 2002). This issue is addressed for Research Question 2 in the SCVs framework in Chapter 6.

The UNCTAD (2001) report is significant in relation to the development of local linkages. Firstly, it recommends that Governments can influence the creation and strengthening of linkages through policies that address different market failures at different levels in the linkage information process. The role of policy is most significant where there is an 'information gap' on the part of both buyers and suppliers about linkage opportunities, a 'capability gap' between requirements of buyers and the supply capacity of suppliers and where the costs and risks for setting up linkages or deepening them can be reduced. It also points out sustainable linkages will only be created if both FDI companies and domestic firms can benefit from them. Therefore such a programme should address the competitive needs of domestic companies and the implications these have for policies, private and public support institutions and support measures (e.g. skills, technology-upgrading).

UNCTAD (2001) continues by recommending that linkage programmes should have two broad objectives: to increase domestic sourcing by foreign affiliates (i.e. create new backward linkages) and to deepen and upgrade existing linkages. Further, linkage programmes should be seen as part of a broader set of FDI and SME policies. As networks of viable suppliers often prosper in clusters of firms, attention should be given to the development of such clusters, particularly for knowledge-intensive industries and activities. The more linkage promotion policies that go hand in hand with SME development and targeted FDI promotion policies, the more they are likely to be successful.

In a later study, Crone (2002) acknowledges that the scope for policy intervention is quite limited, stating that possible opportunities could be targeted where there is a lack of local availability and argues that policy interventions designed to tackle supplier capacity and competitiveness have greater potential over simple 'brokering' services. Overall, Crone advises that it seems unlikely that policies designed to fill gaps in the local supply base would be able to bring about significant increases in the overall level of local sourcing, given the sheer scale of the local availability problems faced by most multinational plants. However, he believes that policy cannot hope to bring about a radical transformation of the sourcing patterns of multinational companies in an environment where underlying forces seem to be encouraging the internationalisation rather than the localisation of production systems and supply chains. Finally, Crone and Watts (2002) reflect that it would be difficult to bring about changes in supply chain patterns through policy interventions.

Key policy recommendations conclude that FDI and indigenous firms should be targeted based on regional requirements (e.g. NIEC, 1991, Crone, 1999), high-value activities should be attracted rather than low cost or end of life activities (e.g. Crone, 1999), policies should be designed to fill gaps in capability (e.g. Twomey and Tomkins, 1996) and information, knowledge and SMEs should be targeted (UNCTAD, 2001).

By way of caution, Crone (1999) asks if the region is the correct scale for linkage policies. As an example, West Cheshire and North East Wales have considered joint opportunities for the respective RDAs to develop (e.g. GVA Grimley, 2004). Crone

and Watts (2002) and Crone (2002) contend that polices to fill gaps or develop capabilities will be difficult and may not result in improved linkage levels. The cluster literature also questions the spatial scale for policy (AIM and WERU, 2005).

In summary of this section, linkages are seen to be valuable to a regional economy although they appear to be weak, particularly in UK regions (see Table 4.2). There are a number of benefits and issues associated with linkages and embedding firms in a region and the literature includes a significant number of policy recommendations and issues in relation to linkage development and embeddedness.

This section has defined, scoped and reviewed a selection of the literature relating to linkages and embeddedness, appropriate to the study. Gaps have been identified where the study can make contributions.

4.4 DEFINITIONS OF PURCHASING AND SUPPLY CHAIN MANAGEMENT

This section introduces and defines the topics of 'purchasing' and 'supply chain management' (P & SCM). There are numerous definitions relating to 'purchasing' and 'SCM' within the literature. Purchasing is also known as procurement in government acquisition processes or simply as a buying task (Bowersox *et al.*, 2007), whereas SCM can be referred to as material and/or logistics management (Quale, 2006). Leenders and Fearon (1997) observe terms such as purchasing, procurement, supply, supply chain, material, materials management, sourcing and logistics are all used inter-changeably. Axelsson and Wynstra (2002, p 15) state that the purchasing function can be described as 'a process, moving from buying, via procurement, to supply management'.

A selection of definitions for purchasing and procurement are summarised below. Recent theses by Zokaei (2009) and Mason (2009) present extensive summaries of the definitions of SCM, explaining how it has evolved from a narrow focus on the physical aspects of the chain into a more comprehensive discipline. The author will not replicate this level of analysis but will provide a summary of illustrative definitions of

purchasing, based on the scope of this study as defined in Figure 4.7 which concentrates on the dyadic relationship between customer and supplier to identify SCVs.

Elliott-Shircore and Steele (1985) define purchasing as the process by which a company or organisation contracts with third parties for goods and services required to fulfil its business objectives in the most timely and cost effective manner whilst Van Weele (2000, p 14) states that purchasing involves 'obtaining from external sources all goods, services, capabilities and knowledge which are necessary for running, maintaining, and managing the company's primary and support activities at the most favourable conditions'. Finally, Lysons and Farrington (2006, p 8) offer a composite definition stating that purchasing is 'the process undertaken by the organisational unit that, either as a function or as part of an integrated supply chain, is responsible for procuring or assisting users to procure, in the most efficient manner, required supplies at the right time, quality, quantity and price and the management of suppliers, thereby contributing to the competitive advantage of the enterprise and the achievement of its corporate strategy'.

Based on these definitions, purchasing is either a process or a combination of activities including the buying of goods and services and the management of such items through inventory control, warehousing and transportation, quality assurance and control. These seem to be more tactical or transactional whereas Lysons and Farrington (2006, p 8) and Elliott-Shircore and Steele (1985) also focus on strategic issues such as meeting company objectives or strategic goals in a timely and cost effective manner. Van Weele (2000) also identifies the difference between tangible goods and intangible knowledge, services or capabilities. This study is interested in identifying both goods and services sourced from outside Wales and the reasons for this, to address Research Question 1.

Kathawala and Abdou (2003, p 141) conclude that SCM 'has been poorly defined and there is a high degree of variability in people's minds about what is meant'. Williams (2004) endorses these concerns and those of Croom *et al.* (2000) as SCM can be defined as structures (Bask and Juga, 2001), relationships (Berry *et al.*, 1994), processes (Lee and Billington, 1992), and the identification of members within the supply chain (Kopczak, 1997).

SCM has been referred to as an end to end integrated process covering activities such as those identified within the definitions of purchasing and procurement, e.g. purchasing, inventory management and transportation (e.g Macbeth *et al.*, 1989; Ellram, 1990; Christopher, 1992; Compton and Jessop, 1995; Stock and Lambert, 2001; Quale, 2006, Lysons and Farrington, 2006). It is also seen as a relational concept (e.g. Saad *et al.*, 2002; Handfield, 2006; Christopher and Peck, 2003). Furthermore, Handfield and Nichols (2002) highlight the importance of information sharing and improved performance. Christopher (1992) emphasises the importance of supply chain networks whilst reducing costs and meeting customer requirements are cited as objectives by Christopher and Peck (2003). Saad and Patel (2006, p 39) focus on 'strong feedback linkages and collective learning'. Both logistics (The Council of Logistics Management, 1993) and materials management (Dobler *et al.*, 1990) have similar activities and goals.

The definition most aligned to this study is Harland (1996) who states that there are four main uses of the term SCM which relate to the internal supply chain, dyadic or two party relationships, a chain of businesses including e.g. a supplier and the suppliers' supplier etc., and the management of a network of connected businesses. The two party or dyadic relationship is concentrated upon when addressing Research Question 1 whilst a network of suppliers is engaged in order to address Research Question 2, when addressing SCVs (see Figure 4.7).

Kempainen and Vepsalainen (2003) summarise that the supply chains of the 1990s were linear with management focussing on the efficiency of material flow. Increasing customer requirements and information technology have affected SCM and transformed supply chains into multi-tiered networks. In future, ongoing outsourcing and specialisation are expected to impact structures further into what these authors' term 'encapsulated networks' with shared technology, systems, extended decision rights and non-territorial services. The implications here for Welsh suppliers is that they must develop strategies to introduce specialist capabilities with which they can collaborate and operate within supply networks.

This section has provided sample definitions of P & SCM. There are no clear, agreed definitions relating to the activities carried out within P & SCM where processes are extensive, involving both internal departments and external parties within a supply chain. This study is interested in meeting customer contingencies via search activities, as highlighted in Chapter 3 whilst focussing on the dyadic relationship between buyers and suppliers, to address Research Question 1. The broader network is used to resolve SCVs in Research Question 2.

4.4.1 PURCHASING AND SUPPLY CHAIN MANAGEMENT – BACKGROUND AND SCOPE OF THE STUDY

This section provides the background and scope of P & SCM in relation to the study. An illustrative literature review has been carried out for specific themes that assist in answering Research Question 1 regarding P & SCM organisational structures, processes, behaviours and SCM structures that may influence SCVs:

- Purchasing Organisations, Professionalism and Decision Making Units (DMUs)
- Customer Priorities demanded from the supply chain/Suppliers – (e.g. Quality, Cost, Delivery)
- Clusters – in relation to Parc Aberporth. Cluster definitions appear to align to its development strategy and there is an overlap with high technology sectors such as Biosciences and Aerospace in addressing SCVs.

Gaps have been identified for these topics where the study registers contributions.

The UNCTAD (2001) assert that organisational changes are making SCM more critical to the competitiveness of firms. On average, a manufacturing firm spends more than half of its revenues on purchased inputs. Some firms are contracting out the entire manufacturing process to 'contract manufacturers', retaining such activities as R & D, design and marketing. In such cases, SCM is even more important.

A typical supply chain example is depicted in Figure 4.7, adapted from Williams (2004, Figure 1.1).

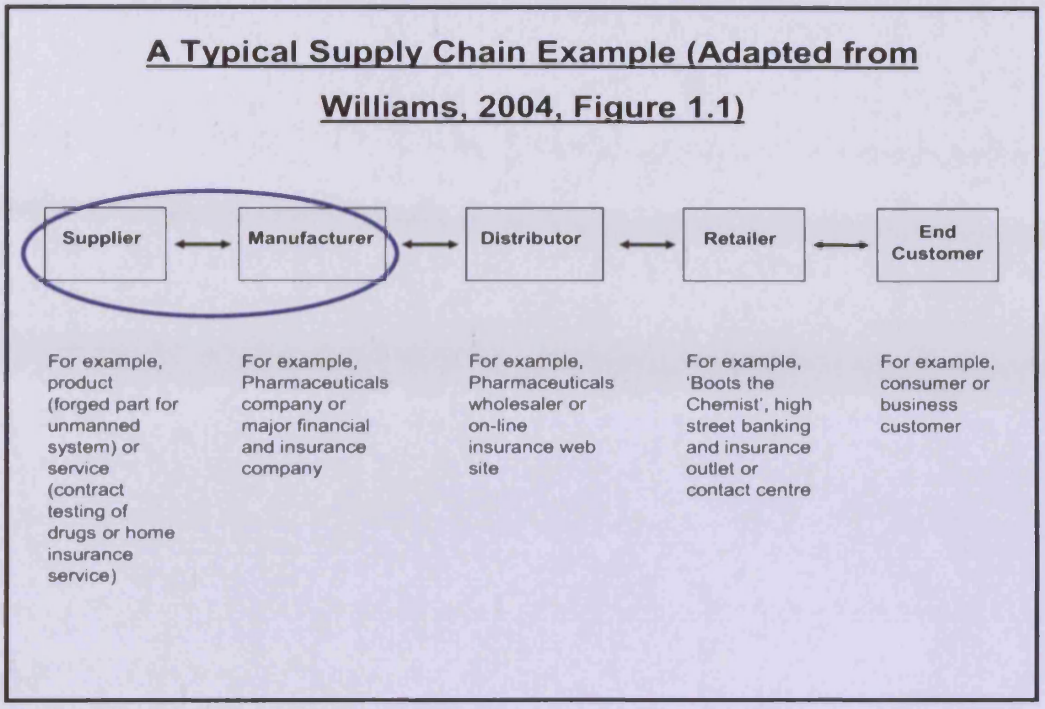


Figure 4.7 – A Typical Supply Chain Example (Source: Adapted from Williams, 2004, Figure 1.1)

In this study, Research Question 1 focuses on buyer and supplier organisations, concerning the perception of what cannot be purchased locally or within Wales and why. This targets the dyadic or two party relationship between the customer and supplier organisations (see Harland, 1996) as it does not differentiate between manufacturing and service based companies. In Figure 4.7, this would focus on the 'supplier' and 'manufacturer' relationship, as highlighted. Research Question 2 expands the study into the regional supply chain in order to address SCVs.

Guinipero *et al.* (2008) complete a comprehensive literature review relating to SCM over ten years. Findings show that the literature relating to P & SCM examines the issues portrayed in existing operations (Guinipero *et al.*, 2008), not potential supply chain requirements. This study investigates 'immediate' SCVs in Chapters 7 and 8 for Biosciences and Financial sectors, along with 'potential' SCVs in support of Unmanned Systems at Parc Aberporth in Chapter 9. Therefore the study contributes to academic knowledge in relation to potential requirements and activities.

Other findings by Guinipero *et al.* (2008) include a noticeable gap relating to the role of 'intermediaries' who may be able to assist in the identification of capability gaps within supply chains and the instigation of possible solutions. Hines (1992) documented the role of intermediaries in the supply network and focused on the 'Source Wales' initiative. In this study, the intermediaries are represented by the WAG who intends to assist the development of regional capabilities within priority supply chains or sectors. Furthermore, Guinipero *et al.* (2008) identify that only 2% of publications include 'buyer behaviour' within research categories. Again, this study, through the application of search and contingency theories, aims to understand better the influences of DMUs and the key priorities required by customer organisations from (potential) suppliers, whilst contributing to academic knowledge.

Guinipero *et al.* (2008) find the majority of empirical SCM research focuses on dyadic relationships. Whilst the SCVs research targets this type of relationship to identify SCVs, it also investigates the broader supply network within sectors to attempt to resolve supply chain capability gaps (Harland, 1996). In addition, it considers the wider sector issues in Wales, in relation to those factors that affect it via the use of PESTEL, SWOT and TOWS analyses. Therefore, a contribution can also be made here.

To summarise this section, the scope of the study initially focuses on the dyadic relationships between buyer and supplier, concentrating on the Welsh region for sources of supply. A number of gaps relating to P & SCM in general have been identified where contributions can be made. The following sections review specific topics relating to P & SCM which relate to the semi-structured interviews carried out within the case studies to address Research Question 1 help to describe and explain findings.

4.4.2 PURCHASING ORGANISATIONS, PROFESSIONALISM/SKILLS AND DECISION MAKING UNITS

This section outlines a selection of the literature relating to purchasing departments and the level of centralisation or decentralisation within an organisation, the degree of professionalism that could be employed by personnel and the construct of the DMU involved in sourcing activities.

4.4.2.1 CENTRALISED OR DECENTRALISED PURCHASING

In organisations, purchasing decisions can be centralised to the responsibility of a specialised purchasing function or site, or can be decentralised at different business units. There are a number of models within the selected literature and three examples are summarised here as they are representative of the existing body of knowledge.

Quale (2006, pp 61 - 62) offers a three level model for purchasing organisations. 'Complete centralisation' is where one centralised department controls the purchasing of all supplies for various units or factories whereas 'complete decentralisation' is the converse, where each separate unit or factory has its own purchasing department, obtaining its own requirements. The 'multi-level structure' is where each unit has its own purchasing department and there is a centralised purchasing department that has some responsibility to coordinate the activities of decentralised units or factories.

The Lyles and Payne (2000) purchasing model also offers three options. 'Coordinated devolved procurement' is where most activities are carried out by the business units or operating divisions but are coordinated by a centralised purchasing function. Procurement of common products and services are centralised. Procurement strategies, policies, systems and standards are centrally controlled. The 'centralised' approach is where no independent units carry out their own purchasing activities and strategies, policies, systems and standards are carried out centrally. The 'consultative' approach is where procurement activities for both strategic and operational needs are carried out at the business units or operating divisions, but taking guidance from the centralised department. The overall control of purchasing strategies etc. resides with the central department.

Finally, Lysons and Farrington (2006, pp 168 – 172) promote a five level model. 'Cross-functional purchasing' involves teams of people from different functions within the organisation whereas 'cross-organisational purchasing' enhances this by including suppliers or customers in the teams. 'Divisional purchasing' is Determined by the focus on a specific product, service, geographical location or customer whilst 'centralised

purchasing' indicates that activities are lead by the company HQ or a regional or divisional centre. Finally, 'decentralisation' is traditionally where plants or divisions have purchasing responsibilities. However, this can also relate to purchasing responsibilities being devolved to actual individuals or users.

This review shows that there is a mix of organisational structures and responsibilities that can be adopted to develop an organisation's purchasing strategy and devise the tactical approaches relating to sourcing decisions which may result in a regional SCV. There are a number of issues associated with such approaches e.g. an organisation's adoption of purchasing structure and activities depends upon contingencies such as organisational strategy (Quale, 2006).

This section has outlined sample typologies of purchasing organisations that may be compared to the case study findings, leading to minor contributions.

4.4.2.2 PURCHASING AND SUPPLY CHAIN MANAGEMENT PROFESSIONALISM

This section briefly outlines a sample of the literature relating to professionalism within P & SCM. The subject of the 'professionalism' of personnel within the P & SCM discipline is represented within both academic (e.g. Lysons and Farrington, 2006) and practitioner literature, for example, *Supply Management*.

A number of definitions of purchasing and procurement professionalism have been identified in the selected literature which are summarised below. This topic has been selected as it could influence the capabilities of P & SCM personnel in firms and how they behave in the search and selection of suitable suppliers, for example.

Carr-Saunders and Wilson (1928), cited by Lysons and Farrington (2006) state that professionalism relates to the competence or development of attributes such as skills based on theoretical knowledge, prolonged training and education, demonstration of competence via tests and examinations and the adherence to a code of practice whilst Lysons and Gillingham (2003, pp 22 - 24) assert that it relates to the level of expertise,

commitment, responsibility and ethics demonstrated by P & SCM personnel and state that it helps to improve the perception of the status of P & SCM in organisations. Bailey *et al.* (2005) find that public sector procurement professionalism is demonstrated through professional training and education of those personnel responsible for setting the strategic direction and application of procurement activities within an organisation, which allies for example, to the role of RDAs in the investigation of SCVs. Quale (2006) reports that the professional development in the discipline over recent years has led to the recognition of the need for established career structures, good education and training programmes and finally, Handfield (2006) recommends that a plethora of skills are required in changing organisations, including specifics related to P & SCM.

Whilst no specific criticisms of this topic have been found within the sample literature, the author accepts that there are numerous sources of professional development and education available to organisations, e.g. those offered by the Chartered Institute of Purchasing and Supply (CIPS), or via higher education institutes and universities. However, the perceptions of these will vary for different customer organisations and individuals.

4.4.2.3 PURCHASING DECISION MAKING UNITS (DMUs)

This section supports the previous two as it outlines sample literature relating to the purchasing DMUs within organisations. Who is involved and their capabilities in relation to the sourcing decision can influence a SCV.

A practical definition of organisational buying is offered by Kotler *et al.* (1999) as the decision making process, by which organisational buyers determine the need for purchased products and services, and identify, evaluate and choose among alternative brands and suppliers.

Webster and Wind (1972) introduced the phrase 'decision making unit' for the group of people involved in organisational buying stating that different members within the group may carry out different roles within the purchasing decision making process. These are summarised in Table 4.5.

DMU Roles	Definition
Users	**Individuals most likely to use the product/service**, initiate the buying process identifying the need and outlining the specification.
Influencers	Others within an organisation who **may have an influence on the specification** and **may provide information on alternatives**.
Decision makers	Ultimately have the **power to reach conclusions on the product/service, specifications and/or suppliers**.
Approvers	A person with the **authority to sanction the purchase** specified by the decision maker.
Buyers	Formal responsibility to **choose suppliers and agree the terms and conditions of the contract.**
Gatekeepers	**Access to DMU members may be controlled by secretaries or personal assistants**, for example. Such personnel may also **filter information** intended for members of the DMU.

Table 4.5 – The Decision Making Unit (DMU) (Source: Webster and Wind, 1972)

Christopher and McDonald (1995) propose that a DMU is appropriate to important, or strategic buying decisions often involving senior managers who like to assert that the decision making process they are engaged in is rational and analytical in its approach. Whilst this study does not concentrate on organisational buyer behavioural traits (e.g. Sheth, 1973), the author acknowledges their importance and influence in the buying process.

Robinson *et al.* (1967) identify three different types of buying decisions which determine involvement in the buying decision making process. These are summarised in Table 4.6.

Type of Buying Decision	Definition
New Task	**New purchases** where the organisation has **no previous experience**, thereby **requiring careful search procedures, extended problem solving and shared decision making**.
Straight Re-buy	**Routine**, low risk, low involvement **repeat purchase decisions**.
Modified Re-buy	A **hybrid** of the 2 previous classifications. New dimensions to the buying task, for example, design changes may require the involvement of relevant specialists such as engineers, technologists and/or accountants.

Table 4.6 – Different Types of Buying Decisions (Source: Robinson *et al.*, 1967)

Wilson *et al.* (1991) empirically test a contingency paradigm of group choice in organisational buying decisions and find that 75% of the buying centres are represented by members from different functional areas of the company who normally meet face to face to discuss supplier choice decisions.

Axelsson and Wynstra (2002) identify that when buying business services, many companies use non-purchasing specialists within specific organisational functions such as marketing (marketing and advertising) finance (auditors), production (technical equipment) or top management (consultancy).

Whilst no criticisms were found in the literature, the type of purchase should dictate the participants of the organisational DMU. However, from the author's personal experience, this is not always the case in practice, which can lead to sub-optimal purchasing decision making and identification of problems further into the P & SCM process.

4.4.3 CUSTOMER PRIORITIES OR PERFORMANCE MEASURES

This section provides an overview of examples from the literature, relating to performance measures or priorities demanded by customers from suppliers. This subject relates to contingency theory in Chapter 3 and factors upon which supplier search activities may be based, resulting in SCVs.

Operations management has been broken down into five performance objectives as shown at Figure 4.8 (Slack *et al.*, 2001)

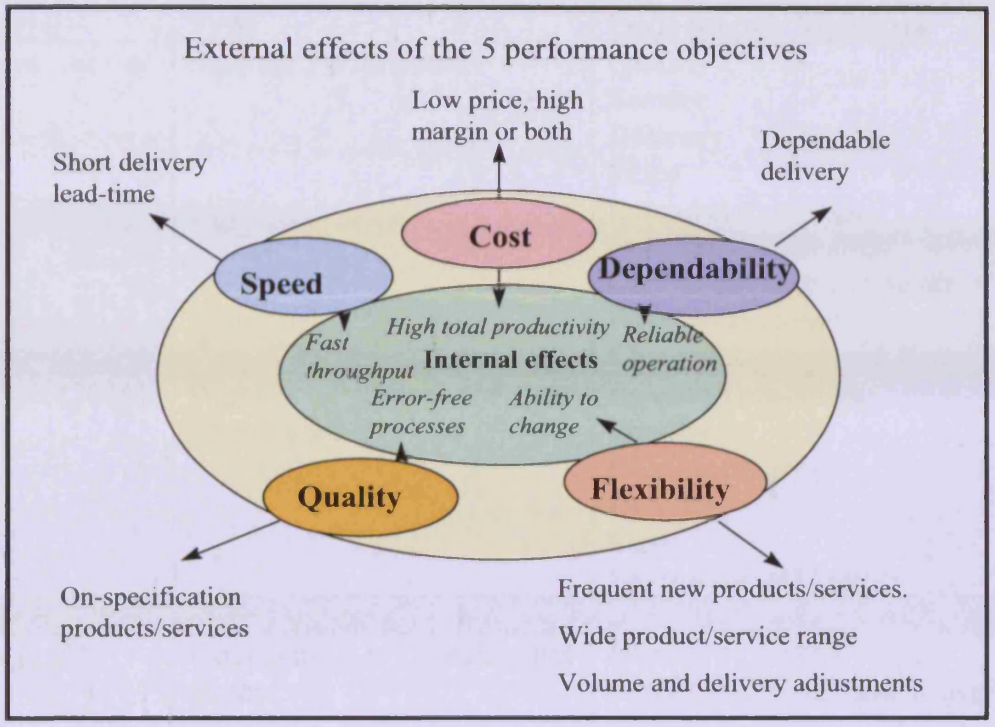


Figure 4.8 - The Five Performance Objectives of Operations Management (Source: Adapted from Slack *et al.*, 2001, p 57)

Examples of purchasing, SCM and operations management performance measures are summarised in Table 4.9.

Author(s)	Type	Performance Measures
Simpson *et al.* (2002)	Supplier Performance	**Quality** **Service** **Delivery** **Price** Extended to include: Supplier Certification Continuous Improvements Physical Distribution Channel Relationship Factors
Varmazis (2006)	Supplier Performance and Compliance	Product Technology **Quality** **Responsiveness** **Delivery** **Cost** Environmental Impact
Heriot (1996)	Purchasing contingency factors	**Quality** (a given) **Price** (cost is the most important factor) **Service** Relationships
Day (2002)	Purchasing	**Cost** **Delivery** **Quality** as Reliability **Quality** as Consistency **Agility** **Service** Innovation
Baily *et al.* (2005)	Purchasing	On time **delivery** Consistent **quality** Good **price** Good **service** back-up **Responsive** to customer needs
Jacoby (2005)	Sourcing	**Cost** **Quality** **Service** **Agility** Asset Utilization
Medori (1999)	Supply Chain	Supplier **Quality** No of Suppliers Manufacturing Lead-Time Material Availability Schedule Adherence Supplier **Delivery** Performance

Saad and Patel (2006)	A Summary of supply chain Performance Measure Sets	Customer Satisfaction Transportation Time Manufacturing and Inventory Buyer Supplier Relation Management Financial Efficiency Information Management
Buffa (1983)	Operations Management	**Cost** **Service** **Quality** **Flexibility**
Hayes & Wheelwright (1984)	Operations Management	**Cost** Dependability **Delivery** **Flexibility**
Hill (1985)	Operations Management	**Cost** **Quality** **Delivery** **Flexibility**

Table 4.7 - Summary of Purchasing, Supply Chain and Operations Management Performance Measures (Source: The Author, based on the selected literature)

Table 4.7 highlights that cost (or price), quality, delivery, service and flexibility (responsiveness or agility) are the most prevalent contingencies so these were included for the semi-structured interviews used to address Research Question 1.

Supply chain measures have been criticised for example, by Beamon (1999) for depending on cost as a primary measure and adopting qualitative measures that are difficult to quantify (i.e. good, fair, adequate and poor). Beamon (1999) therefore recommends that any supply chain measurement system should include three classes of measure:

- 'Resource' including cost, inventory levels and personnel requirements.
- 'Output' including delivery, quality and number of units produced.
- 'Flexibility' including increased customer satisfaction, reduced number of back or late orders and the ability to accommodate new products.

Lee and Billington (1992) and Holmberg (2000) contend that performance measurement systems are fragmented as they do not measure across the whole supply chain (end to

end) and they often cause confusion, owing to the inclusion of an excessive number of measures. Such concerns align to Hoshin Kanri as do those highlighted by Eccles (1991) and Adams *et al.* (1995) who find that performance measures are often not derived from the company strategy and therefore do not support business improvements.

4.4.4 CLUSTERS

Gordon and McCann (2000) argue that three different academic disciplines have developed cluster related theories:

- Regional economics e.g. agglomeration
- Business and management e.g. supply chain coordination
- Geography and sociology e.g. embeddedness and institutional thickness.

The body of literature relating to clusters and networks is significant, as is the literature relating to supply chain coordination, cooperation, collaboration and relationships. However, this study is interested in identifying gaps in regional capabilities and possible suppliers, whilst maintaining awareness of the detailed development and operation of clusters, networks and relational aspects.

This section has its foundation in the classical cluster literature offered by Porter in relation to competitiveness (1990; 1998a; 1998b; 2000; 2003, for example), providing definitions, key features, cluster life cycle stages, perceived benefits and issues or criticisms, along with some policy recommendations or issues. This literature is reviewed in some depth to describe and explain this more contemporary approach, relating to Research Question 1, addressing 'potential' SCVs allied to the development of Parc Aberporth.

4.4.4.1 DEFINITIONS OF CLUSTERS

There are many definitions of clusters within the selected literature and a sample are summarised below.

Porter's earliest definition (1990, p 149) states that 'A cluster consists of industries linked through vertical (buyer/supplier) or horizontal (common customers, technology, channels) relationships'. Latterly, this definition developed further:

- Clusters are 'geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that complete but also cooperate' (Porter (1998a, p 197).
- 'Clusters are geographic concentrations of interconnected companies and institutions in a particular field' (Porter, 1998b, p 78).
- '... a geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types' (Porter (2003, p 562).

Oakey (1995) and Oakey *et al.* (2001) state that functional clustering is where firms gain some benefit from being closely located to each other and these benefits explain why co-location occurs whilst UNCTAD (2001, Overview, p xix) report that clusters are 'concentrations of firms in one or a few industries, benefiting from synergies created by a dense network of competitors, buyers, and suppliers'. More recently, Reid *et al.* (2007) assert that an industrial cluster is a geographically based concentration of firms within a particular industry which extends beyond core firms.

From these definitions, it can be seen that clusters can be geographically located, consisting of firms and other organisations in related industries. However, Porter (1998a, p 197) extends this to include the dynamics of competition and collaboration, which is supported by UNCTAD (2001).

4.4.4.2 KEY FEATURES OF CLUSTERS

Clusters are reported to have a number of defining features, some of which are identified in Appendix E where common themes include the shared products or activities of cluster firms or organisations (e.g. Porter, 1998b; 2003) along with a view

that clusters can be localised and involve collaborators or complementary suppliers from elsewhere (e.g. Alderman, 2005; Rees, 2005).

The study by Rees (2005) demonstrates the potential for historically low technology regions to develop high technology clusters. Non-local collaborations are an important source of competitiveness for high technology clusters, especially those in relatively lagging regions. Local clusters can gain knowledge and resources to compete in the global economy. This case also complements the linkages literature in Section 4.3.

4.4.4.3 LIFE-CYCLES OF CLUSTERS

A growth cycle for high technology firms is proposed by Hanks *et* al. (1993) classified as start-up, through expansion, maturity, diversification to decline, whereas Porter's (1998a) model includes birth, evolution or development and the potential decline and the Advanced Institute of Management Research (AIM, 2005) suggest birth, rapid growth followed by stability, decline and death or renewal. This study is interested in the start-up or birth through expansion and evolution of clusters to help explain findings relating to Parc Aberporth.

Porter (1998a) argues that in the birth stage can be linked to historical circumstances along with factors such as specialised skills, university research expertise, physical location or good infrastructure. Some clusters are born of natural resources whilst others may emanate from e.g. unusual, sophisticated or stringent local demand, the prior existence of suppliers or related industries or clusters, one or two innovative companies that result in the stimulation of others or serendipitous events. Porter (1998a) continues by stating that the evolution or lack of development of clusters is more predictable using three main reasons:

- the intensity of local competition,
- the location and environment for new business start-up
- the efficacy of both formal and informal methods of cluster development.

Porter (1998a) reports that clusters can take up to ten years or so to develop depth and achieve competitive advantage, based on empirical evidence.

4.4.4.4 BENEFITS AND CRITICISMS OF CLUSTERS

Alderman (2005) states that benefits of regional clusters (including temporary coalitions) may relate to local knowledge spillovers between firms, and between firms and knowledge generating organisations, the existence of various specialist service providers, cluster organisations and policy support along with rules and customs that lessen local collaboration under conditions of uncertainty.

Porter (1998b) proposes a number of benefits including companies operate more productively when sourcing inputs; accessing information, technology and institutional support; coordinating with related firms; and measuring and motivating improvements. Clusters are also believed to aid companies to innovate and new companies develop and grow within cluster locations. Ongoing relationships with government bodies, local institutions such as utilities, schools and research groups should be fostered to gain benefits within clusters.

Whilst highlighting benefits, Porter (1998b) also identifies a number of perceived disadvantages of clusters including the susceptibility to internal rigidities and external threats, 'groupthink' and the possibility that over time, a location will decline if it fails to develop capabilities in new technologies or needed supporting firms and institutions. He also argues that 'the mere co-location of companies, suppliers, and institutions creates the potential for economic value; it does not necessarily ensure its realization' (p 88).

Whilst Martin and Sunley (1996) highlight the importance of regional industrial specialisation and concentration in determining competitive advantage, an importance stressed by Porter (1990), they criticise the precarious nature of this strategy, given that increased regional specialisation also leads to increased regional inequalities and risks. They argue that there is a need for much more thought on how local and regional policies can 'foster and support such externalities without simultaneously narrowing the industrial base and increasing the vulnerability of regions to demand shocks' (Martin and Sunley, 1996, p 234). They significantly criticise many facets of the Porter-type clusters, referring to them as 'a chaotic concept in the sense of conflating and equating

quite different types, processes and spatial scales of economic localisation under a single, all-embracing universalistic notion' (p 10).

McDonald *et al.* (2007) find that the results of the analysis of DTI data on clusters in the UK do not provide strong support for Porter type cluster policies. Cluster characteristics highlighted in Porter type approaches are insufficient to promote desirable objectives such as innovation, or to develop specific sectors within regional economic development plans.

4.4.4.5 POLICY RECOMMENDATIONS AND ISSUES

Porter (1998b) recommends that governments must ensure the supply of high quality inputs e.g. education and physical infrastructure to support cluster development. Also, cluster development initiatives should be built upon local sources of uniqueness or advantage.

The DTI (2001) state that clusters should be self sustaining and deep. However, to achieve this, the IWA (2005) suggest that a link is required between private business services, government support systems and the higher education sector. Ffowcs-Williams (2004) argues that whilst cluster development must be driven by the industry itself, government agencies have a core partnership role in the process of cluster development, particularly in terms of providing legitimacy, facilitating local coordination and collaboration, resourcing facilitations and analysis. Through this, a wide range of firms, institutions and linkages are incorporated into the 'triple helix' of regional innovation systems (Saad and Zawdie, 2005; Saad, 2004; Cooke, 2001; Luger, 2000). Furthermore the IWA (2005) recommend that this is how clusters could extend beyond sector-based agglomerations to become self-sustaining and adaptive competitive systems. Therefore, this should be the prime goal for support policy. On a cautionary note, the IWA (2005) state Wales is over-represented in lower GVA growth/declining sectors and under-represented in higher growth sectors.

Porter (2002) reviews the competitiveness of Wales and recommends a cluster development programme to raise competitiveness and innovative capacity, whilst WAG (2005) promotes a sector based strategy.

AIM and WERU (2005), AIM (2005) and AIM (2006) find that UK regional clusters vary in their make-up and stages of development hence policies should be tailored to the development stage of a cluster. AIM (2005) also states that policy focus should be on activities and groups of products and services, not sectors. Moreover, AIM and WERU (2005) highlight concerns about regional clusters in the UK competing against each other, which can be sub-optimal to the UK economy. They recommend that cluster policy should be addressed centrally and on a different spatial scale, rather than regionally through RDAs.

Recently, McDonald *et al.* (2007) contend that current cluster policies encourage the development of deep local network relationships with other firms and support agencies to remove any barriers that may hinder the expansion of numbers and types of firms in clusters. Incentives for firms to strengthen local suppler linkages are also a prominent feature. Consideration should be given to the possibility that local networks may not be as important as linkages with national and international networks, particularly relating to information and knowledge sharing (e.g. Simmie, 2003). This also aligns to the linkage literature in Section 4.3.

This section has reviewed a selection of literature relating to clusters that may be compared to the case study findings resulting in contributions to the literature through addressing Research Question 1.

4.5 DEFINITION OF SUSTAINABLE DEVELOPMENT

This section introduces and defines sustainable development which has been selected to develop the framework by including the imperatives of embeddedness and sustainable development in relation to addressing SCVs in Wales.

The term 'sustainable development' emerged during the 1970s and relates to the impact on the global environment as a consequence of the rapid, seemingly endless economic growth, along with the associated negative affects of population growth including environmental degradation and social changes in both the developed and the developing world (Thomas, 2004). Much of the debate at the global level on sustainable development can be located in Meadows *et al.* (1972) and a range of United Nations publications including the influential report by the Brundtland Commission (WCED, 1987). The Brundtland Commission established the benchmark definition for sustainable development which is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p 43).

In addition to Brundtland, other definitions exist, including Robertson (1999) who contends that sustainable development is an economic enhancement that meets the needs of the current generation without compromising the ability of future generations to meet their needs. Thomas (2004) asserts that sustainable development includes social, economic and environmental aspects and that implementation of sustainable development cannot be the remit of one government department, one agency or one sector of society.

4.5.1 SUSTAINABLE DEVELOPMENT – BACKGROUND AND SCOPE OF THE STUDY

This section defines the scope of sustainable development in relation to the SCVs study which is confined to the Brundtland report when addressing Research Questions 2 and 3 throughout the development of the framework at Chapter 6. Brundtland refers to economic, social and environmental sustainable development which are important considerations when addressing SCVs.

4.5.2 LITERATURE REVIEW FOR SUSTAINABLE DEVELOPMENT

This brief literature review is limited to the scope of Brundtland which promotes the benchmark definition for sustainable development, identifying criticisms of such an

approach, along with any contributions that this study may make. It also highlights a contemporary example of the challenges faced by Devolved Administrations and RDAs in making economic development or FDI decisions, to illustrate the difficulties associated with balancing the needs of the economic, social and environmental issues.

The WCED (1987) alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment. It also states that social equity, economic growth and environmental maintenance are simultaneously possible and that achieving this equity and sustainable growth would require technological and social change. The report highlights three fundamental components of sustainable development:

- Environment – conserve and enhance our resource base by gradually changing the ways in which we develop and use technologies.
- Social equity – developing nations must be allowed to meet their basic needs of employment, food, energy, water and sanitation in a sustainable manner.
- Economic growth – should be revived and developing nations should be allowed a growth of equal quality to the developed nations.

Brundtland defines the environment as our life support system i.e. air, water, metals, rock, other living organisms whilst economic development relates to sustainable development and does not just mean a cleaner environment. The report states that it requires a stable, healthy economy and to deliver a more sustainable economy, society needs to do more with less by making better use of resources, increase investment, promote stability and competition, develop skills and reward work. The report also advises that governments must take a long term view of the economy rather than short term fixes. In relation to society, sustainable development means thriving nations, cities, towns, villages and neighbourhoods that are fundamental to the quality of life. The achievement of a sense of social cohesion, cultural inclusion and people empowerment are seen as important.

Ecological perspectives view this as a get out clause for governments, businesses and communities that wish to mask their real objectives of continued growth through consumption and believe that by linking the terms 'sustainable' and 'development', it is

a cosmetic way of dealing with the tensions created by these terms. As a consequence, there is still no consensus on a definition or to its implications on policy (Thomas, 2004).

Munday and Roberts (2006) advise that the WAG has adopted a broad definition of sustainable development in line with Brundtland (WAG, 2004) and that targets for regional economies continue to be set in terms of economic aggregates which make it difficult to align such measures to broader sustainable development objectives and related indicators.

The Department of Environment, Food and Rural Affairs (DEFRA, 2007) offer an updated set of sustainable objectives for the UK following the publication of the UK Government Sustainable Development Strategy, 'Securing the Future' in March 2005. This outlines 68 indicators set within four key themes:

- Sustainable consumption and production
- Climate change and energy
- Natural resource protection and enhancing the environment
- Creating sustainable communities in a fairer world.

The new sustainable development scheme for the WAG (2008) has two core principles of involvement and integration. Based on these, the WAG is developing a sustainability assessment tool to assess all projects it supports and on any land it sells for development. It is suggested by the author that elements of this tool could be incorporated into the framework for use by WAG to investigate SCVs.

Munday and Roberts (2006) examine a selection of approaches that Wales have considered to monitor and measure progress towards sustainable development. These include the ecological footprint, the index of sustainable economic welfare, the environmental satellite and environmental input-output tables. Findings include that the development of policies to monitor and measure progress relating to sustainable development targets has clearly been negatively impacted by the nature of such targets. Therefore, appropriate monitoring and measurement tools need clear objectives to be set. Also, it is important to acknowledge that the approaches reviewed, even if

employed, may not necessarily lead to greater levels of sustainable development. Owens and Cowell (2002) assert that although a number of policy driven tools and methods to help implement sustainable development may lead to benefits, confidence in their ability to assist in the achievement of objectives may be misplaced. Therefore, sustainable development may be difficult to define and align to indicators, resulting in challenges when working up new policies from the evidence base.

To exemplify the challenges of balancing economic, social and environmental sustainable development, a contemporary example has been included, from Scotland. In 2008, the US property magnate, Donald Trump, was awarded planning permission for a £1bn golf resort and homes in Aberdeenshire. The plan was called in by the Scottish Government and supported after a public inquiry was carried out following a previous rejection by Aberdeenshire Council. However, opponents of the project, such as the Royal Society for the Protection of Birds (RSPB) were angry at the news. The Devolved Administration in Scotland approved the development because of the significant economic and social benefits, although the Trump Organisation would need to make sure that sand dunes and wildlife on the estate at Menie were properly protected (BBC News web site). This example seems to demonstrate that jobs and the economy were seen to be more important than the environment where the development would take place.

Carroll and Stanfield (2001) recommend that economic development programmes for clusters must promote sustainable development from an ecological point of view in addition to preservation of a region's economic and social integrity. They also assert that development activities focussed on individual firms or markets often fail to achieve sustainable development as they are not designed to support the free and uncoordinated contest of ideas that generates growth. Finally, they argue that policies focussing on the attraction of new jobs can cause degradation to sustainable development.

4.6 CONCLUSION AND RELEVANCE TO THE THESIS

This chapter has identified and critically reviewed the selected foreground literature deemed appropriate to this study. In compliance with Saunders *et al.* (2003), this

literature review has provided an understanding and insight relating to Hoshin Kanri or policy deployment, P & SCM, linkages, embeddedness and sustainable development. Trends within the literature indicate the importance of alignment between strategy development and policy deployment for both public and private sector organisations, local versus global issues relating to P & SCM derived from the contingencies and search criteria adopted by organisations and the challenges facing regions in attempting to balance economic, environmental and social needs to achieve sustainable development.

With reference to the Research Questions affirmed at Table 3.1, Table 4.8 now identifies where academic contributions can be made from this review.

Research Questions	Theory, Literature & Author(s)	Research Issue/Gap
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	P & SCM. (Burgess *et al.*, 2006; Croom *et al.*, 2000).	A lack of evidence of theoretical underpinning of SCM studies.
	P & SCM. (Guinipero *et al.*, 2008).	Focus on 'potential' P & SCM requirements.
	P & SCM. (Guinipero *et al.*, 2008).	Only 2% of P & SCM studies include 'buyer behaviour'.
	Material input, supplier or local linkages. (Crone, 1999; Scott-Kennel, 2007).	Carrying out a detailed survey of purchasing requirements, the results of which can aid better targeting of e.g. FDI.
	Material input, supplier or local linkages. (Crone, 1999; Scott-Kennel, 2007; Hewitt-Dundas *et al.*, 2005).	Focus on the service sector and manufacturing companies that are indigenous to Wales and not multinationals.
	Material input, supplier or local linkages. (Scott-Kennel, 2007).	Lack of detailed, multiple case studies.
	Material input, supplier or local linkages and clusters. (Twomey and Tomkins, 1996; Crone, 1999; UNCTAD, 2001; Crone, 2002; Crone and Watts, 2002; Rees, 2005; Alderman, 2005; Porter, 1998a, 1998b).	Viability of policies developed to fill gaps in regional capability. Difficult to develop policies for filling gaps.
	Material input, supplier or local linkages. (Crone, 1999; AIM and WERU, 2005; Rees, 2005; Alderman, 2005).	Spatial scale at which to address local sourcing and/or cluster development.
	Material input, supplier or local linkages. (Crone, 1999; Turok, 1993).	High-value activities should be targeted for FDI over low-value activities.

2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Hoshin Kanri. (Hacker *et al.*, 2001; Marsden, 1998; Radnor *et al.*, 2006)	Lack of empirical studies using Hoshin Kanri in the public sector in the UK and the service sector.
	P & SCM. (Guinipero *et al.*, 2008).	Need for 'intermediaries' to identify capability gaps in supply chains and instigate possible solutions.
	P & SCM. (Guinipero *et al.*, 2008).	The majority of empirical SCM research focuses on the dyadic relationships between 2 firms.
	Material input, supplier or local linkages. (Crone, 1999).	No framework exists to investigate SCVs or detailed material input linkage (MIL) opportunities.
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?	Material input, supplier or local linkages. (OECD, 1993).	Policies that extend beyond 'job creation' and job numbers.
	Sustainable Development and embeddedness. (WCED, 1987; Halinen and Tornroos, 1998; Hess, 2004; Giroud and Mirza, 2004; Polyani, 1944; Granovetter, 1985; Jessop, 2001; Amin and Thrift, 1994; Porter, 1998b; Chen *et al.*, 2004)	Difficult to achieve sustainable development.

Table 4.8 – Alignment of Research Questions to the Foreground Literature and Identification of Contributions to Knowledge (Source: The Author)

Chapter 5 now details the methodological approach and research instruments selected for this study and identify the three sectors in which the multiple case studies take place.

Chapter 5

Research Methodology

CHAPTER 5 - RESEARCH METHODOLOGY

5.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter details the research design and methodology adopted for the study, based on an illustrative selection of methods based literature. It also reports on the preliminary research that identifies the three sectors in which the multiple case studies take place.

Initially, the aims, objectives and Research Questions are briefly expanded beyond the summary in Chapter 1, followed by the research process diagram. A review of the research philosophies, paradigms and strategies is carried out prior to a justification of the selection of those preferred by the author, based upon the Research Questions and nature of the study. Research approaches, time horizons, methods for data collection and analysis and their strength and weaknesses are then reviewed before a section on the reliability, validity and potential for generalisation from such methods. The remaining sections relate to the methods used within the background research phase reported in Chapter 2 which does not address any research questions, research ethics, limitations of the research design, the preliminary study resulting in the selection of three sectors in which to investigate SCVs and finally, a conclusion of the chapter.

5.2 AIMS, OBJECTIVES AND RESEARCH QUESTIONS

The overall aim of the research was to investigate the occurrence of supplier voids in Welsh priority sectors. A secondary aim was to provide a framework that could be employed within the Principality to assist the WAG in addressing such voids. The Research Questions have been aligned to the objectives as detailed in Chapter 1, Table 1.1.

Phillips and Pugh (2005) advise that intelligence gathering questions are 'what' type Research Questions that are appropriate to descriptive work whereas 'why' type questions seek to go beyond description, using analysis to look for explanations. Research Question 1 seeks to explain 'what' and 'why' SCVs exist. Research

Questions 2 and 3 are concerned with if and how a framework can be developed which can convey an open and emerging research design (Creswell, 2009) or are appropriate to case studies in contemporary environments (Yin, 2003).

The Research Questions were applied throughout the study in accordance with PDCA (Deming, 1986) as depicted in Figure 5.1, as introduced in Figure 4.2.

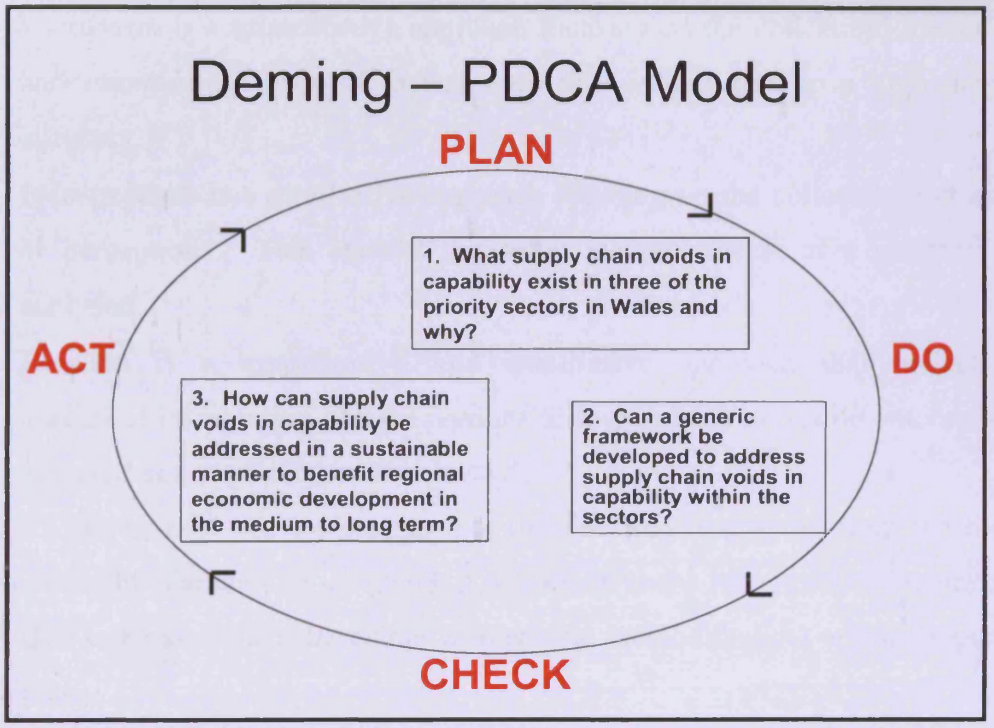


Figure 5.1 – Deming's PDCA Model adapted for use in the Research of Supply Chain Voids in Wales (Source: The Author, based on Deming, 1986)

The research process used to address the Research Questions is shown in Chapter 1, Figure 1.5.

5.3 RESEARCH PHILOSOPHIES AND PARADIGMS

All social sciences have their origins in philosophy but early philosophers do not distinguish between fields of knowledge. The natural and physical sciences were the first to become separated with social sciences only becoming distinct in the last two centuries (Townley, 1986). Research paradigms define the world-view that guides the

researcher in the choices of methods, ontology and epistemology, which are the three elements of a research paradigm. Ontology raises questions about the nature of reality; epistemology deals with the theory of knowledge and the methods focus on how researchers gain knowledge.

There are three research paradigms that dominate the literature (e.g. Saunders *et al.*, 2003, p 83):

- **Positivism** is a **quantitative** approach focusing on the collection, measurement and scientific analysis of factual numerical information to a high degree of accuracy.
- **Interpretism** is a **qualitative** approach focusing on the collection and analysis of perceptions. This enables the softer, social aspects of a situation to be analysed.
- **Realism** is a **quantitative and qualitative** approach that collects both numerical information and perceptions of respondents to enable outcomes to be analysed and explained more robustly.

Figure 5.2 shows how these elements link together and is adapted from the research process onion by Saunders *et al.* (2003, p 83) which is the recommended methods text by CARBS and has guided the author through the methodological options reported in this chapter.

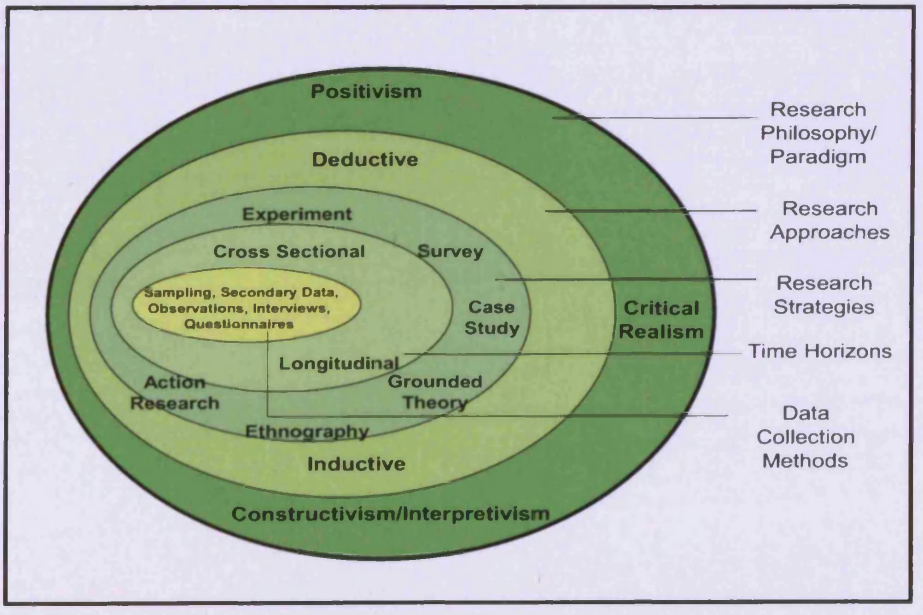


Figure 5.2 – The Research Process Onion (Source: Saunders *et al.*, 2003, p 83)

Wass and Wells (1994, p 9) contrast these three paradigms as shown in Table 5.1 and based on the analysis of this summary, the epistemological perspective of realism has been highlighted in red as most appropriate based on a review of each paradigm against the Research Questions, aims and objectives. Action research is not highlighted for the reasons explained later (see Table 5.4).

Realists assert that a synthesis of extremes, between positivism and naturalism is possible and occurs naturally during most research (Wass and Wells, 1994; Saunders *et al.*, 2003). Saunders *et al.* (2003, p 84) argue that 'realism is based on the belief that a reality exists that is independent of human thoughts and beliefs' and that in business research, social forces and processes affect individuals without them necessarily knowing that such influences or constraints on their interpretations and behaviours exist. Whilst individuals themselves are not the subject of the study, realism is applied to the study, recognising the significance of understanding people's socially constructed interpretations and meanings, or subjective reality.

Epistem-ological perspective	Ontological assumptions	Epistem-ological assumptions	Scientific objective	Nature of scientific knowledge	Cycle of enquiry	Method-ology	Type of data	Techniques for data collection	Bias
Positivism	etic 'realist', real world exists independently of subjective consciousness, this latter is irrelevant to explanation; enquiry can converge on reality	(i) phenomenalism: only that which is objectively observable is valid knowledge (ii) empiricism: explanation comprises of causal laws inferred from empirical regularities; subjects subservient to definition of knowledge, subjective consciousness is meaningless	nomothetic with natural science; abstract from subjective idiosyncrasies to uncover general law; replicability generalizability	privileged, impersonal, value-free, exact, precise, causal, rational, determinate, general	deductive: abstract theories **to** operational hypothesis **to** observations **to** inference using statistical tests 'predictive'	nomethic e.g. census or sample survey, quasi-experiment, operationalism; outsider looking in: extensive and general	quantitative, systematic and precise; directly observable and measurable	self-completion questionnaire, structured interviews, simulation, use of secondary data	concern to account for measurement error and missing data; use of statistical controls
Realism	real world exists independently of subjective consciousness but experience of the real world is through subjective consciousness	(i) knowledge includes the observable and the intangible (ii) general laws are not deterministic, they only partially explain human action; equally subjective interpretations are partially explained by the external world; human action open to various interpretations; possibility of indeterminates	inclusion of subjective in traditional model of science to uncover general laws and how these are interpreted by subjects; laws are tendencies i.e. not deterministic; often applied research, practitioner driven	personal, value-bound, multi-causal, plausible, indeterminate, particular	'retroductive' iterative cycle observation **to/from** theory	methodological pluralism, triangulation, interactive, participatory, action research; method determined by subject of research	all data which are relevant to subject; quantitative and qualitative, observable and interpretive	complete tool kit of techniques often in context of a case study	methods are combined with a view to compensate for weaknesses in a single method

Naturalism (Naïve)	emic 'idealist', real world does not exist outside consciousness of the individual, hence multiple conceptions of reality and enquiry cannot converge on a single reality	(i) phenomenalism: valid knowledge comprises individual comprehension of the external world (ii) empiricism: explanation comprises of causal laws inferred from actors subjective perceptions of their social world; definition of knowledge is determined by the subject; generalisation beyond context is meaningless	from hermeneutics to uncover and explain individual conceptualisation and interpretation of external factors; internal validity, ecological validity	personal, interested, value-bound, uncertain, non-rational, indeterminate, particular	inductive: theory grounded in empirical world observation **to** reflection **to** construction of abstract concepts 'descriptive' explanations	ideographic e.g ethnography; insider seeking 'verstehen' with subjects	qualitative, intangible, subjective conceptions and interpretations of actors; intensive and contextual, detailed, penetrating, 'processual'; written texts	participant observation, unstructured interviews, textual analysis	concerns to account for reactivity and reflexivity in data; use of reactive and reflective accounts

Table 5.1 - A Distribution of Research Perspectives for the Study into Supply Chain Voids in Wales (Adapted from Wass and Wells, 1994, p 9)

There are two forms of realism:

- Empirical realism states that through the use of appropriate methods, reality can be understood (Bryman and Bell, 2003). However, some authors believe that this is a superficial understanding (Bhaskar, 1989). Empiricism is a general approach to the study of reality suggesting that only knowledge gained through experience and senses is acceptable. Therefore ideas must be tested rigorously before they can be considered as knowledge (Bryman and Bell, 2003).
- A naturalistic interpretation of realism is 'critical realism' which is defined by Lovering (1990) as having roots in transcendental realism and emphasises the subject's experience of the external world in explaining activity. The intention is to recognise the reality of the natural order and the events and discourses of the social world through understanding and change as we identify the structures at work that generate those events and discourses (Bryman and Bell, 2003). Ackroyd and Fleetwood (2000, p 7) identify that 'many entities exist independently of us and our investigation of them', e.g. markets. Critical realists are interested in the connections between people's interpretations and the structures and material realities which frame the social world. Therefore, critical realists stress that 'something is real if it has an effect or makes a difference' (Fleetwood, 2004, p 29).

A mix of both empirical and critical realist approaches are relevant to this study because empirical evidence uncovered in response to Research Question 1, alongside how such evidence is constructed, e.g. through search activities, contingencies used and decision making helps to explain the phenomenon.

5.3.1 QUANTITATIVE AND QUALITATIVE RESEARCH PARADIGMS

Quantitative data can be defined as numerical data or data that has been quantified (Saunders *et al.*, 2003) whereas qualitative data is non-numerical that has not been quantified (Saunders *et al.*, 2003; Jankowicz, 2000).

Bryman (2001) compares and contrasts quantitative and qualitative research paradigms as summarised in Table 5.2.

QUANTITATIVE	QUALITATIVE
Numbers	Words/texts
Points of view of the researcher	Points of view of participants
Researcher is distant/objective	Researcher is close/subjective/influential
Theory testing	Theory emergent
Static	Process
Structured	Unstructured/flexible
Generalisation	Contextual understanding
Hard and reliable data	Rich, deep data
Macro orientation	Micro orientation
Behaviour	The meaning of behaviour
Artificial settings/laboratories	Natural settings (within organisations)

Table 5.2 - Summary of the Differences Between Quantitative and Qualitative Research Paradigms (Source: Adapted from Bryman, 2001, p 285)

Similarly, Mangan *et al.* (2004) suggest that quantitative and qualitative methodologies are generally associated with two principal research paradigms known as positivism and phenomenology. These are summarised in Table 5.3 based on Easterby-Smith *et al.* (1991).

	Positivist Paradigm	Phenomenological Paradigm
Basic Beliefs	The world is external and objective	The world is socially constructed and subjective
	Observer is independent	Observer is part of what is observed
	Science is value-free	Science is driven by human interests
Researcher Should	Focus on facts	Focus on meanings
	Look for causality and fundamental laws	Try to understand what is happening
	Reduce phenomena to simplest events	Look at the totality of each situation
	Formulate hypotheses and then test them	Develop ideas through induction from data
Preferred Methods Include	Operationalising concepts so that they can be measured	Using multiple methods to establish different views of the phenomena
	Taking large samples	Small samples investigate in-depth or over time

Table 5.3 - Key Features of Positivist and Phenomenological Paradigms (Source: Easterby-Smith *et al.*, 1991).

In general, the stances identified in Table 5.3 are adhered to according to the type of study being carried out (Eldabi *et al.*, 2002). It can be seen from Tables 5.2 and 5.3 that each stance has both advantages and disadvantages, e.g. quantitative is interested in numbers whilst qualitative seeks to explain meanings.

The collection of qualitative information to supplement, validate, explain or reinterpret quantitative data gathered from the same environment is regarded as the best strategy (Miles and Huberman, 1994). Wass and Wells (1994) state that the management researcher is not constrained by a narrow theoretical and epistemological heritage and as such is able to choose from a range of methodologies and associated data gathering techniques, and even combine and adapt methodologies in a single study to an extent not possible in more established subjects. They also note however that there are constant tensions between positivism and naturalism and state that business and management research is essentially applied research, which is another source of tension as this is often associated with practical and policy issues facing business managers. They summarise that the challenge to business researchers is to achieve the objectives of both academic and applied research to produce work that is not only of high academic quality, but is also relevant. Chapter 1, Table 1.1 identifies both the academic Research Questions and aims for this study and their alignment to the practical objectives of the sponsors. Chapter 1, Section 1.2.2 also reports the author's personal motivation for taking on the challenge of a PhD whilst applying practical management skills and carrying out applied research to address the study and sponsor's needs through the Research Questions.

Bryman (1993) argues that each methodology has its weaknesses and criticises quantitative research methods for their apparent order and linearity, and their lack of concern over the influence of resource constraints.

Qualitative research, on the other hand, is an investigation in distilling the meaning and understanding of the phenomenon (Weick, 1984). Qualitative data can be collected via a number of methods including interviews and observations. Miles (1979) identifies that qualitative data has the essence to produce data that is rich-full, holistic and valid.

Qualitative research emphasises getting close to the subject of study (Eldabi *et al.*, 2002).

Despite support for qualitative methodology (Weick, 1984; Miles, 1979), there are also critics (Miles and Huberman, 1984). Qualitative data analysis techniques are seen to be difficult and not well established, according to Cavaye (1996) who also suggests that the researcher may become overwhelmed by the volume of research. For such reasons, this study focuses on a small number of sectors, companies and case study SCVs. Bryman (1993) has identified a number of contentious issues regarding the use of qualitative research approaches:

- the inability of the researcher to interpret events from the subject's point of view without any bias. Therefore the literature was used.
- the relationship between theory and research can be weak. Chapter 10 demonstrates strong linkage between findings and the literature.

Eldabi *et al.* (2002) suggest that it is relatively difficult to analyse qualitative data, although this does not invalidate such data or the conclusions drawn. Miles (1979) argues that the main reason for using qualitative data and methods relates to the quality of such data.

Caviello (2005) asserts that research should combine both quantitative and qualitative data, as methodologies should be able to accommodate both "soft" and "hard" data. Borch and Arthur (1995) advise that whilst quantitative data is seen as one dimensional, qualitative data is unique in that it can be analysed and interpreted both qualitatively and quantitatively.

This study adopts a mainly qualitative approach requiring some quantitative analysis to address the Research Questions which require explanation and description of the phenomena under investigation. In addition, the sponsors had previously commissioned two quantitative studies into SCVs which did not explain why they exist or how they could be addressed (SCMDC, Swansea, 2004 and DMC Consulting, 2005).

5.4 RESEARCH STRATEGIES

Research design relates to the choice of strategy used to collect the data required to answer the research problem (Ghauri and Gronhaug, 2002). Research methodology is a systematic and orderly approach used in the collection and analysis of data to elicit information from the data (Saunders *et al.*, 2003; Jankowicz, 2000). There are a number of methodological stances that can be applied when conducting research, e.g. Saunders *et al.* (2003) offer the research process onion (Figure 5.2).

Saunders *et al.* (2003, p 91) identify a number of research strategies which are summarised in Table 5.4 along with the justification for applicability or exclusion from this study.

Research Strategies	**Defined by Saunders *et al.* (2003) unless specified**	**Reason(s) for Inclusion/Exclusion in SCVs Research**
Experiment	A **classical form of research** that involves the **definition of a theoretical hypothesis** and the use of a **controlled population, conditions and variables.**	**Discounted**. A positivist approach. Does not address what/why/how questions.
Survey	Usually associated with the **deductive approach** and allows the **collection of large amounts of data.**	**Discounted.** A positivist approach. Findings can be superficial. Rich data required.
Case Study	Robson (2002, p 178) defines case study as 'a strategy for doing research which involves an **empirical investigation of a particular contemporary phenomenon within its real life context** using **multiple sources of evidence**'.	**Applicable**. Mixed methods. Multiple, small targeted cases to gather rich data from which understanding, descriptions and explanations can be derived. Address what/why/how questions.
Grounded Theory	**Theory building** through the use of **induction and deduction** but is also **more associated with the inductive approach** (Glaser and Strauss, (1967).	**Discounted**. Research approach moved from inductive to retroductive. Research is not theory building. However, some elements of grounded theory were relevant in addressing Research Question 2.

Ethnography	An **inductive** approach emanating from the field of **anthropology**, its purpose is to **interpret the social world the research is being carried out in, in the way that the inhabitants interpret it.**	**Discounted**. Interpretation of WAG or companies not required. Ethnography requires a level of observation and immersion not demanded by the Research Questions.
Action Research	This strategy has 3 common themes in the literature which are the **management of change** (Cunningham, 1995), the **involvement of practitioners in the research and collaboration with the researcher** (Eden and Huxham, 1996, p 75) and finally that the **research should have implications beyond the immediate project.**	**Discounted**. The requirement to immerse oneself in the research organisation for a long period of time was not feasible owing to resource constraints. The author could not exercise a decision making role within the WAG or individual firms and was required to maintain an independent stance.

Table 5.4 – Summary of Research Strategies and their Alignment to the Study (Source: The Author, based on the selected literature).

A multiple case study approach taking a realist perspective has been chosen for this study as this is appropriate for organisational and management studies (Yin, 1994) and which, according to Saunders *et al.* (2003) has the potential to address 'why', 'what' and 'how' Research Questions as used in this study.

Stake (1978) asserts that case studies improve the understanding of a phenomenon for the reader. The case strategy was selected for a flexible and holistic research design (Hakim, 1987) that involves a combination of different methods to deal with the complexity and variety of data (Yin, 1994; Hartley, 1994).

Yin (1994) and Robson (2002) identify three classifications of case study which are summarised in Table 5.5.

Case Study Classification	Definition/Description
Exploratory	Identification of questions/hypotheses for subsequent study. **Finding out what is happening. Helps to clarify the understanding of the problem.**
Descriptive	Comprehensive account of the phenomenon within its context. Robson (2002, p 59) states that the objective of a descriptive case study is 'to **portray an accurate profile** of **persons, events** or **situations**'. This maybe an extension or a forerunner to an exploratory phase of research.
Explanatory	Used to test 'cause and effect' relationships as events unfold to **explain the relationships between variables**. This does **not necessarily require statistical analysis** (Saunders *et al.*, 2003).

Table 5.5 – Classifications of Case Study Research (Source: Yin, 1994)

This study commenced as an inductive and exploratory investigation but also sought to describe and explain what is happening in Wales. Therefore, these classifications changed over time as a more retroductive, iterative approach was taken where the literature aided description and explanation of the emerging case study findings (Wass and Wells, 1994, p 9, see Section 5.6).

Multiple cases are investigated and compared in this study. The logic underpinning the use of multiple case studies is based on replication and can be seen to be more robust than single case studies. To achieve this, the researcher must select each case on the basis that it either:

- predicts similar results (a literal replication)
- produced contrasting results for predictable reasons (a theoretical replication)

Two or three cases may deliver literal replication whereas four to six might be designed to pursue different theoretical replications (Yin, 1994). The approach for this study is depicted in Figure 5.3 which shows three different sectors and a variety of SCVs where a mixed economy of both literal and theoretical replication can be made (e.g. Biosciences and Financial can be literally replicated whereas the Unmanned Systems case can produce a theoretical replication). The three sectors were selected in Chapter 2 based on diversity and guided by IWA (2005). The number of SCVs was determined, based on a validation process and research timescales.

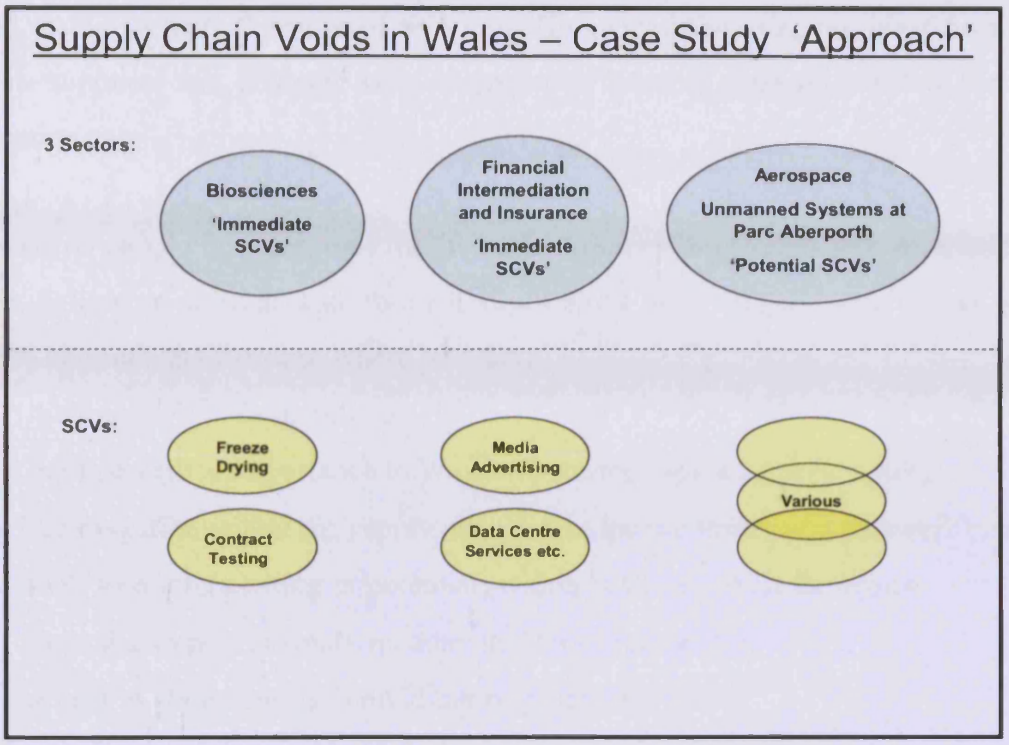


Figure 5.3 – Case Study Approach for Supply Chain Voids (Source: The Author)

A summary of the number of sample companies interviewed and types of interviews used at different stages of the research are shown in Table 5.6.

Dates	Types of Interview	Bioscience ('Immediate' SCVs)	Financial ('Immediate' SCVs)	Unmanned Systems ('Potential' SCVs)
Jan – May 2007	Semi-structured face to face	4 companies	6 companies	Nil
Nov 2007 – Jan 2008	Structured telephone	19 companies	49 companies	Nil
Jun 2008	Semi-structured face to face	Nil	Nil	4 companies

Table 5.6 – Summary of the Interviews Carried Out for the Study (Source: The Author)

Owing to the 'potential' nature of SCVs for Unmanned Systems, the identification of possible suppliers was difficult when compared to locating companies within the other two sectors.

A purposive sample of companies for the semi-structured interviews was selected based on the following criteria and through discussions with Supervisors, WAG sector advisers and Industry Forums, where relevant:

- their portfolio of capabilities
- their perceived importance to Wales (in strategy and economic terms)
- their position within the supply chain i.e. at the top or tier one wherever possible
- their location (existing or potential) within Wales to cover the region
- their size (a mix of small, medium and large companies)
- access to companies or individuals (e.g. Jenkins, 2006).

Contact names, telephone numbers and e-mails where available were obtained from the following sources, for each company, to carry out the tele-interviews:

- The Wales Bioscience Directory,
- the MediWales membership area on their web site,
- WAG Integrated Client Information System (ICIS) database (semi-structured interviews only),
- yell.com

Where accessible, the number of FTEs for each company or organisation was also obtained from these sources.

There are a number of strengths and weaknesses identified for case study strategies and a popular selection is identified within Table 5.7.

Strengths of Case Studies	Weaknesses of Case Studies	Counter measures to deal with Weaknesses
Bryman (1989, p 173) asserts that case studies are useful for **'providing an understanding of areas of organizational functioning that are not well documented and which are not amenable to investigation through fleeting contact with organizations'.**	Case studies **lack statistical reliability and validity** (Gummesson, 2000) and **can be difficult to replicate, owing to the limited number of cases.** This **lacks the sample size needed to achieve validity.** In addition, owing to the **role of the researcher in data generation and interpretation**, there are potential issues relating to **bias.**	Case studies **do not need to be able to generalise.** Lincoln and Guba (2000) explain that this is because **generalisations are assertions of enduring value meaning that they are free of context.** The aim of a case study is to **present context specific knowledge, rather than generalisations.**
Yin (1994, pp 30 – 32) argues that case studies **can be used to test theories and gain theoretical insights** generated from the data. The aim is to **engender patterns and linkages of theoretical importance therefore generalisability is founded on 'analytical generalisations'.** A **previously developed theory is used to compare results** from the case study. **Theories should be tested in comparable contexts to see whether it fits other cases, therefore aligning to 'replication logic'** (Yin, 1993).	Gummesson (2000) states that whilst case studies **can be used to generate hypotheses, they cannot test them.** This relates to **exploratory cases only** and states that case studies **cannot test theories as sample sizes are too small.**	The purpose of case studies is **the use made of them.** Therefore Stake (2000) states that they feed into a **process of 'naturalistic' generalisations or they facilitate the 'transfer' of findings from 1 setting to another, based on the 'fit'** (Lincoln and Guba, 2000).
	Gummesson (2000) asserts that **generalisations cannot be derived from case studies as from a statistical position, the case study is a sample of 1. (This study = multiple cases).**	Some authors contend that **empirical generalisations** (Gomm *et al.*, 2000) and **theoretical generalisations** (Yin, 1994; Silverman, 2000) **are possible.** Gomm *et al.* (2000, p 102) argue that **'most case study research must be directed towards drawing general conclusions'.**

	Silverman (2000) states that the **main concern relates to external validity and the question of generalisability**.	As above.

Table 5.7 - Summary of Advantages, Disadvantages and Countermeasures Relating to Case Study Strategies (Source: The Author, based on the selected literature).

For this study, there are strengths in using mixed methods across multiple, small targeted cases to gather rich data (i.e. patterns and linkages of theoretical importance) from which understanding, descriptions and explanations can be derived (Robson, 2002; Yin, 1993 & 1994). The aim of a case study is to present context specific knowledge (i.e. regional SCVs), rather than generalisations and to facilitate the 'transfer' of findings from one setting to another, based on the 'fit' (Lincoln and Guba, 2000). Therefore the case study findings aligned to the literature in Chapter 10 assist the development of the framework to address Research Question 2.

5.4.1 CASE STUDIES IN SUPPLY CHAIN MANAGEMENT RESEARCH

Case studies are common in SCM research state Kotzab *et al.* (2005) who argue that there are no right or wrong methods and if applied with rigour, all have merit. Sachan and Datta (2005) review SCM and logistics research carried out over five years to establish the research designs used. They conclude that there is an increase in the application of direct observation methods such as case studies and also note that research is more interpretative in nature although surveys are the most popular research strategy in SCM. The use of differing epistemological approaches and research methods in logistics studies was confirmed by Craighead *et al.* (2007). Guinipero *et al.* (2008) summarise that the methods most utilised within SCM studies include empirical surveys or case studies (supported by Burgess *et al.*, 2006) and mail surveys (agreed by Carter and Ellram, 2003).

SCVs in Wales are investigated through a comparative case study strategy that aligns to the Research Questions and is a specific requirement of the sponsors, who already hold

data from previous surveys and questionnaires. In-depth knowledge and understanding is required of what voids exist and the reasons why which allies to Crone (1999). A generic process is required to address SCVs and therefore evidence from different cases, in different industries are demanded to see if that is feasible.

5.5 RESEARCH DESIGN

The realist research philosophy has been adopted for this study utilising a multiple case study strategy (Yin, 2003; Wass and Wells, 1994) and mixed data collection and analysis methods, both quantitative and qualitative. Based on this, Figure 5.4 has been developed by the author to filter or funnel the study from the research paradigm, through the approaches, strategies and specific methods, to investigate SCVs from a targeted sector view, down to specific companies and case study voids.

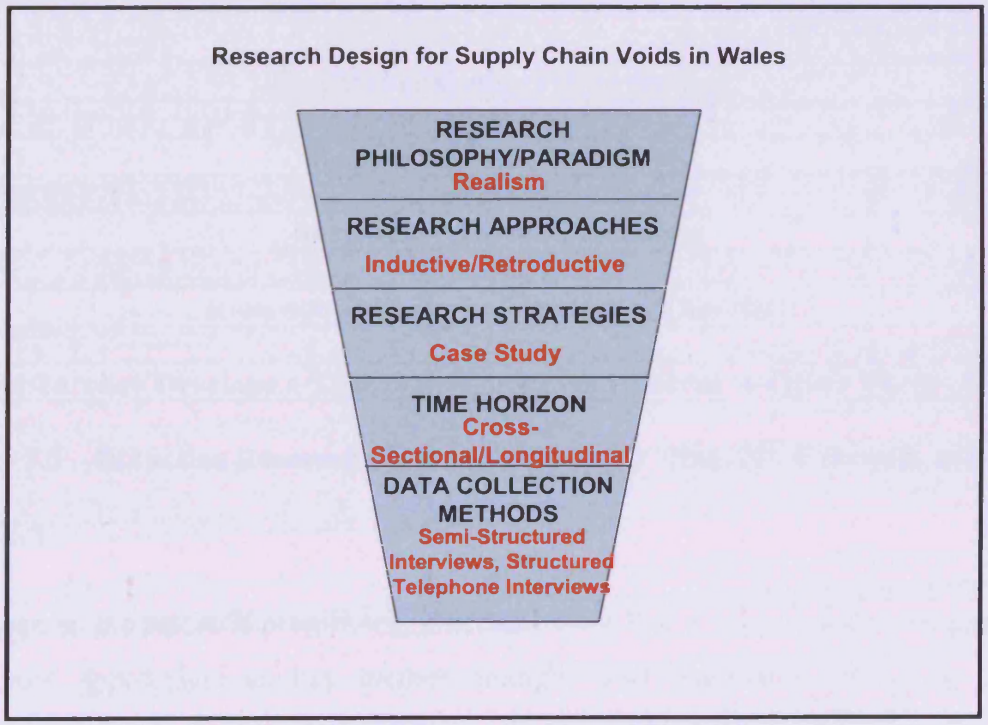


Figure 5.4 – Research Design for Supply Chain Voids in Wales (Source: The Author, based on Saunders *et al.*, 2003)

The following sections provide the reasons for selection of the chosen research design including the research approach, time horizons, data collection and analysis methods.

5.6 RESEARCH APPROACHES

Saunders *et al.* (2003, p 85) identify two research approaches which are 'inductive' and 'deductive'. Inductive means that you 'collect data and develop a theory as a result of your data analysis' and deductive means that you 'develop a theory and hypothesis and design a research strategy to test the hypothesis'.

Wass and Wells (1994, p 9) identify the 'retroductive' approach which is an iterative cycle relying on the development of theory at the same time the research is being carried out as features emerge in the field. The approach for the study began as inductive and exploratory then became more retroductive. This can be demonstrated through Figure 5.5 which indicates the actions of the researcher as the study commenced, following an inductive approach.

Researcher Gathers Information
Leading to
Researcher Asks Questions
Leading to
Researcher Forms Categories
Leading to
Researcher Looks For Patterns (Theories)
Leading to
Researcher Develops a Theory or Compares Patterns to Other Theory/ies

Figure 5.5 – Inductive Research Model (Naturalism) (Source: Creswell, 1994, p 96)

However, as the research progressed, it became clear that a more retroductive approach was more appropriate as key themes emerged that required investigation in the literature, for example, based on emerging findings. Therefore, rather than the linear approach shown in Figure 5.5, the author was required to refer back to the literature to look for new or different texts to inform and guide the study through a more iterative approach.

5.7 RESEARCH TIME HORIZONS

The two time horizons identified by Saunders *et al.* (2003) are 'longitudinal' and 'cross-sectional'. Longitudinal is 'diary' approach over a long period and cross sectional is a 'snapshot' (Saunders *et al.*, 2003, p 95). For this project, initially a cross sectional approach was used to collect and analyse interview data. However, during further data analysis and the framework development phase, a longitudinal approach was maintained, throughout the investigation of case study SCVs until the end of the study. In addition, some information was updated throughout the study to provide a longitudinal view, e.g. Appendix B, Table B1.1 which details the sector strategies adopted by RDAs in the UK between 2002 and 2008/9.

5.8 RESEARCH METHODS FOR DATA COLLECTION AND ANALYSIS

The nature of the specific Research Questions and objectives in this study require detailed information relating to companies' purchasing patterns for high and low-value products and services. This is not available via secondary data sources and therefore primary research, at a detailed level is required.

The first data gathering activity was the literature search, review and evaluation. 'Metalib' was primarily used to search for relevant journal articles, papers and books using specific key words, as themes identified within the evolution of the literature review reported in Appendix D, along with other academic and internet sources (i.e. 'google scholar' and various web sites e.g. for United Nations reports etc.). Metalib searches multiple sources (e.g. Emerald), saving time. In addition, a snowballing technique was adopted in which the researcher is pointed in the direction of potentially informative work from the references section of literature under review. This technique can lead to various articles being uncovered that may not have been found using the restrictive 'key word' search (e.g. Foster and Ford, 2003).

Saunders *et al.* (2003) identify five methods of data collection which are summarised in Table 5.8 along with the reasons for inclusion or rejection in relation to this study.

Methods	Definition/Explanation (Based on Saunders *et al.*, 2003 unless stated otherwise)	Reason(s) for Inclusion/Rejection from this Study
Sampling	Such techniques provide **a range of methods to reduce the amount of data required** by **focussing on a sub-group rather than all possible cases or events**. Saunders *et al.* (1997, p 145) state that a '**purposive**' or '**judgemental**' sample enables the researcher to select cases, based on judgement, that will best enable the answering of Research Questions and to meet research objectives. They caution however, that such samples cannot be considered statistically representative of the total population.	**Inclusion**. Non-probability sampling is suitable for case studies, including **purposive** sampling as it allows the choice of case study to be determined on the basis that it illustrates some feature or process that the researcher is interested in. Denzin & Lincoln (2000) note this involves seeking out the groups, settings and individuals where the processes to be studied are most likely to occur. In this study, the selected samples are used to address Research Question 1. **Other sampling techniques have been discounted** as they do not best match case study strategies or the use of interview techniques (See Appendix K).
Purposive Sampling – Heterogeneous or maximum variation sampling	**Enables data collection that describes and explains the key themes that are observed. Patterns are likely to be of interest and represent key themes. Patton (2002) recommends that to ensure maximum variation, sample selection criteria must be established prior to sample selection.**	**Inclusion**. Selection criteria as specified in Section 5.8.1.4. Used for semi-structured interviews and sampling of SCVs for investigation as case studies. (See Appendix K).
Purposive Sampling - Homogeneous	**Focus is on 1 specific sub group. Enables in-depth study.**	**Inclusion**. Used for telephone interviews and benchmarking. (See Appendix K).
Secondary data	**Data that has already been collected and analysed for another purpose.**	**Inclusion**. Secondary data was used to develop the background for the study, benchmarking, framework design and to track RDA sector priorities (see Appendix B). Primary data has been collected to address Research Question 1.

Observation	Observation is **used in a special way** in research as it means **looking at something without influencing it and simultaneously recording it for later analysis** (True, 1989).	**Rejection**. Such methods are more appropriate to ethnography or action research, for example, and are time consuming.
Interviews	An interview is a **purposeful discussion between 2 or more people** (Kahn and Cannell, 1957, cited in Saunders *et al.*, 2003).	**Inclusion**. Interviews preferred to questionnaires owing to the possible low response rates or insufficient explanation of responses, for example. (See Section 5.8.1 and Appendix K).
Focus Groups or Group Interviews	**The researcher acts as a facilitator in an** open, un-structured discussion (Saunders et al, 2003).	**Rejection**. The preliminary study identified a number of anecdotal SCVs by industry informants. However, once the full study commenced, these were not supported in the detailed purchasing requirements from specific firms (i.e. Crone, 1999).
Questionnaires	**Techniques of data collection** that **ask each person to respond to the same set of questions in a pre-determined order** (deVaus, 2002). It therefore includes **structured interviews, telephone questionnaires and questions that are answered without an interviewer being present**.	**Rejection**. Interviews preferred to gain a better understanding of the responses and seek clarification at the time of the interview.

Table 5.8 – Summary of Research Methods and their Alignment to the Study (Source: The Author, based on the selected literature).

5.8.1 INTERVIEWS

Two types of interviews have been selected as the main method of data collection for use with purposive samples to address Research Question 1. The purpose of an interview is to gain an 'understanding of the experience of other people and the meaning they make of that experience' (Seidman, 1991, p 3). Some authors assert that interviews are the best data collection methods (Ghauri and Gronhaug, 2002). The aim of data collection and analysis of interviews is to construct or reconstruct knowledge rather than excavate it (Mason, 2002).

5.8.1.1 TYPES OF INTERVIEWS

Interviews may be structured using standardised questions for a respondent, or be informal and unstructured conversations. Healey and Rawlinson (1994) define interviews as 'structured' or 'unstructured'. However, a more recent definition is offered by Saunders *et al.* (2003) who categorise them as:

- Structured interviews which are questionnaires based on a standardised set of questions endorsed by May (2001); Mason (2002); Bryman and Bell (2003).
- Semi-structured interviews are non-standardised questions based on a list of themes which the interviewer varies in use;
- Unstructured interviews are similar to semi-structured interviews and are informal.

Sayer and Morgan (1985) observe that the interview type depends on the nature of the Research Questions i.e. standardised should be used when collecting quantitative data for 'extensive' research and semi-structured interviews to generate 'richer', qualitative data that provides detail and depth about individual cases. Such data have greater explanatory power and appropriate to 'intensive' research into complex phenomena. Semi-structured interviews are suitable to address 'what', 'how' and 'why' Research Questions (Saunders *et al.*, 2003).

As indicated previously in Sections 5.3 and 5.4, the lack of previous research into the detailed purchasing patterns of Welsh companies in specific sectors, including services means that an intensive study is required to identify explanatory outcomes.

5.8.1.2 TYPES OF INTERVIEW QUESTIONS

Interview questions can be 'closed' or 'directive' (May, 2001; Healey and Rawlinson, 1993), expecting a straightforward 'yes' or 'no', or a 'tick-box' answer. Other questions are 'open' and anticipate some level of detail which is specific to each company (Healey and Rawlinson, 1993). Most structured interview questions are 'closed' (Bryman and Bell, 2003). Also, questions can be structured in an 'open' or 'non-directive' manner to gain the views of the interviewees in their own words

(Bryman and Bell, 2003; May, 2001). Finally, 'questions about knowledge' and 'informant factual questions' can be asked (Bryman and Bell, 2003). A mix has been used in this study.

5.8.1.3 RECORDING AND ANALYSIS OF INTERVIEW DATA

Responses to interview questions were taken in detailed, note form, as opposed to digital recording and transcription, owing to for example, the timescales involved, as identified by Fielding and Thomas (2001).

Interview data can be analysed in a number of ways. Strategically, Mason (2002) suggests that data can be 'literal' (what is recorded), 'interpretive' (what the data means or represents) and 'reflexive' (location of the interviewer in the interpretation of the data). In this study, interviewee responses were noted literally and then interpreted using the literature to explain findings.

The data gathered from the interviews have been analysed in both quantitative and a qualitative ways (Ghauri and Gronhaug, 2002). Qualitative data analysis was based on a process of coding, reduction and 'pattern matching' as developed by Miles and Huberman (1994) for case study research. There was a mix of data types e.g. categorical i.e. number of jobs, number of companies etc. and purely qualitative text. The data were compiled from the analysis and interpretation of the records of the interviews, organised and ordered by sections or themes used in the interviews or emerging from responses and located within the literature. Quotes from the interviews were highlighted for inclusion in the thesis, where they could add emphasis.

From a quantitative perspective, the value of goods and services bought from outside Wales has been calculated for each company and across the cases. Also, if the same phrases or reasons are quoted by respondents, these have been quantified.

Member checking or respondent validation is a particularly important method of increasing the credibility of qualitative research (Erlandson *et al.*, 1993; Lincoln and Guba, 1985, pp 373 - 378). Interviewees validated their replies and all responses have

been recorded in a spreadsheet to aid codification and retrieval, based on the themes used to set the questions and/or those emerging from responses. In addition, 'data display' (Miles and Huberman, 1994) and 'diagrams and charts' were adopted to depict, for example, supply chain processes. This promotes the triangulation (see Section 5.9) between different types of data analysis and improves reliability and validity.

Along with the validation and agreement obtained from interview respondents, the data were shared with WAG sector experts and respective Industry Forum representatives to validate, comment and for example, to provide technical guidance.

5.8.1.4 INTERVIEW PROCESS

In this study, a semi-structured approach, including a mix of both open and closed questions was initially used to gather data, and was followed up in two sectors by structured telephone interviews to scope sector-based demand and capabilities for SCVs. Owing to the 'potential' nature of the SCVs for Unmanned Systems, this was not possible. Semi-structured interviews averaged between half and one hour. Telephone interviews lasted up to ten minutes and questions were asked in the same order. The attention span of a given respondent is limited to approximately ten minutes, during a telephone interview (Hague, 1987). Healey and Rawlinson (1993) note that it is more difficult to refuse to participate when speaking directly to the researcher on the telephone. The semi-structured interview script used to elicit data relating to 'immediate' SCVs is at Appendix F, the generic script (including specific SCV definitions) for the follow up telephone interviews is at Appendix G and the semi-structures interview script for 'potential' SCVs is at Appendix H.

In the semi-structured interviews, a flexible approach was used regarding the sequencing of questions, to develop other themes and to make additions to the script. Prompts and probes were also used to gain elaboration from interviewees, where appropriate.

The purpose of the semi-structured interviews was to address Research Question 1:

'What supply chain voids in capability exist in three of the priority sectors in Wales and why?'

This was done by asking Purchasing/Sourcing Managers or equivalents within companies for specific purchasing data relating to the top ten high-value purchases from outside of Wales, to identify 'immediate' or 'potential' SCVs.

The majority of companies in Wales have WAG 'Account Managers' (AMs) or KB4B AMs (known as 'gatekeepers') who the author had to contact to gain information and possible access. (KB4B is an initiative to improve the skills, financial strength and business strategy of those companies in Wales who are believed to have high growth potential, regardless of location, size or sector (WAG, 2005)). Therefore, an increased number of gatekeepers were identified for both the Bioscience and Financial sectors. Supervisors also suggested potential respondents. Figure 5.6 demonstrates this contact route, indicating a snowball strategy, although purposive sampling was used.

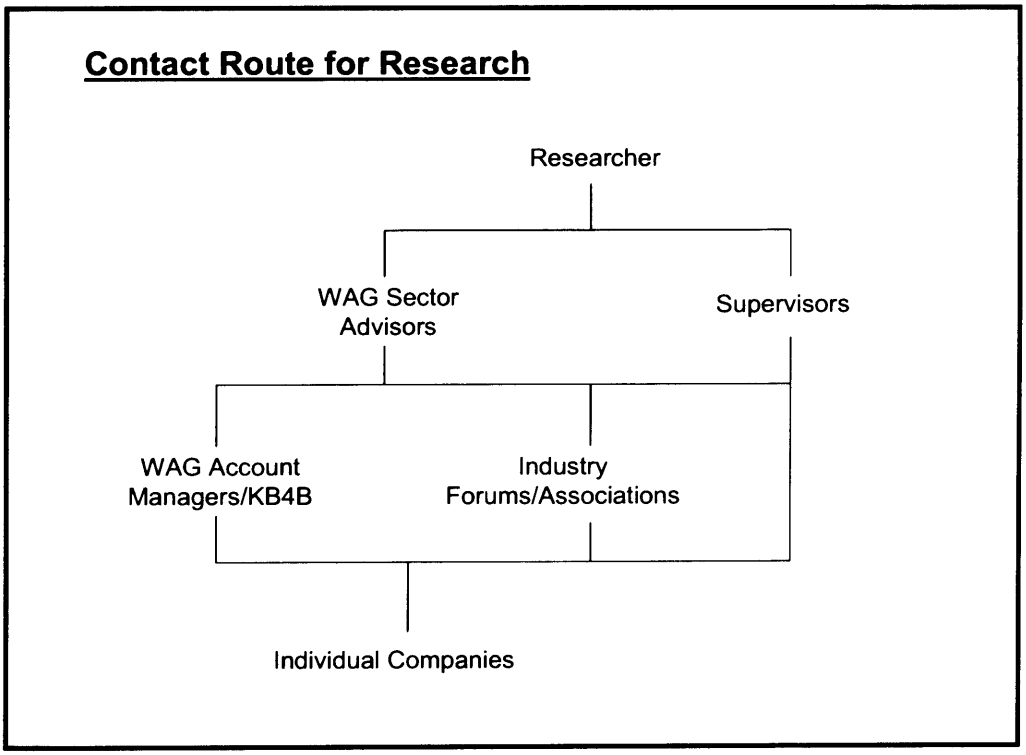


Figure 5.6 - Contact Route for Gaining Access to Companies for Semi-Structured Interviews (Source: The Author)

In addition to the ten initial semi-structured interviews carried out with Bioscience and Financial companies, 11 meetings were held with WAG AM gatekeepers. A record of all interviews and meetings during the study was maintained in the form of a Communications Plan, totalling 229.25 hrs. In addition to the Communications Plan, a Project Plan and Stakeholder Plan were also developed and used to guide the study and to maintain contact with stakeholders throughout. (These plans were too large to include as appendices but can be made available, if required). One method used to keep stakeholders abreast of progress was the periodic issue of a newsletter, a copy of which is shown at Appendix I. In total, five standardised newsletters were issued to stakeholders in addition to tailored executive summaries which were issued to specific stakeholder groups, following semi-structured and telephone interviews. These were mainly for the benefit of WAG strategy and sector managers who could review and take any necessary action.

'Potential' SCVs were addressed for Unmanned Systems to address Research Question 1. Global companies attend a high profile event at Parc Aberporth annually. Therefore the semi-structured interviews were carried out at Parc Aberporth Unmanned Systems (PAUS) 2008.

5.8.2 **BENCHMARKING ANALYSIS**

Heib and Daneva (1995) report that the term 'benchmarking' has in excess of 42 definitions within the literature since 1995, whereas Spendolini (1992) identifies 49. Numerous benchmarking models have been summarised by Anand and Kodali (2008) relating to measurement, comparison, identification of best practices, implementation or improvement activities relating business scope, market, products, process, etc. Spendolini *et al.* (1999) advise that benchmarking processes have been applied to every functional area within an organisation e.g. R & D, marketing, sales, finance, engineering, manufacturing and production, human resources, customer service and distribution. Wong and Wong (2008) review the benchmarking of SCM performance measures. Camp (1989, p 12) is cited by many authors as the most often quoted definition and model for benchmarking as applied at Rank Xerox: 'benchmarking is the

search for the best industry practices which will lead to exceptional performance through the implementation of these best practices'.

A practitioner's definition is offered by Van De Vliet (1996): Benchmarking involves learning about your own practices, the best practices of others, and then making improvements that will enable you to meet or beat the best in the world. The case study in Chapter 9 has mainly applied this definition in learning what is on offer at Parc Aberporth and from key competitors, to improve how Parc Aberporth markets its offering to attract the attention of potential customers, when addressing Research Question 1.

The author considered many benchmarking models from the literature, e.g. the generic model by Camp (1989), those summarised by Arnand and Kodali (2008) and distilled into thirteen common steps and a model based on Deming's PDCA model as promoted by Pulat (1994) and adapted by Wong and Wong (2008) into a wheel diagram from Camp (1989), which has been selected for the case study in Chapter 9 and is shown at Figure 5.7.

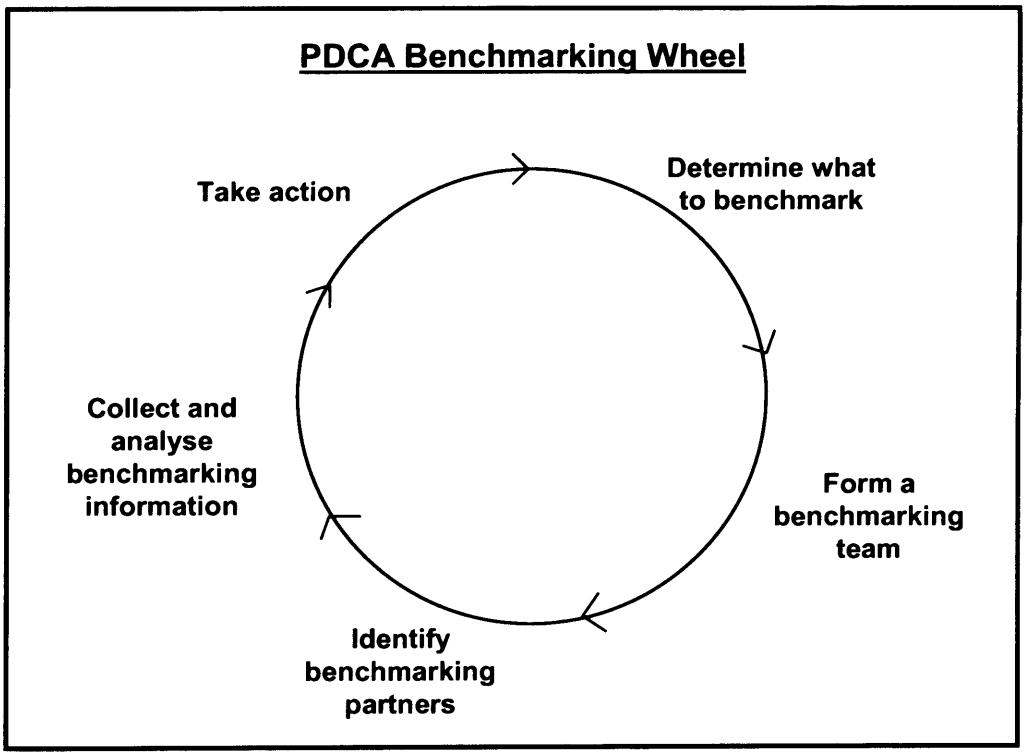


Figure 5.7 – The PDCA Benchmarking Wheel Model (Source: Wong and Wong, 2008, adapted from Camp, 1989)

Wong and Wong (2008) state that Bhutta and Faizul (1999) define each of these phases as identified within Figure 5.7 and explained in Table 5.9, along with how they have been applied in Chapter 9.

PDCA Benchmarking Wheel Phases	Application in Chapter 9
Plan – Selection of benchmarking process and the type of study.	Parc Aberporth - capabilities on offer in comparison to key competitors. Establish how these are 'advertised' by best in class industries, similar industries and the key competitors.
Do – Forming a team and selecting partners to be involved in benchmarking activity.	Author – Best in class industry other aerospace sub-sector and key competitors from same sub-sector i.e. Unmanned Systems.
Check – Comparison of findings and gap analysis.	Compare what and how the best in class, aerospace and key competitors advertise their capabilities.
Act – Implementation of corrective actions required to maintain or improve existing performance/standard.	Recommend/introduce system(s) to improve existing situation. Addressing Research Question 1.

Table 5.9 – Explanation of the PDCA Benchmarking Wheel and its Application in this Thesis (Source: The Author, based Bhutta and Faizul, 1999)

Spendolini *et al.* (1999) identify three levels of benchmarking:

- Level I – Traditional competitive or comparative analysis with partners focussing on the same factors. Quantitative indicators dominate and data is comparative, collected at a central point where benchmarking partners do not interact.
- Level II - Best practices determine the selection of partners including those from in or outside the industry. Includes quantitative and descriptive information.
- Level III - Includes partners from any organisation that may provide relevant information hence non-industry partners are common. The usual suspects are only involved if best practice selection criteria a met. Data includes processes, strategies and improvement goals.

Level II is the approach most suited to Chapter 9 by using examples from inside and outside the industry.

There are a number of critics of benchmarking for example:

- the use of terminology such as 'best practice' or 'world class', that benchmarking looks backward (downstream) rather than forward (upstream), that data collection and analysis requires refinement (e.g. Anderson and McAdam, 2004; Thor, 1996; Collins *et al.*, 2006).
- The identification of suitable partners to benchmark against, resource constraints, the size of the organisation and the comparability of data (Hinton *et al.*, 2000).

Benchmarking has been applied in Chapter 9 to compare the capabilities offered at Parc Aberporth with those on offer by a similar technologically challenged industry, services offered in another sub-sector of aerospace and its main competitors in Unmanned Systems, to address Research Question 1.

5.9 STRENGTHS AND WEAKNESSES OF THE PREFERRED DATA COLLECTION METHODS

The research methods adopted for this study have a number of advantages and disadvantages as detailed within Table 5.10.

Methods	Alignment to Research Questions & Objectives (H/M/L)	Strengths of Method(s)	Weaknesses of Method(s)	Application in Study
General - Mixed Methods	H	Different methods used for different/appropriate purposes. Suitable for inductive then retroductive approaches and case studies. Allows for triangulation of analysis and results. RQs are open and investigative in nature therefore require in-depth understanding of the phenomena.	Time consuming and skills required to use multiple methods.	Throughout the study
Secondary Data	H	Data easily available, saving time. Data Source may be reliable/recognised.	Data/Source may be unreliable, data may be over manipulated or not suitable/reliable for this research. Superficial level of data requiring other methods to carry out more indepth investigation. Possible coverage, validity, reliability and measurement bias issues.	Data for background to study, benchmarking and some literature etc.
Non-probability - Purposive - Heterogeneous or maximum variation sample	H	Use of companies that offer the conditions required for the research. This sample enables the collection of data to describe and explain key themes. Patton (2002) states that different cases that elicit patterns or key themes can be a strength. The identification of selection criteria is important. Don't necessarily require generalisability.	Lacks ability to generalise.	Semi-structured interviews for Bio and Fin/Ins companies.
Non-probability - Purposive - Homogeneous sample	H	This focuses on a specific sub-group in some depth.	Lacks ability to generalise.	Telephone interviews for Bio and Fin/Ins companies. Benchmarking.

Non-probability - Purposive - Heterogeneous or maximum variation sample	H	Use of companies that offer the conditions required for the research. This sample enables the collection of data to describe and explain key themes. Patton (2002) states that different cases that elicit patterns or key themes can be a strength. The identification of selection criteria is important). Don't necessarily require generalisability.	Lack ability to generalise.	Semi-structured interviews for Unmanned Syster companies.
Semi-Structured Interviews	H	Applicable to inductive and retroductive approaches, flexible enabling conversation and probing to obtain richer data to aid understanding. Different companies allow for the triangulation of data and provide 'insight' into the contextual influences surrounding SCVs in Wales. Such 'insights' are not reflected within the secondary data. Researcher has experience of interviewing. Need informant verificaton.	Time consuming, need to maintain focus, note taking or recording, researcher requires skills. Need some standardisation in order to deliver reliability, validity and generalisation. Potential bias.	Semi-structured interviews for all sectors.
Structured Telephone Interviews	H	Standardised questions in a set order. Ability to collect data from lots of organisations relatively quickly. Researcher has experience in Interviewing. Need informant verification. Good for reliability/validity. Triangulates/enhances data from semi-structured interviews.	Time consuming, depending on the number of companies/respondents. Limited/superficial level of data. Note taking/recording of information. Quantitative orientation with little if any explanation of results. Potential bias.	Telephone intervi for Bio and Fin/In companies.

Table 5.10 - Strengths and Weaknesses of the Chosen Research Methods (Source: The Author, based on Saunders *et al.*, 2003)

Other methods could have been selected but have been discounted for the reasons shown at Appendix J.

Hussey and Hussey (1997) state that the use of different research approaches, methods and techniques in the same study is known as triangulation which can assist in overcoming some of the potential bias and sterility of single method approaches. Triangulation is understood to be an effective way to mix qualitative and quantitative methods resulting in cross method synergies and an approved approach to studying SCM (van Hoek, 2001). Some authors recommend the triangulation of data as a means of limiting the weaknesses of individual tools (Denzin, 1978; Wass and Wells, 1994). Saunders *et al.* (2003) suggest that the employment of multiple methods within a study can be valuable. Smith (1975) argues that each method, tool or technique has its own unique strengths and weaknesses and results obtained through different methods can produce different results. Therefore, Saunders *et al.* (2003) suggest that it makes sense to use a number of different methods to cancel out the 'method effect'.

Easterby-Smith *et al.* (1991) identified four different types of triangulation:

- Data triangulation
- Investigator triangulation
- Methodological triangulation
- Triangulation of theories.

In this study data (from primary and secondary sources), methods (different types of interviews) and theories (literature) are triangulated.

5.10 RELIABILITY, VALIDITY AND GENERALISABILITY

Reliability and validity of research findings are very important in qualitative study owing to the criticisms of some academics (Robson, 2002). Reliability relates to the level of consistency with which research methods are carried out and it can be assessed by asking three questions (Easterby-Smith *et al.*, 2002, p 53):

- Will the measures yield the same results on other occasions?
- Will similar observations be reached by other observers?

- Is there transparency in how sense was made of the raw data?

Validity is concerned with the integrity of the conclusions that are generated from the research (Bryman and Bell, 2003). There are two aspects to validity:

- Internal validity refers to whether the methods, approaches and techniques actually relate to, or measure the issues that have been investigated (Blaxter *et al.*, 1996). This is also known as measurement validity. In qualitative research, this also applies to the validity of interpretations and 'whether there is a good match between researchers' observations and the theoretical ideas they develop' (Bryman, 2001, p 271).
- External validity relates to the extent to which findings can be generalised.

Typical approaches to achieve validity of qualitative data include triangulation and respondent validation, both used in this study.

Silverman (2000) argues that in qualitative research, there is no opportunity for the reader personally to review all the data. Therefore, he or she needs to be convinced by the validity and reliability of the researcher's interpretations. Reflexivity can be used to counter such concerns, e.g. the researcher needs to 'represent faithfully and accurately the social world or phenomena studied' (Altheide and Johnson, 1998) and suggest that researchers should make clear, certain aspects of how the study was conducted. These are summarised in Table 5.11 along with the author's responses. Denzin and Lincoln (1994) suggest alternative criteria against which to assess qualitative studies and these relate to trustworthiness and authenticity.

Altheide and Johnson Criteria	Author's Response
Access to organisations	Via WAG/other gate keepers (see Figure 5.6), research ethics, stakeholder and communication plans.
Approach and self-presentation	Professional, business-like, mature, experienced, smartly attired, project, stakeholder and communications plans
Trust and rapport	Research ethics (i.e. research explained, consent obtained, company pseudonyms, confidentiality protected, allowed to withdraw at any time) open, professional, identifying benefits to both parties, stakeholder and communications plans, newsletters
The researcher's role and way of fitting in	Sponsored, investigative, potential benefits, common interests (personal and professional), networking, stakeholder plan and communications plan
Mistakes, misconceptions and surprises	Complexity of Bioscience sector terminology and processes, willingness of respondents to provide information, confidentiality agreements, speed (i.e. often slow to gain access, validate data with WAG stakeholders, etc.).
Types and varieties of data	Secondary, interviews. (See Appendix K).
Data collection and recording	Interviews etc. (See Appendix K).
Data coding and organisation	Themes, spreadsheets (Miles and Huberman, 1994). (See Appendix K).
Data demonstration and analytical use	Thesis and stakeholder reports.
Narrative report	Thesis and stakeholder reports.

Table 5.11 - Summary to Aid Validity and Reliability of Interpretations (Source: The Author, based on Altheide and Johnson, 1998).

The results from a limited number of companies used in the case studies are unlikely to be representative of whole sectors. However, Hartley (1994) counters such an argument by observing that statistical generalisations may be outdated by the time they are interpreted, whereas a description of a process or situation may be valuable.

Yin (1994) and Silverman (2000) propose that purposive or theoretical samples can be used to make analytical generalisations which can only be achieved if it can be demonstrated that the case study selection fits with the existing literature and theory relating to the research topic. Informed sampling choices such as purposive or

theoretical can generate and test theory from the analysis of the data. If the study seeks to test a theoretical concept, it is vital to justify that case findings are generalised in these other contexts. This study uses purposive sampling techniques and develops and pilot tests a framework.

Empirical generalisations can be made (Gomm *et al.*, 2000) if linkages can be forged between a case, which may be typical or atypical, to the broader population of cases. The characteristics of the case need to be compared with the population to which a generalisation is intended. Therefore, it is the consideration of the representativeness of such cases to that of the population.

Yin (1994) favours the positivist criteria for assessing case study research rigour, i.e. validity, reliability and generalisability through generalisation in the form of analytical generalisability. Evidence in multiple case studies has substantial analytical benefits compared to only one case study. Robert Yin (2003) states that under varied circumstances, common conclusions can be derived from multiple cases and can have immeasurably expand the external generalisability of research findings, compared to those from a single case study.

SCVs cannot be generalised from case to case but the method used to identify and address them can be. Therefore, the framework developed for potential use by the WAG may work in other RDAs. Discussions have already taken place with Advantage West Midlands (AWM) Manufacturing Advisory Service (2008) who said that such an approach could assist the strategic development of their sourcing activities. Other RDAs have also been contacted and expressed an interest in the findings from the study and the resulting framework (Yorkshire Forward (11 Sep 07), SEEDA (26 Sep 07) and EEDA (11 Nov 07)).

Appendix K summarises the methods of data collection and analysis and their alignment to reliability, validity and possible generalisation. The background decisions and justifications for the chosen methods have been recorded in the authors' research diary throughout the period of the study.

5.11 RESEARCH METHODS ADOPTED FOR THE PRELIMINARY RESEARCH/BACKGROUND TO THE STUDY

Chapter 2, Section 2.6 reports on the preliminary research which resulted in the selection of the three sectors in which to carry out the case studies. Whilst this work did not address any research questions, a number of research instruments were adopted.

Secondary data (Saunders *et al.*, 2003) was used to gather information relating to the priority sectors in Wales, forming a purposive, heterogeneous sample. The sources of data were the WAG 'statswales' web site, based on economic data from the ONS, purchasing 'linkage' data from the Welsh Input-Output Tables for 2000 (WERU, 2004) and qualitative information relating to competences, risks and trade opportunities from WERU (2002) and the IWA (2005) which had used MSQA.

This data was cross-sectional from a specific time scale and was analysed using quantitative analysis, summarised within a Table of Characteristics (ToC) created by the author to identify trends in the size of sectors as depicted by the numbers of FTEs and purchasing activities by value, for example (See Table 2.4). The results of this analysis were then guided by the IWA 2005, p 9) recommendations to select three sectors for case study investigations. A longitudinal analysis was prevented owing to the nature of the data sources and the methods used by different organisations to generate then, which differed over time (e.g. Input-Output Tables, Jones, 20 Jun 06).

Complementary to the ToC analysis, 30 exploratory, structured interviews (Healey and Rawlinson, 1994) were carried out with sector informants from a purposive, homogenous sample in order to identify anecdotal SCVs for each sector.

5.12 RESEARCH ETHICS

Cardiff University has adopted the Economic & Social Research Council (ESRC) Ethics Framework (2005) and has introduced its own Guidelines (Cardiff University, 2005). The CARBS web site provides guidance for business students. Research ethics need to be considered before the study commences, during the fieldwork and at the

reporting stages (Saunders *et al.*, 2003). Diener and Crandall (1978) highlight four recurring issues associated with ethical transgressions including harm to participants, lack of informed consent, invasion of privacy and deception. Ethical approval for the original research approach was applied for in June 2006 and approved on 5th July 2006 by the CARBS Ethics Committee and the Social Research Ethics Committee. This chapter records the actual approach. A copy of the 'Request for Approval' form and accompanying consent forms are attached at Appendix L.

Before the research commenced, access to companies and informed consent of individuals required careful consideration. Confidentiality and anonymity were the biggest issues for this study relating to companies, their data, business operations, markets, competitors, capabilities and so on. Company confidentiality agreements were signed where requested.

Pseudonyms have been adopted for the companies, locations, job titles and individuals, where appropriate. Companies were written to, to reassure them of any concerns. A copy of the letter template is at Appendix M.

Obtaining access to companies proved to be interesting owing to a number of issues which the author had to address and overcome. Examples of these are:

- Obtaining contact names e.g company policy not to pass on contact details of purchasing managers or to speak to researchers.
- Choice of letter format, headings, logos etc. Inclusion of Cardiff University and WAG?
- Flexible introductions i.e. student, mature, sponsored by WAG, Cardiff University, etc.
- Persistence to get in, explaining the potential benefits etc.

Such issues had previously been highlighted by other researchers, e.g. Jenkins (2006).

The study has been guided by the approved ethical approach.

5.13 LIMITATIONS OF THE RESEARCH DESIGN

Any research strategy and programme has potential limitations based on the decisions taken by the researcher, in addressing the Research Questions. Table 5.12 identifies limitations which affect this study. Chapter 11 reports the outcomes of the key limitations.

Concern	Cause	Countermeasure
Research is Wales Centric (Rosenzweig, 2008)	Funding from WAG Sponsors	Informants and involvement of people from different sectors, Industry Forums etc. Secondary Data compared to UK data etc, where appropriate. Empirical research compared to the Literature. Other RDAs consulted at the framework development stage for comparisons, where available.
Research focus is South East (SE) Wales centric	Research is sponsored by WAG SE Wales office.	Research must include representative businesses from across Wales.
Use of secondary data is unreliable	Data may have been collected/manipulated in previous analysis that may impact this study	Use standard data from WAG and MSQA results from WERU & IWA in background phase.
WERU Input-Output Tables etc. are cross-sectional not longitudinal	1-off pieces of research in specific timescales	Tried to update the WERU Input-Output data/results with the latest version from WERU but cautioned against it by WERU as data collection, manipulation etc. was not using the same methods as those used previously. However, Input-Output Tables identify where local purchasing levels are low which help to make policy recommendations in Chapter 11 from the ToC in Chapter 2.
Businesses included on WAG & Industry Forum databases do not include all businesses in all sectors in Wales.	Only those that are e.g. members of Industry Forums/equivalent, or who have contacted/completed a questionnaire for WAG are included in databases.	Believed to be the most representative, relevant and accurate data available. Updated using company web sites.

Semi-structured interviews only covered 10 companies for 'immediate' SCVs in Bio and Fin sectors	Non-Probability sampling used. Purposive samples from each sector. Criteria for sample led to purposive sample, time limits precluded more interviews.	Purposive heterogeneous samples and homogeneous samples used, with specific selection criteria. Follow on telephone interviews to all companies in sub/sector.
Access to companies could have resulted in bias/lack of objectivity	Identifying companies, based on clear criteria and then seeking advice/information/acces s via stakeholders i.e. Industry Forums, WAG AMs, KB4Bs etc.	Ensuring that the original criteria were sound and that samples were purposive.
Macro and other economic factors for example, exchange rates, forward linkages, displacement, dead weight and/or substitution were not addressed.	Time scales of the research were prohibitive to go into such detail.	Addressed factors that could be accommodated within the timescales. Scope defined in Chapter 4.
Only 4 sample companies included in Unmanned Systems for 'potential' SCVs.	Criteria for sample selection led to purposive sample and time limits precluded interviewing more companies	Once SCVs identified and examples selected to investigate further, developed suitable solution for framework based on investigation of 'immediate' SCVs.
Focus on 'Backward linkages' only which is a small element of the economic multiplier.	Interested in SCVs identified by Welsh customers. Scope defined in Chapter 4.	Alignment to a significant body of literature from economic geography.

Table 5.12 – Table of Limitations (Source: The Author)

5.14 CONCLUSION AND RELEVANCE TO THE THESIS

Recent published works have identified that a number of research methods, including mixed methods, have merit and can be applied to supply chains (Kotzab *et al.*, 2005; Sachan and Datta, 2005). Trends in supply chain research methods show that case studies are on the increase, although surveys remain the number one strategy (Sachan and Datta, 2005). The key challenge as the research progressed was to ensure a balance between the academic and practical demands of the sponsors so it was important that

the research strategy, approach and methods chosen could ultimately lead to results that demonstrate reliability and validity.

This chapter has set out and defended the chosen research design and methodology for this study, along with the selection of the three sectors in which the case studies reside. Chapter 6 describes the framework developed by the author for potential use by the WAG, whilst addressing Research Questions 2 and 3. Chapters 7, 8 and 9 present the case studies for three sectors, providing the reader with a contextual sensitisation concerning 'immediate' and 'potential' SCVs in Wales, whilst addressing Research Question 1.

Chapter 6

Development of the Supply Chain Voids 'Policy Deployment' Framework

CHAPTER 6 – DEVELOPMENT OF THE 'SUPPLY CHAIN VOIDS POLICY DEPLOYMENT FRAMEWORK'

6.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter describes the creation and development of a Hoshin Kanri policy deployment framework (see Chapter 4), generated and pilot tested alongside the case studies reported in Chapters 7, 8 and 9, with the exception of the WAG orientated return on investment (ROI) and sustainable development assessment, for example. It addresses Research Questions 2 and 3 (see Chapter 1, Table 1.1). The framework has been designed by the author, based on Figures 4.3 and 4.4.

Firstly, the chapter introduces the scope of the case studies before describing the development, content and pilot testing of the framework, linking this to the relevant chapters within this thesis. Finally, a section concludes this chapter relating to the relevance of the framework to the study.

6.2 THE SCOPE OF THE CASE STUDIES AND ADDRESSING THE RESEARCH QUESTIONS

The definition for SCVs in Wales is in Chapter 1, Section 1.1.1. Figure 4.7 shows the scope of the study in relation to P & SCM which concentrates initially on the dyadic relationship between buyer and supplier. On investigating 'immediate' SCVs for Biosciences and Financial services, the focus on the supply chain broadens out to identify potential solutions to SCVs, seeking options across the supply base or 'supply potential' within specific sectors in Wales, as demonstrated by Figure 6.1.

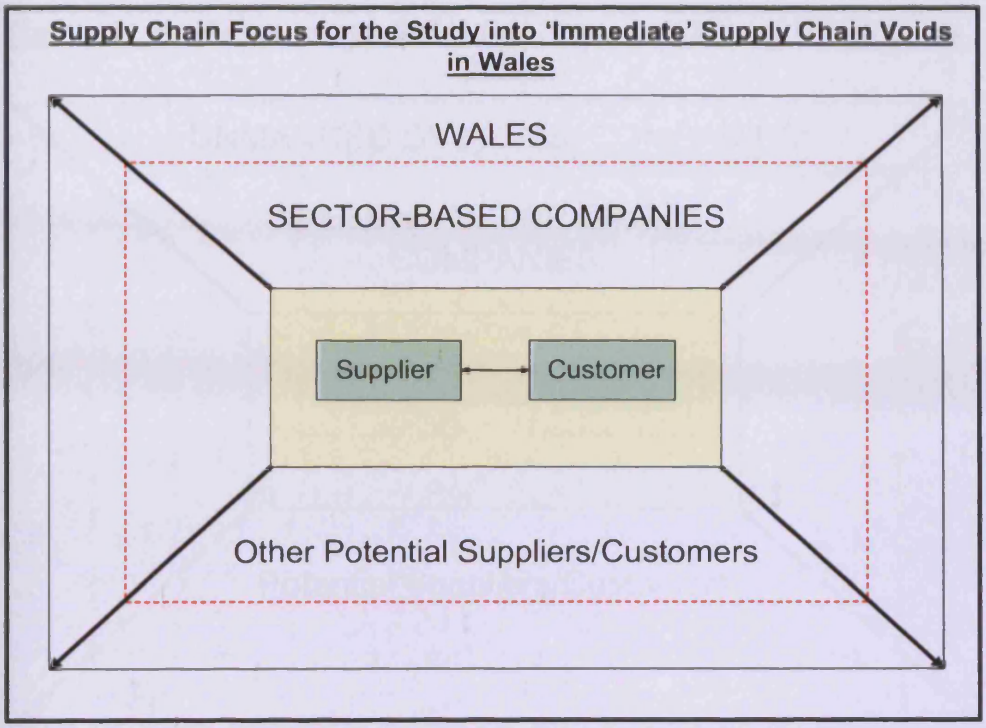


Figure 6.1 – Supply Chain Focus for the Study into 'Immediate' Supply Chain Voids in Wales (Source: The Author)

For 'potential' SCVs, as customers may be from within or outside Wales, looking to invest in Parc Aberporth, they may seek local sourcing opportunities as shown at Figure 6.2, where the focus on the supply chain narrows down to identify potential solutions from the supply base within Wales (continuous black arrows). It also recognises the WAG vision of potential customers in markets outside the region (dashed black arrows).

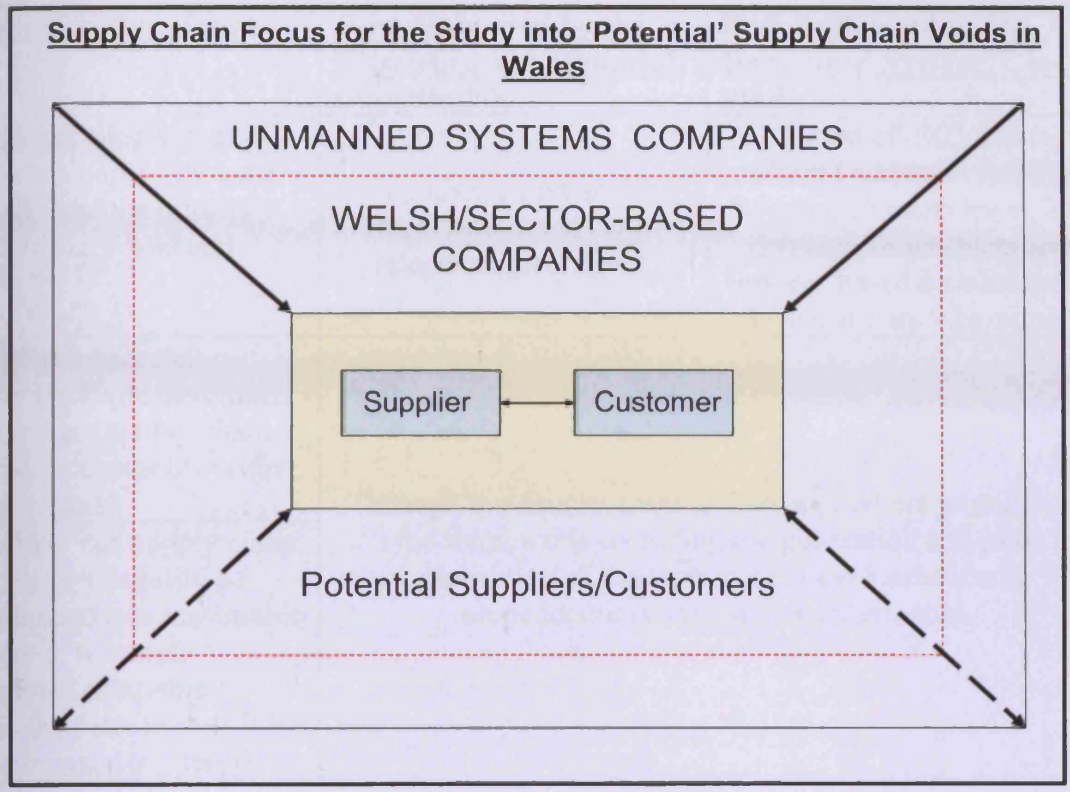


Figure 6.2 – Supply Chain Focus for the Study into 'Potential' Supply Chain Voids in Wales (Source: The Author)

The case studies address Research Questions 1 – 3 as shown in Table 6.1 and pilot test the framework developed here.

Research Questions	How Addressed by the Bioscience and Financial Case Studies	How Addressed by the Unmanned Systems Case Study
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	Data gathered and analysed from face to face and telephone interviews.	'Potential' SCVs data gathered and analysed from face to face interviews. The demand for products and services based on occupancy levels at Parc Aberporth.
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Through the development and testing, where possible, of the framework, including the generation and pilot application of the sustainable development and embeddedness assessment criteria tool.	
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?		

Table 6.1 – Research Questions and How they are Addressed Through the Case Studies (Source: The Author)

There are four stages of the research as depicted at Figure 6.3. The preliminary Stage 0 is reported in Chapter 2, resulting in the selection of three sectors in which to investigate SCVs. Stages 1 and 2 are carried out within the case studies and address Research Questions 1 - 3. Finally, Stage 3 is completed at the end of the case studies resulting in the academic thesis, user guide for potential use by the WAG and executive summaries for stakeholders.

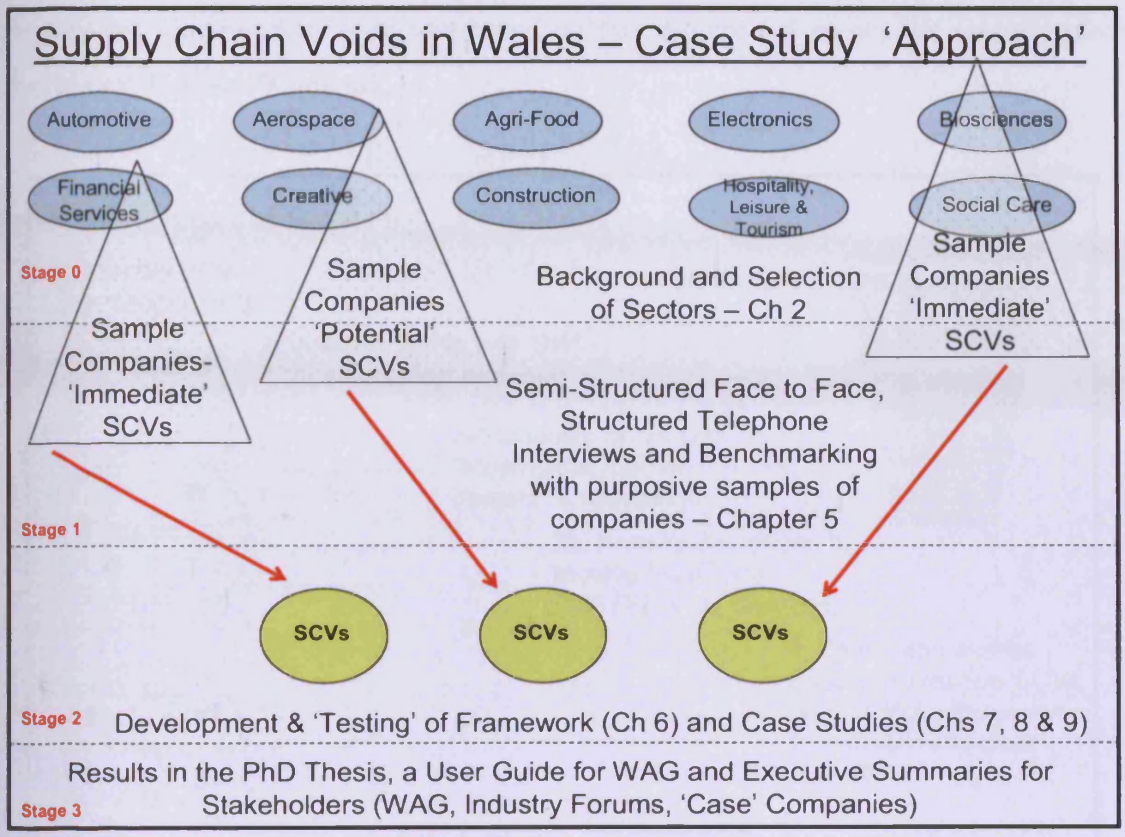


Figure 6.3 – Supply Chain Voids Case Study Approach (Source: The Author)

The next section explains the background and evolution of the SCVs framework.

6.3 DEVELOPMENT OF THE 'SUPPLY CHAIN VOIDS POLICY DEPLOYMENT FRAMEWORK'

Chapter 1 defines the study into SCVs in Wales and identifies the requirements of the WAG sponsors to understand how they could be identified and investigated to benefit the Welsh economy. Chapter 2 details the background to the study, identifying a selection of WAG strategies and policies relevant to this study. Figure 3.1 shows the background and foreground literature selected for review as reflected in Chapters 3 and 4, which have been referred to throughout the development of the framework. In particular, this study extends the work of Crone (1999) in relation to the investigation of material linkages through the use of a framework, and Guinipero *et al.* (2008) relating to the role of 'intermediaries' during the investigation of capability gaps within, with the WAG filling such a role. The case studies identify that the type of SCV determines

the way the framework is used and based on this, Figure 6.4 shows the original ideas used to develop the framework.

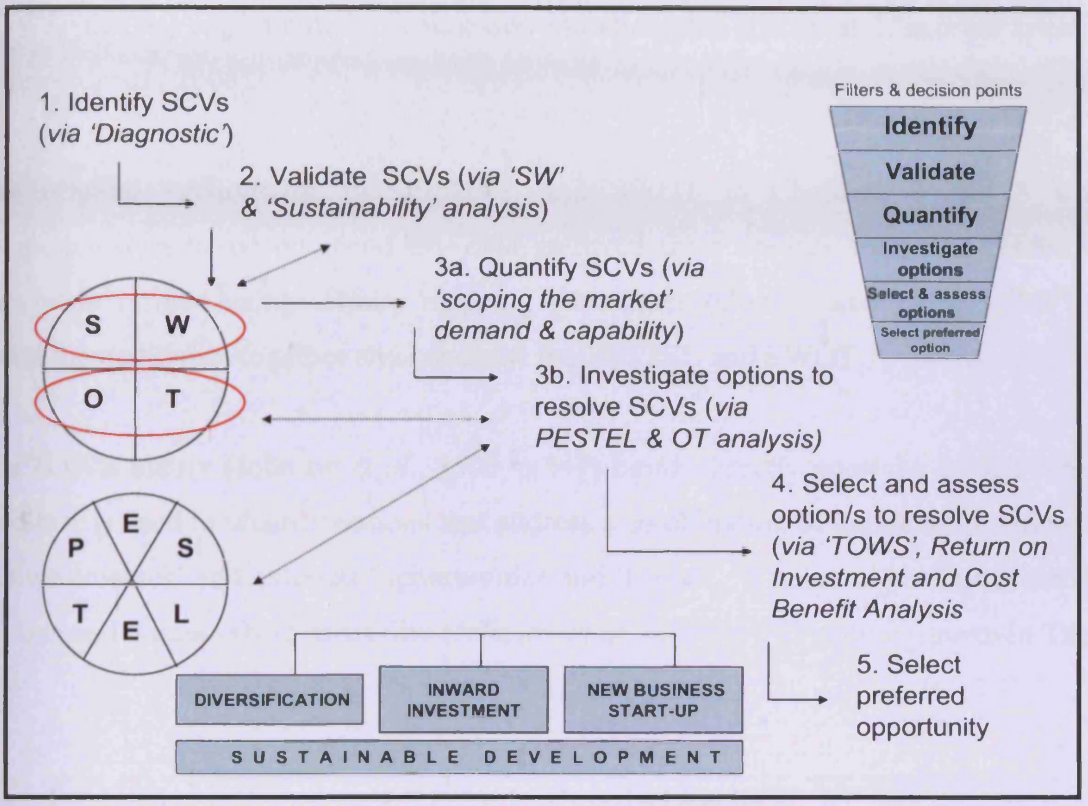


Figure 6.4 – Early Framework Development Ideas (Source: The Author)

Figure 6.4 is orientated around the filter shown in the top right hand corner. The process flows from identification, through validation, quantification, investigation and resolution, resulting in the selection of a preferred option for dealing with a SCV, where possible.

6.3.1 STRATEGIC TOOLS OF ANALYSIS INCLUDED WITHIN THE FRAMEWORK: PESTEL, SWOT, TOWS AND SUCCESS CRITERIA

Standard, strategic business analysis tools were identified for use to address Research Question 2. A brief overview is provided for those selected as most appropriate for use. Others were considered but deemed less suitable e.g. Porter's diamond (1990) used to determine a nation's advantage. A recent study by Taylor (2003) applied this to assess

the Welsh economy. Therefore, the analyses identified for use in this study include PESTEL (political, economic, social, technological, environmental and legal external environmental factors), SWOT (strengths, weaknesses, opportunities and threats), TOWS (threats, opportunities, weaknesses and strengths) matrix and 'success criteria' (Johnson *et al.*, 2006).

The original versions of the PESTEL and SWOT in Chapters 7 and 8 were comprehensive, based on secondary data gathered from various sources. Therefore, they were refined using affinity mapping techniques (Cowley and Domb, 1997) to group themed topics together and condense the PESTEL and SWOT.

The TOWS matrix (Johnson *et al.*, 2006, p 347) builds directly upon the SWOT where each box is used to identify options that address a combination of the internal 'strengths and weaknesses' and external 'opportunities and threats'. It helps to generate strategic options and address their suitability (Johnson *et al.*, 2006, p 347) and is shown in Table 6.2.

		Internal Factors	
		Strengths (S)	**Weaknesses (W)**
External Factors	**Opportunities (O)**	**SO Strategic Options** Generate options here that use strengths to take advantage of opportunities	**WO Strategic Options** Generate options here that take advantage of opportunities by overcoming weaknesses
	Threats (T)	**ST Strategic Options** Generate options here that use strengths to avoid threats	**WT Strategic Options** Generate options here that minimise weaknesses and avoid threats

Table 6.2 – The TOWS Matrix (Source: Johnson *et al.*, 2006, p 347)

'Success criteria' are defined by Johnson *et al.* (2006, p 357) as 'being used to assess the likely success of a strategic option'. In this study there is a need to align the

assessment of SCVs with those WAG strategies identified in Chapter 2. Success criteria are defined as follows (Johnson *et al.*, (2006):

- **Suitability** is concerned with if a strategy addresses the circumstances in which an organisation is operating – the 'strategic position' which is 'concerned with the impact on strategy of the external environment, an organisation's strategic capability (resources and competences) and the expectations and influence of stakeholders' (p 17). Johnson *et al.* assert that suitability requires a broad assessment of the extent to which new strategies would fit with the future trends and changes in the environment to exploit the 'strategic capability' of an organisation and meet the *expectations* of stakeholders. Suitability can also be seen as the 'rationale' of a strategy and whether it 'makes sense' in relation to the strategic position of an organisation. Table 6.3 demonstrates how this aligns to the SCVs assessment.
- **Acceptability** relates to the expected 'performance outcomes' (e.g. return or risk) of a strategy and the extent to which these align to the 'expectations' of the stakeholders. In this study, this relates to the assessment of the potential benefits or issues associated with the SCVs and options to address them, based on stakeholders' views.
- '**Feasibility** is concerned with whether a strategy could work in practice. Assessing the feasibility of a strategy requires an emphasis on more detailed practicalities of 'strategic capability' (resources and competences)'. In this study, this relates to the assessment of the potential viability of addressing a SCV.

Suitability	**Johnson *et al.* (2006) Definition**	**Interpretation for use in the SCVs assessment**
1	Whether a strategy addresses the circumstances in which an organisation is operating	Assessment of SCVs against the WAG policies and strategies
2	Alignment to strategic position	Assessment of SCVs by key sector stakeholders from the WAG and e.g. Industry Forums, using their experience and knowledge.

3	Broad assessment of fit of new strategies to the environment	Fit of options to address SCVs with WAG policies and strategies, both existing and developing
4	Exploitation of strategic capability	Resources and competences of the WAG and Industry Forums in relation to assisting the specific sector in Wales and the consideration of the capabilities in companies located in Wales
5	Expectations of stakeholders	Working with the WAG, Industry Forums and individual companies

Table 6.3 - The Author's Interpretation of 'Suitability' as Defined by Johnson *et al.* (2006, p 357) for Use in the Assessment of Options to Address Supply Chain Voids (Source: The Author, based on Johnson *et al.*, 2006)

'Success criteria' is the key determinant for the validation and selection of SCVs for further investigation as demonstrated within Figure 6.5.

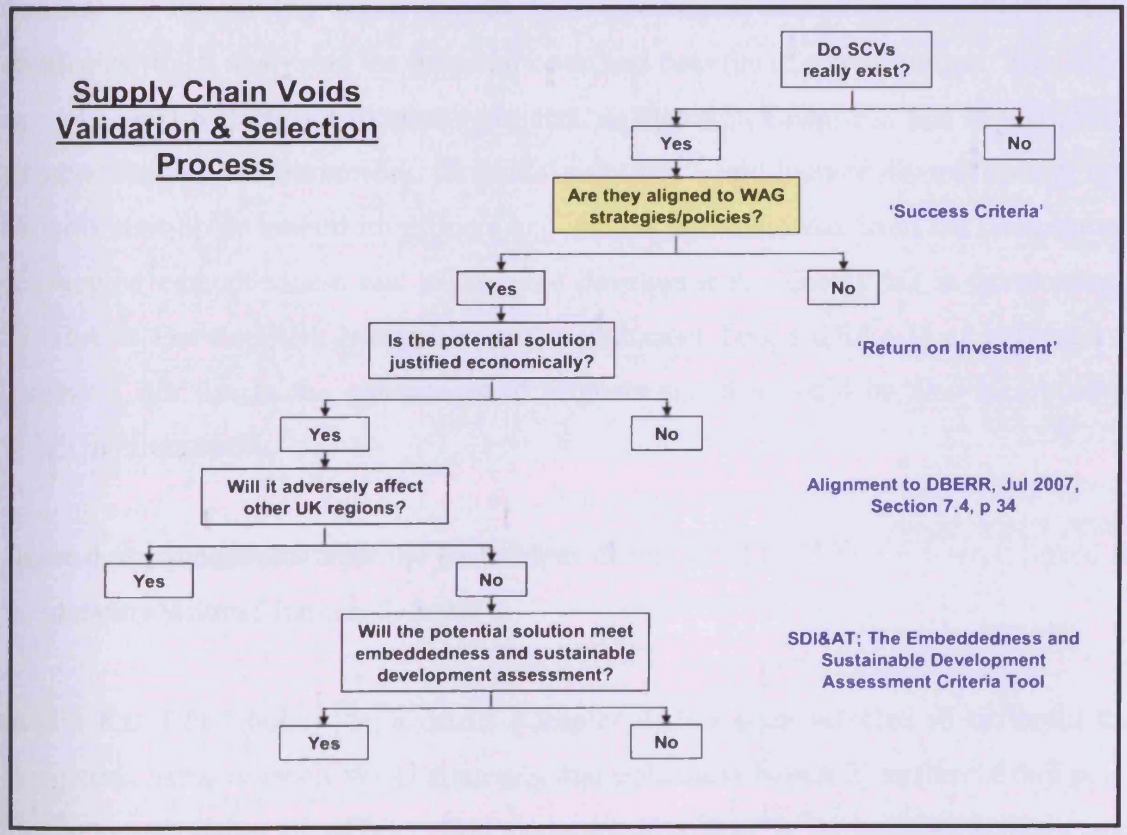


Figure 6.5 - Supply Chain Voids Validation and Selection Process (Source: The Author)

Owing to the lack of specific sector strategies, seeking alignment is less effective at present so the economic justification within this validation process is important. If sector strategies are introduced, a more targeted and balanced assessment could be made upfront, including the use of embeddedness and sustainable development criteria.

6.3.2 ORGANISATION, DESIGN AND APPLICATION OF THE FRAMEWORK

It is proposed that the identification of SCVs could be encompassed within the new WAG diagnostic process, carried out by Relationship Managers, when dealing with their companies. SCVs could be recorded centrally in the new WAG customer relationship management (CRM) system where they could be accessed by those assigned to investigate them. The framework could be followed to investigate SCVs through environmental analyses (PESTEL and SWOT), scoping the broader potential demand and capabilities for a specific SCV product or service within Welsh based companies whilst analysing the potential costs and benefits of any solutions. The WAG has developed a ROI tool to assess projects, as stated in Chapter 2 and this could be incorporated into the framework. Potential solutions could include diversification, new business start-up or inward investment and should be considered from the perspectives of potential embeddedness and sustainable development. The WAG is developing a Sustainable Development Integration and Assessment Tool (SDI&AT) as indicated in Chapter 4, for use in the assessment of projects and this could be also incorporated within the framework.

Figure 6.6 demonstrates how the early ideas documented in Figure 6.4 were linked to the literature within Chapters 2, 3 and 4.

Hoshin Kanri and policy deployment (Chapter 4) has been selected to underpin the framework, using relevant WAG strategies and policies (Chapter 2) as the starting point for the investigation of SCVs. For example, if a firm is in a priority sector and identifies a SCV during a diagnostic meeting, then this could be a criterion to record and potentially investigate further.

The sectors within this study have been used as examples within Figure 6.6. The 'immediate' SCVs investigated for the Bioscience and Financial sectors are shown at the top of Figure 6.6 and described as 'pull'. Alternatively, Parc Aberporth and Unmanned Systems are shown as 'push'. These are based on SCM literature, for example Ahn and Kaminsky (2005) who state that in traditional supply chains, a 'push-based supply chain' is characterised by production and distribution decisions that are based on long-term forecasts, leading to slow reaction to the changing marketplace. Parc Aberporth was established in 2005 based on a 'push' strategy by the then WDA and Chapter 9 briefly describes the background and the current challenges to make it work. Alternatively, a 'pull-based supply chain' is classified by production and distribution that are demand driven so that they are coordinated with true customer demand rather than forecast demand.

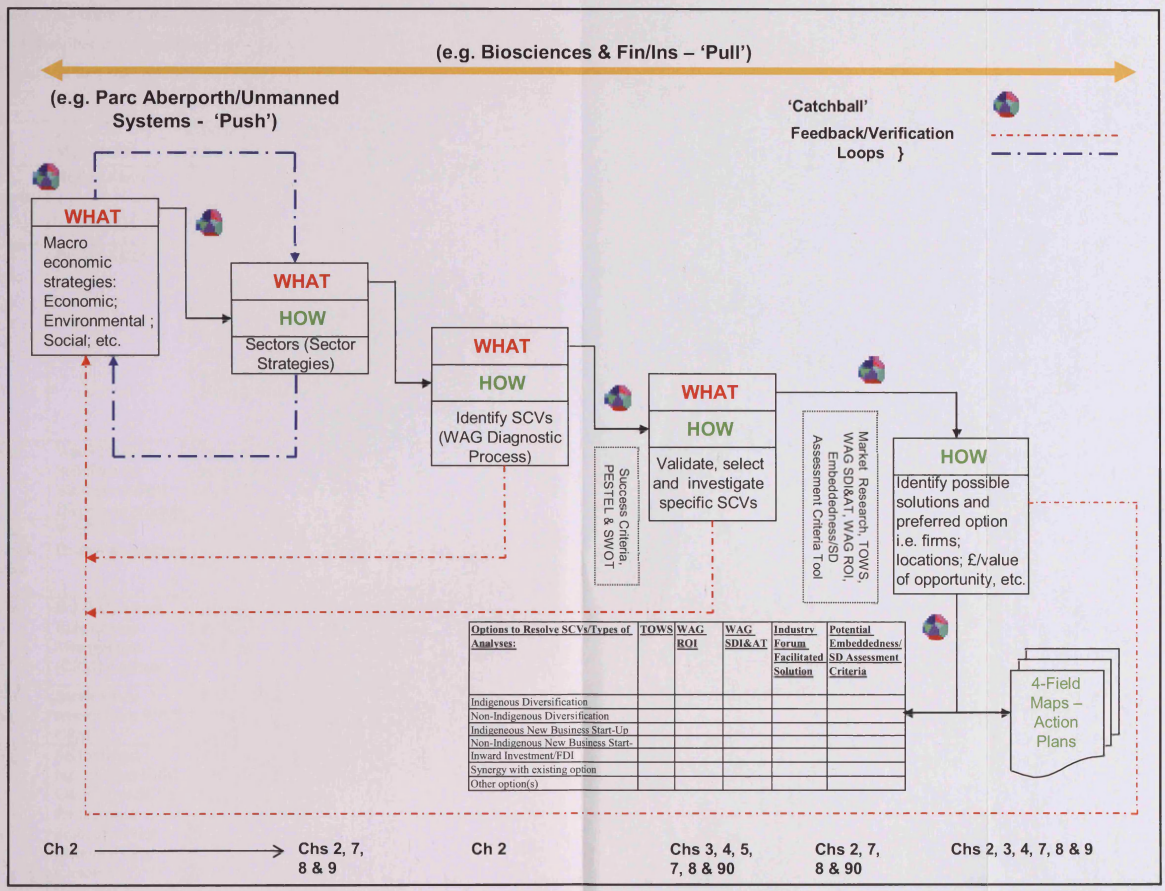


Figure 6.6 – Policy Deployment Framework for Potential Use by the Welsh Assembly Government (WAG) (Source: The Author)

The output format of a Four-Field map, adapted from Dimancescu (1992, pp 100 – 116), at Table 6.4 describes the elements of this framework, where they derive from within the thesis and how they may be operated by the WAG and sector stakeholders.

WHAT - ACTIVITY	**HOW - METHOD**	**WHO - ROLE(S)**	**STANDARD(S) - Thesis Chapter, WAG, etc.)**
Strategy development/policy deployment	Hoshin Kanri	WAG Strategy & Policy Department plus stakeholders	Ch 2 (WAG strategies and policies), Ch 4 (Hoshin Kanri – see Table 6.5)
Development of sector strategies	Hoshin Kanri	WAG Strategy & Policy Department, **WAG sector teams** (not yet in place) plus stakeholders e.g. Industry Forums	Ch 4 (Hoshin Kanri – definitions and models). **Sector strategies for priority sectors do not currently exist**, resulting in a lack of targeted, coordinated activity by WAG and other stakeholders in Wales (e.g. Industry Forum)
WAG diagnostic process	WAG Flexible Solutions for Business (FS4B) Diagnostic process	Assigned WAG Relationship Manager	Ch 6, WAG FS4B Training Manuals
Identification of individual product or service related SCVs	WAG FS4B Diagnostic process	Assigned WAG Relationship Manager	Ch 2 (WAG Strategies and policies), **Sector strategy**
Recording SCVs	WAG Customer Relationship Management (CRM) database	Assigned WAG Relationship Manager	Ch 2 (WAG Strategies and policies), **Sector strategy**
Review of identified SCVs	Sector based reports from WAG CRM	**To be identified - WAG sector teams**	Ch 2 (WAG Strategies and policies), **Sector strategy**
Validate SCV(s)	Sector based reports from CRM. Cumulative SCVs for the same product/service identified by a number of firms/Relationship Managers	**To be identified - WAG sector teams**	Ch 2 (WAG Strategies and policies), **Sector strategy**

Select appropriate SCV(s) for investigation	Sector based reports from CRM, selection criteria	**To be identified - WAG sector teams**	Ch 2 (WAG Strategies and policies), Success criteria, **Sector strategy**
Quantify broader sector demand and capabilities for SCV(s) in the region	Market research within other sector based firms in Wales (**or broader spatial scale?**)	**To be identified - WAG sector teams**, sector stakeholders e.g. Industry Forums	Ch 2 (WAG Strategies and policies), Ch 3 (Search – see Table 6.6; Contingencies – see Table 6.7), Chapter 5 (Interviews), Chapters 7, 8 and 9 (Case Studies), **Sector strategy**
Investigate options to resolve SCV(s)	Compare/utilise market research data with PESTEL, SWOT, TOWS, WAG ROI, WAG SDI&AT, potential embeddedness and sustainable development assessment criteria, Industry Forum facilitation, other analyses	**To be identified - WAG sector teams**, Finance Wales, sector stakeholders e.g. Industry Forums, Firms	Ch 2 (WAG Strategies and policies), Ch 3 (Search and contingencies – see above), Ch 4 (Foreground literature i.e. clusters, linkages and embeddedness; sustainable development), Ch 5 (Interviews), PESTEL and SWOT, Chapters 7, 8 and 9 (Case Studies), **Sector strategy**
Select most suitable option(s) to resolve SCV(s)	Outputs of various analyses	**To be identified - WAG sector teams**, sector stakeholders e.g. Industry Forums, Firms	Ch 2 (WAG Strategies and policies), Chapters 7, 8 and 9 (Case Studies), **Sector strategy**
Develop action plan to implement preferred solution e.g. diversification, new business start-up, inward investment, other, etc.	Four-Field map output format/action plan	**To be identified - WAG sector teams**, sector stakeholders e.g Industry Forums, Firms	Ch 2 (WAG Strategies and policies), Chapters 7, 8 and 9 (Case Studies), **Sector strategy**
Decision making	'Catchballs' ●	**To be identified - WAG sector teams**, sector stakeholders e.g Industry Forums, Firms	Ch 2 (WAG Strategies and policies), Ch 4 (Hoshin Kanri i.e. Akao, 1991; Cowley and Domb, 1997), **Sector strategy**

Review and evaluation	Feedback and verification loops	**To be identified - WAG sector teams**, sector stakeholders e.g Finance Wales, Industry Forums, Firms	Ch 2 (WAG Strategies and policies), Ch 4 (Hoshin Kanri i.e. Cowley and Domb, 1997), **Sector Strategy**

Table 6.4 – Four-Field Map Output Format Detailing the Actions Required of Welsh Assembly Government to Operationalise Figure 6.6 (Source: The Author, adapted from the Four Field Map Output by Dimancescu, 1992, pp 110 - 116)

The process flow is not necessarily sequential or linear as during the investigation of specific SCVs it may become clear that some methods of analyses are more contingent than others, e.g. in relation to the needs of 'immediate' versus 'potential' SCVs (see Chapters 7, 8 and 9).

With reference to the market research activity, although this study is focussing on Wales, the literature recommends broadening spatial scales to collaborate with other regions for linkages (e.g. Crone, 1999), hence the reference to spatial scale here. This framework could be adopted in a contingent manner for use by a number of regions working together, if their regional economic objectives were aligned in relation to addressing specific SCVs, although regions may have to utilise their own ROI models, for example but resources could be shared for the strategic analyses.

The roles and strategies emboldened within Table 6.4 are not in place within WAG or sector based stakeholder organisations. The WAG is undergoing a structural reorganisation in 2008/9 resulting in new job roles such as Relationship Managers and new business support processes such as FS4B. In addition, WAG (2009) acknowledges that the Industry Sector Planning Group and the Ministerial Advisory Group have recommended an outline structure for sector teams and the way in which sector strategies should be implemented. Whilst this study has borne such changes in mind, it is still unclear as to the final structure of sector teams, and the author understands that multi-disciplinary teams in WAG (same or cross-sector, based on the SCVs under investigation e.g. Media Advertising in Chapter 8), consulting with sector based experts

such as Industry Forums would be best placed to carry out investigations into SCVs. This could result in an enhanced type of 'Source Wales' programme where targeted gaps in capability could be filled through more strategically directed solutions (Crone, 1999).

The standards for the Hoshin Kanri literature in Table 6.4 are explained in Table 6.5.

Author(s)	**Applicability of Hoshin Kanri to the Proposed WAG Framework**
Soin, 1992	Simplified PDCA model.
Cowley and Associates, 1995, cited by Cowley and Domb (1997)	Simplified hoshin planning process.
Domb (2005)	Big 'W' of policy deployment.
Lethbridge *et al.* (2007)	Full policy deployment process.
Tenant and Roberts (2001)	Key elements of Hoshin Kanri.
Akao, 1991; Cowley and Domb, 1997	Catchball definitions.
Watson (in Akao, 1991); Deming (1986)	Japanese and Western companies are different and the adoption of hoshin is not prescriptive, but contingent depending on organisational context, for example. Both the WAG and the context of the SCVs have been at the forefront during development of the framework.
Daneke (1980)	Implementation should be considered at policy formulation whilst policy evaluation and feedback is vital in an ongoing process of policy deployment.
Marsden (1998)	Policy deployment systems vary based on several contingencies, examples of which have been borne in mind.
Hacker *et al.* (2001)	Implementation frameworks should be underpinned by PDCA.
Radnor *et al.* (2006)	Policy deployment brings cohesion to implementation plans.
Barber (2007)	The 'how' of implementing public services.

Table 6.5 – Hoshin Kanri Standards and their Alignment to the Framework (Source: The Author, base on the selected literature)

The standards identified for search theory are amplified in Table 6.6.

Author(s)	Applicability to WAG when using the Framework
Stigler (1961)	Wealthy consumers search less than poor consumers. WAG is resource constrained so search activities will be limited by e.g. time and budget.
Soelberg (1967)	In organisational decision making, choice processes of individuals are a key feature of management. Decision making of WAG sector managers.
Salop (1973)	Searchers' first explore the most attractive possibilities and if these prove unsatisfactory, they demand less from what remains. WAG may initially target the best options to address SCVs.
Gronau (1971); Axell (1974)	The cost of search increases as time goes on. The consumer must weigh the cost of improving the basis of decision making against the expected benefit of continued search. WAG is resource constrained so search activities will be limited by e.g. time and budget.
Rothschild (1974)	The optimal search rule is sequential (i.e. where the searcher decides, after each quotation, whether or not to get another quotation, or buy). This is opposed to the Fixed Sample Size (FSS) strategy recommended by Manning and Morgan (1982). WAG may adopt the sequential approach for some SCVs and the FSS for others e.g. Financial sector vs Biosciences, goods/services.
Manning (1976)	Specialist traders endeavour to find out whatever they can but non-specialist traders will not be able to discover facts which a specialist would be able to exploit. Sector experts/teams should investigate SCVs.
Proctor (1978)	When exercising choice between alternative courses of action, firms set minimum values to be obtained, selecting the strategy that reaches or exceeds such requirements. WAG must set criteria or contingencies when addressing SCVs.
Manning and Morgan (1982)	FSS strategy where the searcher obtains a specific number of quotations before making a final decision. Opposite of sequential search (Rothschild, 1974).
Palich and Bagby (1995)	People with limited experience may simplify the search process whilst those with considerable experience may better target sources of information. WAG experts/sector teams should investigate SCVs.
Belich and Dubinsky (1995)	Internal factors e.g. managerial, processes, organisational structures and capabilities can impact information search. WAG managers operate in line with such factors.
Schmidt and Spreng (1996)	Individuals' motivators and ability are relevant to successful search. WAG sector managers are subject to this.
Foster and Ford (2003)	Information seeking is complex and serendipitous. Researchers may have an idea of what is required but not if it exists, or where.
Dellaert and Haubl (2004)	The searcher has a tendency to optimise locally i.e. to over-rely on recently encountered information. To achieve solutions to SCVs, WAG must carry out sequential searches bounded only by resource constraints.
Ioannides and Loury (2004)	Access to information is heavily influenced by social structure and networks. Sector experts and companies can provide assistance in resolving SCVs.
Yeoh (2005)	Larger firms have the resources to obtain and process greater amounts of information compared to smaller firms. WAG are resource constrained but have expertise, information, systems etc. that may aid the search process to address SCVs e.g. Contract Shop, CRM database, etc.

Table 6.6 – Applicability of Search Theory to the Framework (Source: The Author, based on the selected literature)

Table 6.7 highlights the standards from Table 6.4 relating to contingency theory that are appropriate to the proposed framework.

Author(s)	Contingencies/Context	Applicability to WAG when using the Framework
Child (1984); Schein (1965)	General	The importance of management planning and policy deployment has been identified as important to high organisational performance.
Burns and Stalker (1961); Duncan (1972); Pennings (1992)	Environment	PESTEL type environmental factors affect the investigation and possible solution to SCVs.
Groff and Muth (1974)	Environment	Capability in the operations area should align to the requirements of the firm as determined by the environment it operates in. WAG to investigate SCVs with a 'fit'.
Weber (1968); Child (1973, 1975 and 1984, p 4); Kast and Rosenzweig (1985, pp 16 – 119)	Organisation size	Whilst WAG is large and bureaucratic, the framework promotes a process with targeted roles and responsibilities for those investigating SCVs.
Chandler (1962); Galbraith (1973)	Organisational strategy	Contingencies affect the strategy development, deployment and the management of activities within the framework. This also includes the team structure responsible for operating the framework i.e. diversified.
Woodward (1965); Perrow (1967 and 1970)	Technology	Technology used in different sectors influences decision making processes used by WAG during the investigation of SCVs e.g. Financial services SCVs can be less technologically complex than Biosciences.
Luthans (1976)	A general contingency theory of management	Contingencies affect the management and decision making by WAG within the framework.

Alford and Hughes (2008)	Contingency theory in the public sector	There is no 'one best way' and management approaches depend upon the circumstances, context or nature of the task in hand. The framework and its operation depend upon the sector, SCV etc. under investigation and the process is not comprehensive or linear in operation. How it is used depends upon the SCV under investigation.

Table 6.7 – Applicability of Contingency Theory to the Framework (Source: The Author, based on the selected literature)

It may be as found by DMC Consulting (2005), a void cannot be filled within the region as it is, e.g. cost prohibitive. Therefore, not all SCVs that are resourced for investigation will be filled. However, it is imperative that any SCVs selected for examination are understood to deliver potential benefits to Wales, thereby only assigning scarce, valuable WAG and other resources to those that align to appropriate strategies and selection criteria.

'Catchballs' (e.g. Cowley and Domb, 1997) require the discussion and agreement of personnel within the roles identified in Table 7.4 to, for example, determine if a SCV is appropriate for investigation and which data collection and analyses methods are most appropriate.

Feedback and verification loops (e.g. Cowley and Domb, 1997) are included to ensure that investigations and potential solutions align to WAG strategies and policies. Where there is misalignment, this should be highlighted to review a strategy or the investigation of a SCV, for example.

Figure 6.6 identifies a number of analyses or activities required to aid the decision-making process in the potential resolution of SCVs and these are highlighted in Table 6.8.

Options to Resolve SCVs/Types of Analyses:	TOWS	WAG ROI	WAG SDI&AT	Industry Forum Facilitated Solution	Potential Embeddedness /Sustainable Development Assessment Criteria
Indigenous Diversification					
Non-Indigenous Diversification					
Indigenous New Business Start-Up					
Non-Indigenous New Business Start-Up					
Inward Investment/FDI					
Synergy with existing option					
Other option(s)					

Table 6.8 – Analyses Required to Aid the Decision-Making and Potential Solutions to Supply Chain Voids in Wales (Source: The Author)

Options for the possible resolution of SCVs include e.g. diversification, new business start up and inward investment. These are familiar approaches in regional development and should consider options offered by indigenous firms with HQs in Wales as a priority, before foreign owned solutions (e.g. OECD, 1993; Morgan, 1997) providing that they have the requisite 'supply potential'. However, some of the proposed methods to achieve these potential solutions require clarification, e.g. the facilitation by Industry Forums or similar organisations and the assessment of potential embeddedness and sustainable development and the appropriate level of incentive regarding Regional Selective Assistance (RSA) (now the Single Investment Fund, 2009).

Where a SCV is identified and investigated, but further clarification is required, e.g. in relation to 'potential' SCVs for Unmanned Systems at Parc Aberporth (see Chapter 9), it may be best to get customers and potential suppliers together to discuss detailed requirements and identify potential supply chain solutions. Therefore, it is suggested that the relevant Industry Forums or similar organisation is engaged to facilitate such an activity, supporting Stigler's (1961) assertion that employers and workers, or in this

case buyers and suppliers need to invest resources to meet to explore opportunities. A precedent of this includes the 'meet the buyer' activity at the annual 'Aerolink' conference currently organised by the Aerospace Wales Forum and funded by the WAG.

6.3.3 EMBEDDEDNESS AND SUSTAINABLE DEVELOPMENT ASSESSMENT CRITERIA TOOL

Chapter 4 reviews the literature for P & SCM, material linkages, embeddedness and sustainable development. The author has linked these topics to develop an assessment criteria tool for use in strategy development and objective setting and the investigation of SCVs, as shown in Figure 6.7. This is framed by the Brundtland definitions of sustainable development and the perceived benefits resulting from of linkages and embeddedness. These could also be used to develop further the WAG ROI and SDI&AT models. The application of the framework at Figure 6.4 is determined by the SCV where this assessment criteria tool starts and includes elements from both contingency and search theories, based on the results of the case studies.

The sustainable development definitions from Brundtland (WCED, 1987) for economic, environmental and social are colour coded as shown in Figure 6.7 and where WAG strategy or policy statements, linkage or embeddedess factors or benefits align to these definitions, they have been colour coded to demonstrate potential alignment to these sustainable development definitions. By using such criteria to determine objectives and assess possible solutions to fill SCVs, for example, the WAG could be considering the potential for embeddedness or sustainable development. This relates to the need for sector strategies that focus on specific development objectives for each sector. Targeting what is required and achieving such a goal would demonstrate success i.e. if job numbers are all important, target those. If knowledge based skills or technological spillovers are required, address these.

The criteria identified within Figure 6.7 may not be restricted to the use in the investigation of SCVs but could also be adapted to assess potential FDI opportunities.

Some of these elements were used in the semi-structured interviews to address the first of the three Research Questions in relation to 'potential' SCVs.

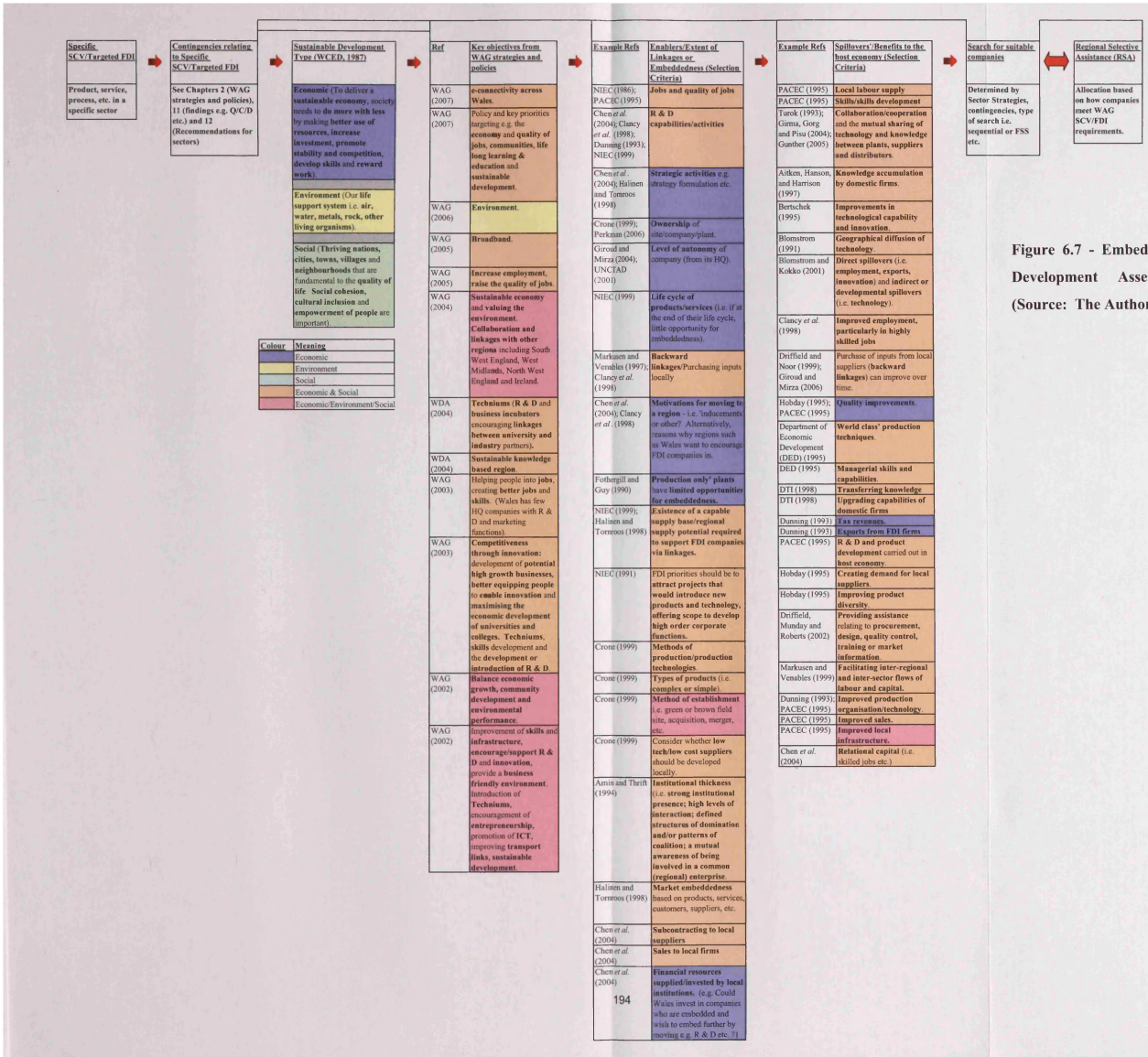


Figure 6.7 - Embeddedness and Sustainable Development Assessment Criteria Tool (Source: The Author)

6.3.4 PILOT TESTING THE FRAMEWORK

Table 6.9 demonstrates the extent to which the framework has been developed and pilot tested.

Framework Activity	Developed by the Author	Developed by WAG	Pilot Tested	Issues
Specific Sector Strategies	No	No – some work in 2009, post study completion	Yes. Utilised existing regional economic development and other strategies.	Sector teams and sector strategies considered in 2009, post study completion.
WAG Diagnostic Process	No	Yes	Yes. Utilised interviews for this purpose as detailed in Chapter 5.	Diagnostic process not in use until 2009
PESTEL	Yes	No	Yes	
SWOT	Yes	No	Yes	
TOWS	Yes	No	Yes	
Success Criteria	Yes	No	Yes	
SCV Validation Process	Yes	No	Yes	Based on existing strategies. Recommend specific sector strategies.
Market Research	Yes	No	Yes	Tele-interviews detailed in Chapter 5 and Industry Forum assessments.
WAG SDI & AT	No	Yes	No	Still under development during the study
WAG ROI	No	Yes	No	Development and testing during the study
Embeddedness and Sustainable Development Criteria Tool	Yes	No	Yes	Developed late in the study during Chapter 9 and not available for Biosciences and Financial.

Possible Solutions to fill SCVS	Yes	No	Yes	See case studies in Chapters 7, 8 and 9
Catchballs	Yes	No	Yes	During SCV validation with sector experts, for example
Feedback loops to amend policies	Yes	No	Yes	See policy recommendations in Chapter 11

Table 6.9 - Pilot Testing of the Supply Chain Voids Framework (Source: The Author)

Table 6.9 shows that the majority of elements within the framework were tested within the study. Those activities that were not tested were not developed within the study time scales but have been weaved into the framework for future application, based on the new business processes introduced within the WAG. Validation of SCVs against generic strategies was difficult and would be improved by the introduction of specific strategies for each sector, targeting embeddedness and sustainable development objectives. Stakeholders and sector experts were familiar with PESTEL and SWOT analyses. However these and the TOWS took some time to complete but were essential in order to understand what was happening in and outside of the study region and how such factors may affect the application of the framework for specific sectors. Other issues are identified within the case studies at Chapters 7, 8 and 9.

6.4 INTEREST IN THE POSSIBLE APPLICATION OF THE PROPOSED FRAMEWORK – OTHER ORGANISATIONS

During the development of this framework, other RDAs were consulted regarding their views on the study (e.g. Yorkshire Forward, 11 Sep 07; One Northeast, 10 Sep 07) and in one case, Advantage West Midlands (AWM) were interested to review the proposed framework which they thought could be applied in their region to carry out similar roles (Meeting with Manufacturing Advisory Service West Midlands, 30 Jul 08). In addition, Cardiff City Council (CCC) also expressed an interest in the approach in conjunction

with their developing strategy for P & SCM (Meeting between the Lean Enterprise Research Centre (LERC) and CCC 7 Nov 08).

6.5 CONCLUSION AND RELEVANCE TO THE THESIS

This chapter has recorded the rationale for and the development of the proposed framework for use by the WAG, thereby addressing Research Questions 2 and 3 as summarised in Table 6.10.

Research Questions	Potential Framework for WAG Use
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Yes. It could also be used in other WAG contexts e.g. assessing potential FDI opportunities.
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?	Through the application of the embeddedness and sustainable development assessment criteria tool.

Table 6.10 – Summary of the Applicability of the Framework to the Thesis Through the Alignment to Research Questions 2 and 3 (Source: The Author)

Chapters 7, 8 and 9 now detail the case studies for the investigation of SCVs in Wales within three priority sectors.

Chapter 7

Case Study

—

Biosciences

—

'Immediate' Supply Chain Voids

CHAPTER 7 – CASE STUDY – BIOSCIENCES – 'IMMEDIATE' SUPPLY CHAIN VOIDS

7.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter reports the results of the case study into 'immediate' SCVs within the Bioscience sector in Wales. Firstly, the results of the semi-structured interviews are presented, identifying the SCVs uncovered and the perceived lack of local availability. These are then validated with stakeholders before selecting two to investigate further via telephone interviews and analysis, with reference where possible to the framework developed in Chapter 6. PESTEL and SWOT analyses are carried out to link the SCVs to the wider Welsh and external environmental issues prior to TOWS analysis which recommends potential courses of action for Wales. The chapter concludes by aligning the findings to the Research Questions.

7.2 RESULTS OF THE SEMI-STRUCTURED INTERVIEWS – IDENTIFICATION OF 'IMMEDIATE' SUPPLY CHAIN VOIDS

The scope of the case studies is defined in Chapter 6 where Figure 6.3 demonstrates the case study approach across four Stages (i.e. 0 – 3). The following sections report the findings of Stages 1 and 2. Chapter 5 details the methodology used.

Semi-structured interviews were carried with four companies between January and May 2007 to address Research Question 1 and this section reports the findings. Initial questions relate to the companies themselves i.e. size, ownership, etc., followed by those relating to P & SCM and material linkages. To maintain anonymity and confidentiality requirements, each company has been given a pseudonym:

- Anenome
- Buttercup
- Clover
- Daisy

7.2.1 RESULTS OF THE COMPANY DATA ANALYSIS

Companies were interviewed based on their site or office and where they were also the 'HQ' site, they responded in relation to HQ based purchasing responsibilities. All provided data in relation to their entire purchasing budget, or expenditure per annum (p.a.).

The types of companies interviewed and their key markets are summarised in Table 7.1. 'HQ' or 'Branch' identify if the participating company is a headquarters organisation or a 'branch' or 'regional office' of that company. The 'country' shows if the company's HQ is in Wales, RoUK, Europe or elsewhere. This helps to understand where the purchasing decision making occurs.

Company/Type	HQ/Branch	Product/Service	Market	No of Employees	No of Years in Wales
Anemone - Analysis and Manufacture	Branch/RoUK	Medium to large scale manufacture.	Healthcare	50 - 250	Over 15 years
Buttercup - Molecular Design and Manufacture	Branch/RoUK	Small scale design, specialist testing and manufacture in early phases of drug development.	Pharmaceutical companies, Healthcare	50 - 250	Over 15 years
Clover - Research, Development and Manufacture	HQ/Wales	Chemical and analytical development. Drug Formulation. Stability testing. Clinical trials packaging. Manufacture of supplies, logistics and presentation of data to meet requirements of European and US Federal regulators.	Healthcare	50 - 250	Over 15 years
Daisy - Development, Manufacture and Supply	Branch/Europe	Development, manufacture and supply. Medium to large scale manufacture.	Healthcare	50 - 250	Over 15 years

Table 7.1 - Summary of the Sample Companies Interviewed (Source: The Author)

Table 7.1 demonstrates that all companies carry out some form of manufacture, with two also doing development work. Only one of the companies is Welsh owned (Clover) with two others being branch plants from UK owned companies (Anemone, Buttercup) whilst the other is a branch plant of European ownership (Daisy). All have been operating in Wales for over 15 years, although not necessarily under the same trading name. Anemone changed ownership and name in 1999 whilst Buttercup has operated in Wales since 1966 under a number of names and owners. Clover started in England in 1979 and moved to Wales in 1986. Daisy has changed ownership and name in the past four to five years.

Table 7.1 also shows that all four companies employ 50 – 250 FTEs or equivalents:

- Anemone has between 130 and 140
- Buttercup employs 75, half of which are PhD graduates
- Clover has over 200
- Daisy has approximately 230.

The companies are located across Wales with two in the North, one in the West and one in the South. All serve the healthcare sector with Buttercup also providing services to pharmaceutical companies.

Daisy had an annual turnover of less than or equal to £6,750,000 (EU 10m) and the remaining three companies had a turnover of less than or = to £33,750,000 (EU 50m).

Respondents were asked about standards and/or accreditations they have to comply with. All four adhere to UK Medicines and Healthcare products Regulatory Agency (MHRA) whilst Anemone, Buttercup and Clover also comply with the USA Food and Drugs Administration (FDA) regulations. Daisy was working to attain the FDA accreditation for 2008 to expand into the US cosmetics market. Anemone also complies with the EU European Medicine Agency (EMEA) and the DEFRA standards. Buttercup, Clover and Daisy specify compliance with the Good Manufacturing Practice (GMP) standard which is a set of guidelines and rules that all pharmaceutical companies have to comply with, harmonising MHRA and FDA. Buttercup stated that they adhere

with general environmental standards e.g. the Integrated Pollution Prevention Control Permit. Finally, Clover specified compliance with ISO 14001 for quality.

7.2.2 RESULTS OF THE PURCHASING AND SUPPLY CHAIN DATA ANALYSIS

The following information deals with P & SCM and material linkage activities.

Buttercup and Clover report annual purchasing budgets or expenditure of between £1 – 5m. Buttercup's purchases mainly relate to specialist chemicals whereas Clover's largest expenditure allies to comparators (i.e. finished pharmaceutical products) and cold chain packaging and transportation. Anemone has between £5 – 10m although this includes the purchase of capital equipment from the UK and Europe in the last financial year. In addition, another expensive service bought in by Anemone was under review as the company would prefer to buy in Wales, UK or Europe, rather than from the USA. Daisy spends over £10m, 15% of which was spent on specialist consultancy services in support of their pursuit of FDA accreditation. They also invested in capital equipment in the last financial year.

In relation to P & SCM personnel having professional qualifications, Buttercup advised that theirs do not have purchasing qualifications but are highly qualified to degree or PhD level in specialist subjects. Anemone, Clover and Daisy all have people qualified as Member(s) of the Chartered Institute of Purchasing and Supply (MCIPS) awarded by, or being studied for in various institutions including Glamorgan and Liverpool Universities and the distance learning option of the Cheltenham Tutorial College. Anemone also has people qualified in the Institute of Industrial Management Diploma (Swansea) and the Certificate of Production and Inventory Management (Glamorgan).

All companies were asked if their purchasing activity is centralised or de-centralised when all stated that they make on-site decisions, thereby operating as decentralised purchasing, albeit Clover is an HQ, as such.

When asked about who is involved in the purchasing decision making process, Anemone stated that they use their Requisitioning Department, Daisy involves the Purchasing Manager or equivalent and Buttercup and Clover both make such decisions using a multi-disciplinary team approach utilising the expertise of other specialists.

Companies were asked if their suppliers have to comply with standards or accreditations to supply goods or services to them. All suppliers have to comply with MHRA. In addition, suppliers to all except for Daisy must comply with FDA. Suppliers to Anemone must have the EMEA standard and comply with Anemone's 'Approved Supplier Status' programme. All companies except for Anemone require their suppliers to work to the GMP guidelines. Daisy elaborated that it depends on what is being sourced because if an item relates to a GMP approved product, then the supplier must be subject to a postal audit. These suppliers are rated as High/Medium/Low (H/M/L). H or M suppliers have to complete a postal questionnaire and there also may be a facility audit for all H and some M classed companies. If the product or service is non-GMP then this process does not apply. Clover also requires suppliers to comply with the Drug Master File and ISO 9001/2 accreditations, whilst Buttercup requires ISO 9000 2002 and Daisy requires ISO 9001 2000.

When asked if they have a risk assessment policy for overseas suppliers, Anemone, Buttercup and Daisy advised they do. Clover did not answer but stated that commercial risk is assessed to check that suppliers are solvent, for example. They also advised that quality is assessed by their audit facility that looks at the criticality of raw materials. In addition, overseas suppliers are audited by the Quality Assurance (QA) department, depending on the type of raw material supplied and the anticipated volume of purchases.

When asked to specify the key priorities demanded from their supply chain, Anemone listed cost as its top priority, followed by quality. As shown previously, Anemone decides their own on-site purchasing requirements, except for items subject to 'corporate policy' (see Table 7.3 i.e. Consultancy, Legal and Accountancy services), based on these priorities. Buttercup and Clover cited quality as their top priority and delivery (on time and in full) as the second priority. Both make their purchasing

decisions on-site, albeit Clover is an HQ. Daisy stated that both quality and delivery are equally important to them and whilst they make the majority of purchasing decisions on-site, there are developments in group purchasing activities (see Table 7.3 i.e. Laboratory Consumables). Therefore, quality is either priority one or two for all companies, with delivery a close third. Flexibility is seen as third or fourth priority by Buttercup, Clover and Anemone respectively. Local supply is only ranked by one company, Clover in fourth place. They also rate cost in fifth position.

Companies were asked about the number of suppliers they have on their 'supplier database'. Buttercup did not specify a number, Anemone stated that they have approximately 440 and of these, the top 160 are bought from regularly, stating that not all are audited as some may be suppliers of stationary for example, but audits are carried out in suppliers who provide key product content. Clover stated that they have approximately 75 core vendors and Daisy advised that they have 1900, which has been reduced from previous levels and continues to be addressed.

When asked to identify the location (i.e. Wales, RoUK, Europe or Other) of suppliers who are used regularly, the companies advised:

Company	Country	<10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 100	>100
Anemone	Wales					■		
	RoUK							■
	Europe	■						
	Other	■						
Buttercup	Wales	Not stated						
	RoUK							
	Europe							
	Other							
Clover	Wales	■						
	RoUK					■		
	Europe		■					
	Other							
Daisy	Wales					■		
	RoUK							■
	Europe	■						
	Other	■						

Table 7.2 – Locations of Suppliers (Source: The Author)

Detailed results are:

- Anemone stated that Welsh suppliers number between 41 - 50; RoUK over 100, EU less than 10 with less than 10 from other countries. These have been selected on cost, quality, delivery and flexibility.
- Buttercup did not provide any details.
- Clover advised that less than ten are in Wales, 41 – 50 are in the RoUK and 11 – 20 are in Europe, based on the supply chain priorities of quality, delivery, flexibility, local and cost.
- Daisy reported that suppliers in Wales number 41 - 50 (50), with less than ten (7) in Europe, less than ten (5) in other countries and the remainder, over 100, are in the RoUK. Daisy selects these based on the supply chain priorities of quality and delivery, which are of equal importance.

In summary, the majority of purchases are from the RoUK, followed by Wales, Europe and finally, other countries which can be cross-referred to Appendix A where the Input-Output Tables identified that 35% was bought from the RoUK, 33% from Wales and 32% from elsewhere.

When asked if they are concerned about sourcing items locally to reduce logistics costs or environmental impacts, Anemone replied that quality is the primary issue and transportation costs feature little in their considerations as they have to spend a lot on transportation owing to the lack of capability in Wales, RoUK or Europe for e.g. 'freeze drying'. Buttercup reported that although logistics costs are very small, local or European suppliers would be better because of the duty/taxes incurred when buying from elsewhere. Clover said that transportation costs are a major issue for them at £0.5m p.a. and rising. Clover does consider 'local' suppliers as a priority from their supply chain, albeit at priority four.

With reference to environmental impacts, Anemone stated that as they have to transport key material around the world and there is no other option to this at present. The other three companies were troubled about environmental impacts but Buttercup was more worried about the net overall cost as they operate in an international market where

competitiveness is important. Daisy stated that the company had an environmental policy to improve recycling.

When asked if there were any comments the companies would like to make about the research project, three responded positively. Anemone believed that the research could be beneficial to them if companies with certain capabilities could be identified (i.e. freeze drying). They also highlighted that general infrastructure issues such as the vagaries of the utilities supplies (i.e. only a stand-by generator on site) are a problem in their area of Wales. Clover thought that the research had practical benefits and Daisy said it is a good idea to support local, Welsh suppliers. Buttercup had no comments to make.

A supplementary question was added over the timescale of the interviews and where companies had already been interviewed, this question was asked as a follow-up to the interviews, via e-mail or telephone call. It was added owing to the type of data being collected, as a popular theme across two sectors was being identified. Companies were asked if they have Disaster Recovery contracts and responses have been included and highlighted in Table 7.3.

Anemone stated that they do have a Disaster Recovery contract. It has existed for a couple of years and the service covers their three UK sites. The full details of the contract are not known but it is believed it gives access to hardware for a period of time and a mobile server room. A trial re-store is carried out at the provider's site once a year. Annual cost is somewhere between £6,000 and £6,500. Buttercup and Clover did not respond. Daisy has nothing in place at present but the subject is under discussion between their Information Technology (IT) and Security departments.

7.2.3 IDENTIFICATION OF HIGH AND LOW-VALUE 'IMMEDIATE' SUPPLY CHAIN VOIDS

To discover 'immediate' SCVs, companies were asked to identify by value p.a. (£), the top ten products and/or services bought from outside of Wales, which companies and locations are they bought from and why? A prepared form was completed during the

interviews, or data were provided by individual companies, which were subsequently put into the format by the author and agreed with the interviewees. A total of 44 SCVs were reported. Other voids identified but not quantified include a fermentation facility and a 'catalogue company' that provides general chemicals to universities and companies for laboratory-scale projects. In general, infrastructure weaknesses were identified e.g. utilities, telecommunications and transportation links.

On analysing and grouping the SCVs and aggregating the values in £ spent by individual companies, the results have been summarised in Table 7.3 where Disaster Recovery is highlighted in yellow as it has commonality with Financial SCVs.

Product/Service Description	Country/Location of Supply	Reason(s) why bought from outside Wales (See below)	Total Value in £ p.a.
Capital Equipment e.g. Bio process rigs – specialist equipment where entry costs are high	RoUK/Europe	No Supplier	Varies £2m - £5m
Contract Manufacture e.g. freeze drying of product	USA	No Supplier	Approx £1.4m
(Manufacturing) Process Chemicals	RoUK/Europe	No Supplier	Approx £850K
Sterile Bags	RoUK/Europe	No Supplier	Approx £400K
Filters e.g. highly specialised viral filters	RoUK/Japan	No Supplier	Approx £350K
Contract Testing e.g. specialist capability for testing (potency) of products and raw materials	RoUK/Europe (Ireland)	No Supplier	Approx £1.250m
Consultancy e.g. Regulatory advice	RoUK	Corporate Policy/No Supplier in Wales	Over £1.5m
Legal Services	RoUK	Corporate Policy	Varies
Accounting Services	RoUK	Corporate Policy	Approx £40K
Equipment Maintenance, Spares, Machine Parts	RoUK/England/ Italy	No Supplier/Technical Competence	Approx £420K
Insurance	RoUK	Corporate Policy	Approx £340K

Disaster Recovery/access to hardware and mobile server room	RoUK	No Supplier	Approx £6,000 to £6,500
Specialist Chemicals/Raw Materials	Various/USA, Belgium	Not available/highly specialist chemicals	£1,714,539
Comparators (Finished Pharmaceutical Products contained within e.g. a branded cold sore product. Companies use different 'compounds' to do the same job. (Such expenditure will increase as the company's growth strategy is implemented).	RoUK/England	No supplier in Wales	£500,000 to £1,200,000
Cold Chain Transport/Shippers	RoUK/England	----------"---------- -	£620,000
Electricity	RoUK/England	Too expensive	£150,000
Lab Chemicals	RoUK/England	No supplier in Wales	£150,000
Gas	RoUK/England	Too expensive	£70,000
Special Waste Disposal	RoUK/England	No supplier in Wales	£51,000
Cold Chain Packaging	RoUK/England	----------"---------- -	£25,000
Validation Services	RoUK/England	----------"---------- -	£21,000
Telephone Charges	RoUK/England	No supplier in Wales	£13,000
Closures and Seals (for Vials)	RoUK Agent – manufactured in France	Specialist products – No local availability	£400k
Vials (glass bottles)	RoUK Agent – manufactured in Switzerland	--------- " ----------	£400k
Packaging (cartons labels, leaflets)	RoUK	--------- " ----------	£200k
Laboratory Consumables. (This is part of the global deal made by the company – covering 5 sites in the Group)	RoUK	--------- " ----------	£100k

Table 7.3 – High-Value Supply Chain Voids Identified During the Semi-Structured Interviews with Bioscience Companies in Wales (Source: The Author)

The total value of these aggregated, 'immediate' high-value SCVs is approximately £16.672m p.a.

Of the 26 aggregated SCVs:

- 16 are single sourced in the RoUK;
- seven are dual sourced in the RoUK and Europe;
- one is single sourced from the 'other' category i.e. USA;
- one is dual sourced in the RoUK and other;
- one is dual sourced in Europe and other.

This aligns to the responses to the previous question and Input-Output data which indicate that the majority of purchases within this sector are made in the RoUK, followed by Wales, Europe and other countries. Companies were unwilling to name specific suppliers in the majority of cases.

The reasons given for these products and services not being sourced within Wales vary. Of the 26 SCVs:

- 17 are sourced elsewhere as there is believed to be no supplier or availability in Wales, for example capital equipment, contract manufacture and contract testing;
- three are subject to corporate policy from a company's HQ e.g. insurance, legal and accounting services;
- two are cited as 'specialist' requirements with no supplier or local availability e.g. chemicals and closures or seals for vials;
- two are believed to be too expensive in Wales e.g. utilities;
- one is understood to be subject to corporate policy and there is no supplier;
- one is believed to have no supplier in Wales and it is for a technical competence that does not reside within Wales e.g. equipment maintenance, spares and machine parts.

The top five 'immediate' high-value SCVs for this sector are shown in Table 7.4 and were derived following the aggregation of those voids identified for the same product or service by individual companies.

Product/Service Description	Supplier Country/Location	Total Value in £ p.a.
Capital Equipment e.g. Bio process rigs – specialist equipment	RoUK/Europe	Varies £2m - £5m
Specialist Chemicals/Raw Materials (Miscellaneous)	Misc	£1.725m
Consultancy Services (Regulatory advice, to achieve FDA accreditation etc)	RoUK	Over £1.5m
Contract Manufacture e.g. freeze drying	USA	Approx £1.4m
Contract Testing Houses	RoUK/Europe (RoI)	Approx £1.25m

Table 7.4 - The Aggregated Top Five High-Value 'Immediate' Supply Chain Voids Identified During the Semi-Structured Interviews with Bioscience Companies in Wales (Source: The Author)

These top five SCVs are only based on the data from the four companies interviewed. However, as the values are significant, these requirements may be reflected within the wider sector in Wales.

Further to the identification of specific SCVs, companies were asked if a supplier or service provider was available in Wales, would they consider using them. All four companies said that they would, even though only Clover cited 'local' as a priority from their supply chain, albeit priority four. Buttercup, Clover and Daisy stated that the caveat would be that e.g. quality, cost and service levels would have to be achieved. Daisy also mentioned that if the requirement was for a non-GMP product, then there would be no problems. However, if it was for a GMP product, which is extremely well regulated, once a supplier is found and approved, then generally the company would stick with them as it is costly to search and contract with other companies for GMP products.

As a catch all question, companies were asked if there are any other products or services that they buy from outside of Wales, that are not high-value and they would prefer to buy locally. Anemone and Daisy identified requirements as shown in Table 7.5. Buttercup did not highlight specifics but clarified that they have three types of purchases as shown in Table 7.6.

Product/Service Description	**Country/ Location**	**Reason(s) why bought from outside Wales**	**Total Value in £ p.a.**
Equipment Maintenance & Spares of capital equipment e.g. bearings, electrical spares, building maintenance, calibration.	N/K	No local supplier	N/K
General Consumables e.g. PPE – personal protection equipment required for health and safety (H & S). (Local suppliers being sought).	N/K	No local supplier	N/K
Detergent – Decphene (for cleaning the plant) – specified in the Product Licence. (This is not allowed to be transported by air and therefore comes by sea).	USA	Specialised – no local supplier available	£39k

Table 7.5 – Low-Value 'Immediate' Supply Chain Voids Identified During the Semi-Structured Interviews with Bioscience Companies in Wales (Source: The Author)

Buttercup Requirements	**E.g. Types of Purchases**	**Bought from**
General	Stationary, furniture	Local suppliers
Commodity	Engineering items, maintenance and repairs, basic chemicals	Wales
High-value	Speciality chemicals (See Table 8.3)	Outside Wales i.e. RoUK, Europe, Other

Table 7.6 - Three Types of Purchases Made by Buttercup (Source: The Author)

In summary of this section, the 'immediate' SCVs identified have been assigned reasons or perceptions, by the respondents, as to why they believe they exist in Wales, addressing the first Research Question. Other 'immediate' SCVs are identified for the Financial sector in Chapter 8 and 'potential' SCVs for Unmanned Systems in Chapter 9.

7.3 THE SUPPLY CHAIN VOIDS VALIDATION AND SELECTION PROCESS

The 'immediate', high-value SCVs identified in Table 7.3 are varied and required validation with stakeholders to agree one or two samples to investigate further and to aid development and testing of the framework in Chapter 6. Figure 6.5 details the validation and selection process determined by the 'success criteria' detailed in Section 6.3.1 relating to alignment with WAG strategies and policies.

The validation assessment was carried out on 13 Jun 2007 with WAG Department for the Economy & Transport (DE & T), WAG International Business Wales (IBW) and the MediWales Industry Forum sector experts. Whilst all 26 of the 'immediate', high-value SCVs were reviewed during the meeting, it was agreed that they should be prioritised by value (£). Therefore, the top five SCVs summarised in Table 7.4 were assessed against the 'success criteria', the results of which are displayed in Table 7.7.

Supporting WAG Strategies/Policies/Plans etc	Key Elements of WAG Strategies etc.	Capital Equipment (Y/N)	Specialist Chemicals (Y/N)	Consultancy Services (Y/N)	Freeze Drying (Y/N)	Contract Testing (Y/N)
One Wales **(WAG, 2007)**	Economy, number and quality of jobs, skills enhancement, communities, transport, sustainable development	Possibly	N	Y	Y	Y
IBW Operations Plan **(WAG IBW, 2007)**	Bioscience sector-based priorities including medical technologies, invitro diagnostics, analysis technologies.	Possibly	N	Y	N (but meeting held 13 Jun 07 agreed Y)	Y
Environment Strategy for Wales **(WAG, 2006)**	Sustainable development, use of resources, environmental hazards e.g. chemicals. Underpins other strategies e.g. *Wales: A Vibrant Economy.*	Possibly	N	Y	Y	Y
Wales: A Vibrant Economy **(WAG, 2005)**	Sector-based priorities, increase number and quality of jobs	Possibly	Possibly	Y	Y	Y
Spatial Plan (WAG, 2004)	Sustainable development of the economy and environment, university expertise e.g. Cardiff.	Possibly	N	Y	Y	Y

***Sustainable Development Action Plan* (WAG, 2004)**	Economic, environmental and social aspects. Focuses on e.g. energy, sustainable development of production of goods and services, minimising the effect on people and the environment, quality jobs, entrepreneurship and innovation, R & D. Tougher assessments of projects for land use etc.	Possibly	N	Y	Y	Y
***WDA Business Plan 2005 – 2008* (WDA, 2004)**	Sector-based priorities. Emphasis on R & D, innovation and entrepreneurship. Improved ICT systems and infrastructure. Supply chains and networks.	Possibly	N	Y	Y	Y
***Future Technologies* (WDA, 2004)**	Technologies in e.g. Biosciences and healthcare.	Possibly	Possibly	Possibly	Possibly	Possibly
***Wales: A Better Country* (WAG, 2003)**	High-value and quality jobs, skills, Knowledge Bank focus on high growth businesses, broadband, infrastructure, business support, tough public assessments for new developments, minimum environmental impact.	Possibly	N	Y	Y	Y

Wales for Innovation **(WAG, 2003)**	High-value jobs and growth sectors (e.g. Biosciences) and businesses, developing, exploiting and commercialising output from universities, colleges, integrating industry and universities, roll-out of Techniums, skills development and R & D.	Possibly	N	Y	Y	Y
A Winning Wales **(WAG, 2002)**	High-value jobs and skills, infrastructure and transport, R & D, Techniums, innovation, business friendly environment, ICT, sustainable development.	Possibly	N	Y	Y	Y

Table 7.7 - The Success Criteria Assessment of the Top Five Supply Chain Voids for Bioscience Companies in Wales (Source: The Author)

Table 7.7 shows the success criteria assessment, based on the WAG strategies, policies or objectives. In the absence of a sector strategy, these are the existing reference points. The assessment is based on the comparison of each SCV against the key elements of the WAG document and if that appears to support the activities associated with the SCV, it is allocated 'Y' as being supported. Where there is an 'N', development of such a capability in Wales for e.g. specialist chemicals is not supported. Where 'N/A' has been recorded, there is no suitable reference relating to the type of SCV (i.e. technology, manufacturing, skills, etc.) therefore no assessment can be made. Similarly, where 'Possibly' has been used, it depends upon the type of SCV.

A more detailed assessment could have been possible if a sector strategy existed. Also, if the potential embeddedness/sustainable development assessment criteria tool had been available, this may have refined the selection process. Therefore, in this study there is a general assessment carried out in conjunction with WAG sector experts.

Table 7.7 shows that Capital Equipment is possibly supported by all strategies and policies but further details of specific equipment, for example, would need to be identified. Consultancy Services, Freeze Drying and Contract Testing are all well supported and whilst the IBW Operations Plan (2007) does not specify Freeze Drying in its priorities, the department was keen to have it researched in this study.

Specialist Chemicals are not supported by the majority of strategies. *Wales: A Better Country* (WAG, 2003) identifies that there should be tougher public health assessments for new developments in relation to countryside, planning and the environment. The 'Sustainable Development Action Plan' (WAG, 2004) also states that tougher public health assessments are to be introduced for new land use developments (p 11). Therefore, these could preclude chemicals because of potential impacts on public health. WAG (2004) also states that international commitments have been made to minimise the adverse effects of chemicals on human health and the environment by 2020 (p 4). Therefore, these may have prompted DE & T and IBW representatives to preclude the further investigation of chemicals.

A simple environmental assessment considers the opportunity to reduce transportation mileage, where appropriate to products, not services, as shown in Table 7.8. This demonstrates that supply chains could be reduced for four of the five SCVs.

Top Five 'Immediate' High-Value SCVs	Current Source of Supply	Reduce Transportation (Y/N)
Capital Equipment	RoUK/Europe	Y
Specialist Chemicals/Raw Materials	Misc	Y
Consultancy Services	RoUK	N
Freeze Drying	USA	Y
Contract Testing Houses	RoUK/Europe (RoI)	Y

Table 7.8 – A Simple Environmental Assessment of the Top Five 'Immediate' High-Value Supply Chain Voids (Source: The Author)

Item five on the agenda for 13 Jun 2007 asked if the WAG departments had a list of SCV type priorities that they were already pursuing. Representatives advised that they did not. However, by March 2008, IBW produced a summary of opportunities being pursued for inward investment or support to indigenous companies. An assessment of these would not necessarily align to existing WAG strategies.

7.3.1 SELECTION OF CASE STUDY SUPPLY CHAIN VOIDS

A purposive sample of one or two SCVs was required to aid framework development and testing, where possible. Based on the value of the top five high-value SCVs identified in Table 7.4 and the success criteria assessment, the two SCVs to be investigated further are Freeze Drying and Contract Testing. Coincidently, in discussions with stakeholders, it became apparent that these SCVs were already of interest to the WAG DE & T, IBW sector teams and MediWales. The SCVs research was seen to complement and add value to their activities.

The semi-structured interviews identified a total £1.4m p.a. for Freeze Drying services being bought from the USA by one company, Anemone, as shown in a simplified supply chain for their product in Figure 7.1. However, sector advisors from WAG

stated that there is a broader gap in capability, not only for Wales but for the RoI, RoUK and Europe (13 Jun 2007). The PESTEL and SWOT analyses reflect this.

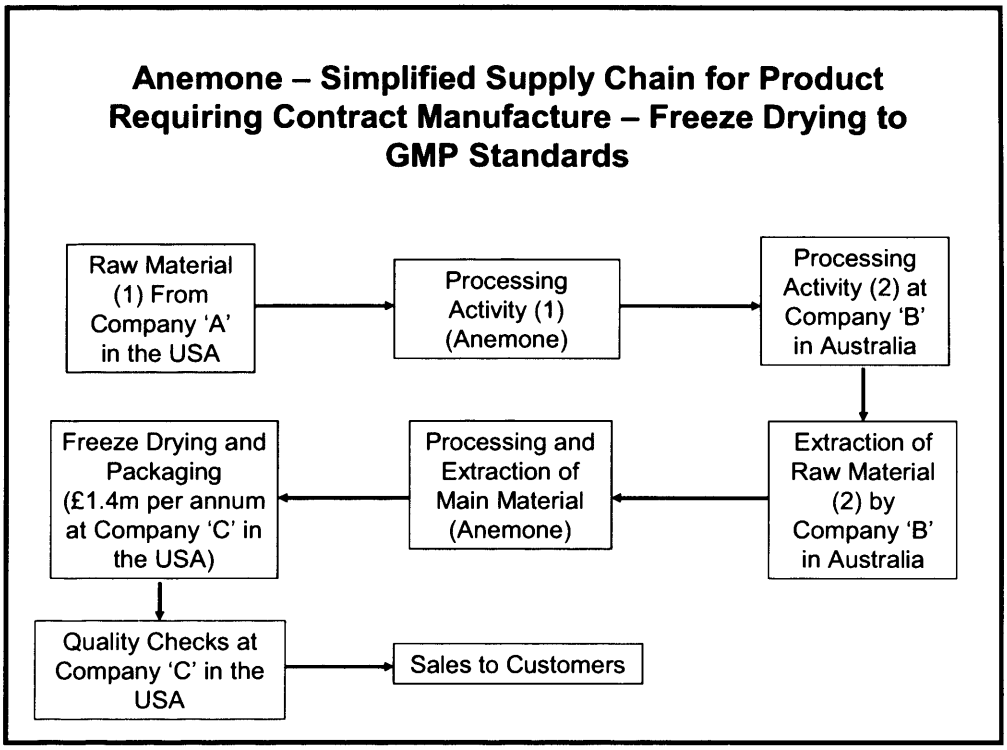


Figure 7.1 - Anemone's Simplified Supply Chain for Freeze Drying (Source: The Author)

The supply chain identified for Contract Testing is identified at Figure 7.2.

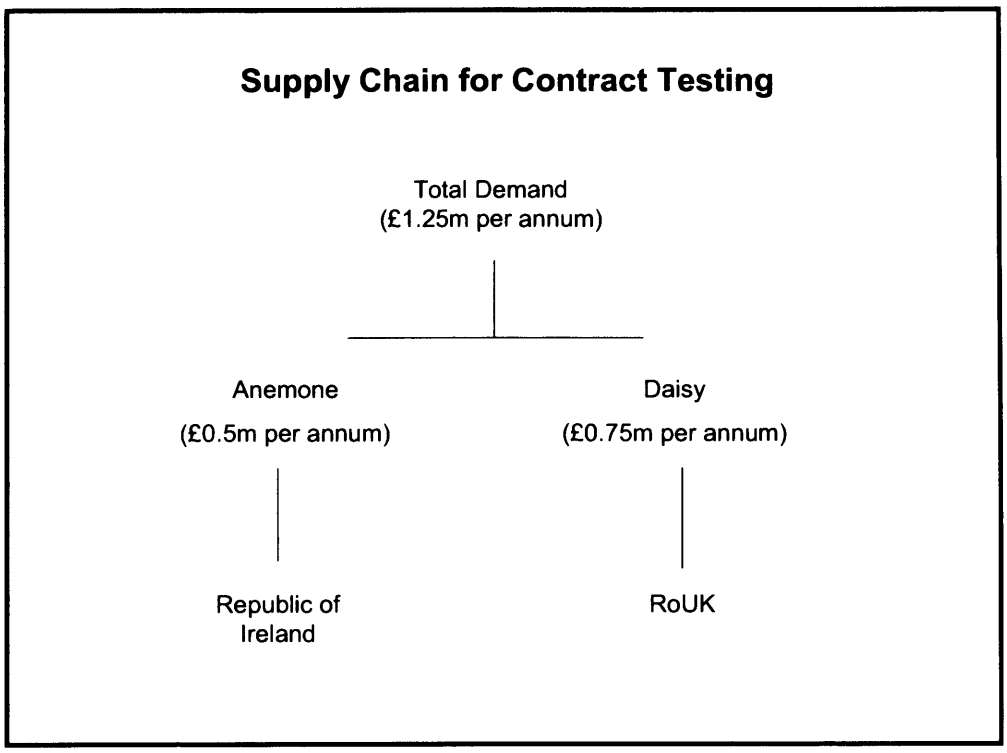


Figure 7.2 - The Supply Chain for Contract Testing (Source: The Author)

The other 'immediate' high-value SCVs were eliminated based on Table 7.7, for the following reasons:

- Whilst some strategic alignment exists in support of Capital Equipment in the Bioscience sector, it is difficult to classify as it is contingent upon the technology, processes, skills required to operate, for example and is often specific to a single company, its operations and products. It was therefore agreed that this would be difficult to investigate because of asset specificity issues.
- Specialist Chemicals and similar raw materials are highly hazardous and the WAG strategies no longer appear to support the environmentally challenging activities used to manufacture and store such materials. It goes against the Government's environmental strategies and is therefore excluded from this study.
- Consultancy Services in support of gaining specialist accreditations such as FDA, for example, could equally have been investigated as those chosen above (i.e. Freeze Drying and Contract Testing). Such jobs and skills would be of high-value and welcomed within Wales. However, it was agreed with

supervisors (18 Jul 07), that as two services were being investigated in the Financial sector that this service could be eliminated from further research to maintain the variety of the purposive sample.

7.4 REGIONAL ECONOMIC DEVELOPMENT OPPORTUNITIES FOR THE BIOSCIENCE SECTOR – PESTEL, SWOT AND TOWS ANALYSES

This section reports the outcome of macro and micro level environmental analyses for the Bioscience sector in Wales and the specific SCVs under investigation within this chapter. Section 6.3.1 defines PESTEL, SWOT and TOWS analyses which were carried out concurrently with the face to face and tele-interviews.

7.4.1 PESTEL ANALYSIS

A comprehensive PESTEL analysis was carried out to identify sector level environmental factors for the global Bioscience sector whilst helping to improve the author's knowledge of the sector. The full PESTEL was refined based on the sector priorities identified by WAG (Meeting Williams, 23 May 08) which are:

- The aging population
- Preventative medicine
- Earlier diagnostics and treatment and
- The changing business model or structure in the Bioscience industry

The refined PESTEL analysis is shown at Appendix N based on these sector priorities, which are codified and highlighted showing 41 factors:

- Political has two issues: one relates to early diagnosis and treatments and the other to the aging population.
- Economic lists the most issues totalling 23: Sixteen are relevant to the changing business model for the sector, four to early diagnosis and treatment, two to the aging population and changing business model and one to the preventative, diagnostic and treatment grouping.

- Social records seven issues: four relate to the aging population and three to early diagnosis and treatment.
- Technology registers six issues: four are allied to the changing business model and two to early diagnosis and treatment.
- Environmental has no issues directly relating to the WAG priorities.
- Legal shows three issues: two are aligned to the changing business model whilst one links to prevention, diagnosis and treatment.

The changing business model dominates the prioritised PESTEL for this sector, particularly for economic factors, followed some way behind by the need for early diagnosis and treatment and the other issues.

7.4.2 **SWOT ANALYSIS**

Comprehensive SWOT analyses were carried out in relation to the Bioscience sector and the specific SCVs under investigation and like the PESTEL, this was refined based on the WAG priorities above, the results of which are summarised at Appendix O.

The prioritised SWOT reflects the PESTEL in its domination by factors relating to the changing business model and structure of the sector with 37 factors in total consisting of eight strengths, three weaknesses, 12 opportunities and 14 threats. Earlier diagnostics and treatments register five factors with three strengths, one weakness and one opportunity. Preventative medicines, diagnostics and treatments total seven factors with one weakness, two opportunities and four threats. Finally, the aging population only registers one factor as an opportunity.

SWOT analyses for the specific SCVs under investigation were developed based on the sector PESTEL and SWOT and the evidence gathered in the semi-structured interviews, to assess if they really exist and to identify possible opportunities to address them. Comprehensive SWOTs for Freeze Drying and Contract Testing were refined and used to generate the TOWS.

There are many similarities recorded within the SWOTs for both SCVs. However, specifics to Freeze Drying include the asset specificity issue whilst particular factors for Contract Testing include weaknesses such as little connectivity to higher education, a lack of cost competitiveness and 'research' type companies.

7.4.3 **TOWS ANALYSIS**

To assess the opportunities and recommend possible approaches to address SCVs in Wales, detailed TOWS analyses were also carried out and the results of these are shown in Table 7.9 for the Bioscience sector, Table 7.10 for Freeze Drying and Table 7.11 for Contract Testing.

		Internal Factors	
		Strengths	***Weaknesses***
		• Increased job numbers in Bioscience sub-sector 'Infrastructure' in the UK.	• Low cost competition
		• Land and property costs, loyal workforce, highly skilled labour, lower labour costs and public sector funding.	• Slower growth in pharmaceuticals.
		• Recruitment of staff from Welsh universities.	• Labour shortages for GMP trained/skilled staff in support of Diagnostic Technologies.
		• Medical Technologies are the strongest Bioscience sub sector.	• Erosion of profits owing to drugs going off patent with cheaper generics taking market share and marked reduction in new drugs being approved for sale, pressure from purchasers e.g. NHS to reduce costs.
		• Strong In-vitro diagnostics and drug discovery sub-sectors.	• Job cuts in large pharmaceutical companies owing industry restructuring.
		• Leading manufacturer of assays.	• A lack of 'research phase' companies.
		• Strong regional network of Bioscience companies in South Wales.	• Lack of fermentation capability.
		• Systems Biology - academic expertise at the Cardiff Gene Park, Swansea University Institute of Life Sciences, Boots Centre for Innovation, Cardiff University School of Bioscience, University of Wales, Bangor plus GE Healthcare.	
		• Bioscience Techniums, Business Parks, Bangor Bioincu, Cardiff Business & Technology Centre, Cardiff Medicentre.	
		• Medical devices.	
	Opportunities	***(SO) Strategic Options***	***(WO) Strategic Options***
	• Increased use of Freeze Drying and Contract Testing.	WAG to identify and pursue 'vital few'	
	• Cluster development for CROs.		

	• Invitro Diagnostics collaboration or inward investment opportunities.		Labour shortages and a lack of skills could reduce opportunities in the diagnostics sub-sector. Hence, education and training and development needs to be addressed.
	• Systems Biology inward collaboration or inward investment opportunities.		
	• Increased connectivity to higher education establishments and graduates.	WAG to develop 'triple helix' type activities between NHS carve-outs, SMEs, universities and Techniums.	
	• Improved links with NHS carve-outs and high tech SMEs.		
	Threats	***(ST) Strategic Options***	***(WT) Strategic Options***
	• Competition from other Bioscience regions in UK, EU and Asia.	WAG need to emphasise strengths in e.g. skills, incentives, property, universities, Boots, Techniums etc. to compete with other Bio regions in the RoUK and elsewhere.	The challenges facing the pharmaceutical sector could continue owing to competition from low cost countries and Bioscience regions and the lack of investment resulting from the credit crunch. WAG should review its priorities to see if pharmaceuticals should be included/increased or removed
	• Favourable corporate tax offerings from e.g. RoI and Singapore encourage major Bio companies to locate there.		
	• Takeovers in the Bio sector in Wales now dominant.	Credit crunch may help inward investors or merger and acquisition companies to better target collaborations with assay, genomics, genetics, medical technologies etc.	
	• Asian companies from e.g. India looking to enter EU market via acquisition of small biotech companies with established EU/USA drug development/supply accreditations.		
	• M & A and consolidation of cross-border activity between Bio companies.		
	• Asian companies entering the UK and EU market via acquisition. (Possible loss of Welsh HQs)		
	• Challenges raising finance to support growth.		The lack of a fermentation facility in Wales (and the RoUK) and competition from other Bio regions and low cost
	• Venture capital in short supply to		

The TOWS analysis for the Welsh Bioscience sector shows that by applying strengths to opportunities, WAG need to identify and pursue a 'vital few' priorities that help to develop targeted CRO and CMO, whether through the development of indigenous companies or by inward investment. Similarly, WAG may need to identify and pursue a few priorities that support the development of companies, products or services that can meet the increasing demand of the aging population in Wales and the UK e.g. diagnostics, drugs etc. In addition, WAG could identify and pursue those few priorities that target investment on novel IP requiring collaboration, making use of equipment and skills of Welsh Techniums, universities and their graduates. WAG also need to develop and match skills to those priorities that help to attract inward investment and collaborate with Techniums and universities and employ graduates. Finally, WAG could develop 'triple helix' type activities between NHS carve-outs, SMEs, universities and Techniums.

Wales appear to be supporting CRO, CMO, genomics, diagnostics, medical technologies, systems biology plus wound management and stem cell research as shown in the PESTEL. These seem varied and may require a review to prioritise those 'vital few' that Wales should support.

By applying weaknesses and opportunities, the lack of a fermentation facility in Wales (and the UK) could undermine CRO and CMO development in Wales. Whilst the manufacture of generics could help to support the aging population in Wales and the UK, competition from low cost countries could reduce such opportunities. Therefore, WAG should emphasise differentiators e.g. incentives and property where relevant. Attraction of venture capitalists could help with the development of research based companies in Wales. However, low cost competition and threats resulting from the credit crunch may prevent such investment. Labour shortages and a lack of GMP skills could reduce opportunities in the diagnostics sub-sector. Therefore, the WAG must improve education and skills development in this area.

Further analysis relating to strengths and threats shows that WAG need to emphasise strengths in e.g. skills, incentives, property, universities, the Boots Centre for Innovation, Techniums etc. to compete with other Bioscience regions in the UK and

elsewhere. Also, the credit crunch may help inward investors or M & A seeking companies better to target collaborations with assay, genomics, genetics, medical technologies etc. in Wales. Collaboration with universities, Techniums, Boots etc. may help companies (indigenous an inward investors) to ameliorate such threats as R & D timescales, high costs etc. Further growth or development within the various WAG priorities may be impacted owing to a lack of skills in certain areas e.g. CRO, CMO and drug development.

Finally, on applying weaknesses and threats, the concerns resulting from the weaknesses and opportunities analysis are reinforced. The challenges affecting the pharmaceutical sector could continue owing to competition from low cost countries and other Bioscience regions and the lack of investment resulting from the credit crunch. Also, the erosion of profits and the increase of generics may push pharmaceutical manufacturing companies to low cost countries. Therefore, the WAG should review the priority of pharmaceuticals. The lack of a fermentation facility in Wales (and the RoUK) and competition from other Bioscience regions and low cost countries could also undermine for example, CRO and CMO development in Wales. Hence, the WAG should investigate this SCV as a priority.

In summary, better prioritisation of WAG objectives and alignment of skills development is important as multiple objectives and activities appear to be supported at present. Certainly more collaboration between e.g. Techniums, universities, NHS carve-outs and SMEs could help with knowledge development and sharing in Wales, for those priorities that WAG support. The lack of a fermentation facility in Wales and the UK may impact certain sub-sectors and this would need to be investigated further as competing regions may have such facilities e.g. Sigma Aldrich in Israel and Putra University in Malaysia. Labour and skills shortages, particularly in the diagnostics sub-sector, need to be addressed, if it remains a priority for WAG. The credit crunch is now biting and impeding M & As and venture capital investments, for example. Therefore companies looking to invest may be assisted by WAG through better targeting of those companies and spin-outs that may benefit the economy more. Any Welsh companies acquired by larger multinationals could lose HQ status but if the collaborative opportunities outweigh such a threat, this could be better in the current economic

climate. The biggest opportunities appear to be in the refinement of WAG priorities and the largest weaknesses and threats are from low cost competitors and the credit crunch.

To counter weaknesses and threats, WAG must emphasise the differentiators on offer including skills where strong, property, incentives and the variety of collaborative opportunities.

		Internal Factors	
		Strengths	***Weaknesses***
		• Net gains in the number of jobs in the Bio sub-sector 'Infrastructure' (e.g. Freeze Drying & Contract Testing) over the past 3 years.	• Some Freeze Drying is subject to specific products/licences so capabilities in companies cannot necessarily be used for other products.
			• Limited market demand in Wales for Freeze Drying - 1 company - £1.4m p.a. for GMP standard.
			• Market not in Wales but in RoUK, EU, North America, Australia and Japan.
			• No Welsh suppliers used by 2 companies with identified demand/possible demand (Suppliers in USA/Glasgow)
ors	***Opportunities***	***(SO) Strategic Options***	***(WO) Stratetgic Options***
	• Daffodil may introduce Freeze Drying capabilities in 18 months to 2 years (from Dec 07)	Build upon recent growth in the CRO and CMO sub sector. Realistically focus on inward investment because of incentives. However, diversification of an existing company (Welsh, UK or other ownership) may be an option.	Any inward investment would need to service broader markets for 'general' GMP Freeze Drying. Products requiring asset specific Freeze Drying can only be addressed on a case by case basis and may be cost prohibitive for WAG to support.
	• Potential additional demand £120k p.a. (but a Scottish supplier quoted).		
	• Demand for Freeze Drying is increasing owing to the trend in drug development, from small chemical entities to larger biological entities. This affects both drug development and diagnostic sub sectors.		
	• Opportunities for CROs and CMOs owing to industry restructuring. (Inward investment, diversification or start-up?)		
	• Market growth opportunities for CROs.		
	• As profit margins for CROs are smaller than major Biotechs and operating costs are more important, Wales may have a		

The TOWS analysis for Freeze Drying shows that by applying strengths to opportunities, Wales could build upon recent growth in the CRO and CMO sub sector, optimising the restructuring underway in the industry. However, WAG need to realistically focus on inward investment because of incentives and benefits perceived by foreign companies. Also, diversification of an existing company, whether Welsh, RoUK or internationally owned may be an option.

By applying weaknesses and opportunities, it becomes clear that Wales has significant problems relating to a limited internal market and asset specificity factors for Freeze Drying. Any inward investment would need to service broader markets for 'general' GMP Freeze Drying. Products requiring asset specific Freeze Drying can only be addressed on a case by case basis and may be cost prohibitive for WAG to support.

Further analysis relating to strengths and threats shows that any gains in job numbers realised in recent years may erode owing to low cost competition, hence WAG need to emphasise differentiators such as skills, property and grants. Conversely, any continued growth in the 'infrastructure' sub sector should lead to increased demand for education, training and development to improve skills. Hence, the WAG and DCELLS need to build capability and capacity into their planning.

Finally, on applying weaknesses and threats, the concerns resulting from the weaknesses and opportunities analysis are reinforced. Asset specificity reduces options for specialised GMP Freeze Drying. WAG need to understand where SCVs can be identified and filled, meeting a broader market demand, which may be in 'general' Freeze Drying. Continued focus on specialised services may not be viable for WAG when considering possible developments in low cost competition for such services.

In summary, whilst Freeze Drying was supported by WAG strategies and experts for investigation in this case study, the realities of the SWOT and resulting TOWS analyses show that there are significant realities in Wales which preclude the development of asset specific Freeze Drying capabilities, but a possibility may exist for general capabilities.

		Internal Factors	
		Strengths	***Weaknesses***
		• Net gains in the number of jobs in the Bio sub-sector 'Infrastructure' (e.g. Freeze Drying & Contract Testing) over the past 3 years.	• Limited market demand in Wales for Contract Testing - 8 companies £1.359m p.a.
			• Market not in Wales but in RoUK, Europe, North America, Australia and Japan
			• Limited capabilities exist in Wales but no Welsh suppliers used by 8 companies who responded during interviews with specific demand (Suppliers in UK/RoI)
			• Some concern that Welsh services may be too expensive - £56k p.a. lost on this basis.
			• Insufficient connectivity to higher education establishments and graduates in Wales
			• A lack of 'research phase' companies in Wales who can test if molecules stop enzymes working on the target cell/organ etc.
tors	***Opportunities***	***(SO) Strategic Options***	***(WO) Strategic Options***
	• Daffodil may introduce contract testing capabilities in 18 months to 2 years (from Dec 07)	May be opportunities for diversification.	NHS labs, higher education facilities or small number of Welsh companies may be able to meet local demand, if supply chain priorities of customers are competitive i.e. cost and time scales.
	• Small scale opportunities may exist in NHS labs (but customer timescales may be compromised)		
	• The need to attract additional CROs to build critical mass/cluster development.	Build upon recent growth in the CRO and CMO sub sector. Realistically focus on inward investment because of incentives. However, diversification of an existing company may be a good option as 1	Any inward investment would need to compete with e.g. RoI who offers better tax rates and would need to service broader
	• Demand for contract testing is increasing owing to the trend in drug development, from small chemical entities to larger biological entities. This affects both drug development and diagnostic sub sectors.		
	• Opportunities for CROs and CMOs owing to industry restructuring. (Inward		

The TOWS analysis for Contract Testing shows that by applying strengths to opportunities, Wales could build upon recent growth in the CRO and CMO sub sector, as with Freeze Drying. Also, diversification of an existing company (Daffodil) may be an option.

By applying weaknesses and opportunities, it becomes clear that Wales has significant problems relating to a limited internal market, as with Freeze Drying. Any inward investment would need to service broader markets and compete with e.g. RoI which offers better tax rates. In addition, NHS labs, higher education facilities or the small number of Welsh companies identified during the tele-interviews may be able to meet local demand, if supply chain priorities of customers are met i.e. cost and time scales.

As with Freeze Drying, further analysis relating to strengths and threats for Contract Testing shows that any gains in job numbers realised in recent years may erode, hence WAG need to emphasise differentiators when competing with other Bioscience regions. Also, any continued growth in the 'infrastructure' sub sector should lead to increased demand for education, training and development to improve skills, so DCELLS need to build capability and capacity, as for Freeze Drying.

Finally, on applying weaknesses and threats, the concerns resulting from the weaknesses and opportunities analysis are reinforced. Continued focus on Contract Testing, with such low demand in Wales, may not be viable for WAG when considering low cost competition and tax competitors such as the RoI. Conversely, WAG should act to increase and formalise connectivity and communication between companies and higher education establishments to share capabilities, develop training and education and strengthen the sector, as appropriate, in Wales (i.e. 'Triple helix').

In summary, as with Freeze Drying, Contract Testing was supported by WAG strategies and experts for investigation in this case study. However, the realities of the SWOT and resulting TOWS analyses show that there are factors which indicate that developing Contract Testing capabilities in Wales may not be a viable proposition owing to low demand, low cost and tax rate competitors. Options for small scale requirements may involve using local companies, NHS or higher education facilities, providing that they

could meet supply chain priorities. However, Contract Testing does not have the asset specificity issues that Freeze Drying has. Therefore, there may be opportunities for e.g. diversification, as being considered by Daffodil.

7.5 RESULTS OF THE TELE-INTERVIEWS – MARKET RESEARCH

Complementary to the environmental analyses, the next stage of the study investigated the market demand and capability in the rest of the sector to see what the broader demand is for the SCVs, where they are currently sourced from and any supply options. Sample companies were identified using the WAG sponsored Bioscience Directory web site and all those who responded with useable data were allocated pseudonyms to maintain confidentiality.

A total of 33 companies or organisations were identified for the purposive sample, based on information and advice from WAG sector experts. The sample was deemed to be companies or organisations that would require Freeze Drying and/or Contract Testing as part of development or production processes, from both the Pharmaceutical and Diagnostics sub sectors of Biosciences. Interview questions and the final sample were agreed with WAG IBW (Meeting 24 Oct 07, Williams at the GE Healthcare Biosciences event).

Of the 33 companies identified:

- nine were eliminated because they were deemed to be too small (i.e. had less than ten FTEs).
- one was eliminated as it no longer operated within Wales.
- four were eliminated after being contacted. These were University departments or research centres. Having been contacted, they did not respond to requests to take part in the research.

The final sample size was 19 companies.

The method used for the investigation was structured telephone interviews with Purchasing Managers or equivalents in these companies. In some cases, the tele-

questions were e-mailed to companies, at their request, for them to review and complete as appropriate. The interviews were carried out between mid Nov 07 – mid Jan 08. This was challenging as from mid December, some companies struggled to answer telephones or e-mails or make time available to answer questions. The reasons for this seemed to vary, for example:

- Christmas activities
- Financial year end
- High profile projects that took priority over assisting with the research

Of the 19 companies contacted, when asked for the location of their HQ and the size of their Welsh operation, based on the number of FTEs or equivalents, they advised:

Location of HQ	No	%	Size of Company (Welsh Site)
Wales	7	37%	5 small; 2 medium
RoUK	4	21%	1 small; 3 large
RO EU	3	15.7%	2 small; 1 medium
RotW (i.e. USA or India, for example)	5	26.3%	1 small; 1 medium; 3 large

Table 7.12 – Tele-Interviews - Company Information (Source: The Author)

Of the 19 companies contacted:

- 14 responded with information
- five did not respond for their own reasons

Respondents	Number	%
Information Provided	14	73.7%
No Information Provided	5	26.3%

Table 7.13 – Tele-Interviews - Responses (Source: The Author)

Of the 14 companies that responded in relation to Freeze Drying:

- four did not have a requirement
- eight had a requirement

- one had identified a potential requirement for Freeze Drying, depending on new product development activities (*)
- one had identified a longer term requirement for Freeze Drying in the next 18 months to two years (from Dec 07) which may be satisfied in-house via capability development (Daffodil).

Requirement for Freeze Drying?	No of Companies	Value of Requirement (£) pa
Nil Requirement	4	Nil
Requirement	8	N/K (In-house)
Potential Requirement	2	£120k *

Table 7.14 – Tele-Interviews – Freeze Drying Requirements (Source: The Author)

Of the 14 companies that responded in relation to Contract Testing:

- two did not have a requirement
- 11 had a requirement
- one had identified a longer term requirement for Contract Testing in the next 18 months to two years (from Dec 07) and was considering meeting it in-house (Daffodil).

Requirement for Contract Testing?	No of Companies	Value of Requirement (£) pa
Nil Requirement	2	Nil
Requirement	11	£85.5k
Potential Requirement	1	N/K

Table 7.15 – Tele-Interviews – Contract Testing Requirements (Source: The Author)

Of the 14 companies who responded:

- seven required both Contract Testing and Freeze Drying
- two required neither Contract Testing nor Freeze Drying
- five required either Contract Testing or Freeze Drying

One company provided details of capabilities for Freeze Drying but were unable to specify demand or capabilities for Contract Testing because of their company confidentiality policy.

The requirements identified during the tele-interviews were added to those identified during the semi-structured interviews. The results for Freeze Drying are summarised in Table 7.16 and for Contract Testing in Table 7.17.

Company	Size	Main Activity	HQ	In-House	Supplier Location	Freeze Drying - ISO 9000	Freeze Drying - GMP	Value (£) p.a.
Anemone	M	Manufacture	RoUK	N	USA	N	Y	£1.4m
Bell Flower	S	Manufacture	Wales	Y	Parent company, France	N/K	N/K	N/K
Bluebell	M	Development & manufacture	RotW	Y	Glasgow & Blaenavon sites	Glasgow & Blaenavon Y	Blaenavon Y	N/K
Cornflower	M	R & D and manufacture	Wales	Y	Maesteg	Y	Y	N/K
Globe Flower	S	Manufacture	Wales	N	Not divulged but not Wales	Y	Y	N/K
Gypsophilia	L	Development & manufacture	RoUK	Y	Cardiff & Gloucester	Cardiff Y	Gloucester Y	N/K
Marjoram	S	Contract manufacture	Wales	N	Glasgow	N	Y	Potential requirement estimated at £120k p.a.
Marigold	S	Development & manufacture	RotW	Y	Cardiff (Small scale)	Y	Y	N/K
Nasturtium	S	Development & manufacture	Wales	Y	Deeside (Small scale)	N/K	N/K	N/K
Orchid	L	Development & manufacture of diagnostics	RoUK	Y	Cardiff	N	Y but not on a commercial basis - in-house use only	N/K

Table 7.16 - The Total Requirements Identified for Freeze Drying & Potential Sources of Supply Satisfaction (Source: The Author)

It can be seen from Table 7.16 where demand exists within Wales for ISO 9000 or GMP standard, a source of supply may also exist in Wales. The total requirement within Wales p.a. is approximately £1.5m, based on the requirements of two sample companies. It would appear that Freeze Drying may not be a true SCV in Wales. Six

companies have in-house facilities in Wales for Freeze Drying, to both ISO 9000 and GMP standard and to different scales, although one does not offer these on a commercial basis. Therefore, a local supplier may be found, if suitable in meeting the requirements of the customer. One company also has an in-house capability, albeit in the parent company in France. However, issues may include asset specificity regarding freeze driers in relation to specific product licences.

For clarification, both Anemone and Marjoram make purchasing decisions on site.

Company	Size	Main Activity	HQ	In-House	Supplier Location	Contract Testing	Value (£) p.a.
Anemone	M	Manufacture	RoUK	N	RoUK, RoI	Misc	£500k
Bell Flower	S	Manufacture	Wales	Y	Cardiff	Sterility & Bioburden	N/K
Betony	S	Product evaluation and development	RoEU	Y	Parent company, Dublin	All	N/K
Bluebell	M	Development and manufacture	RotW	N	Fareham & Ashford	Bioburden & Identification (Fareham), Bioburden & Endotoxin (Ashford)	£5.5k
Cornflower	M	R & D, manufacture	Wales	Y	Maesteg (in-house) & Swansea (Sister company)	Sterility (Maesteg), Identification, Bioburden & Sterility (Swansea)	N/K
Daffodil	S	Manufacture, storage & distribution.	RoEU	N	Fareham	All	£6 - 9k
Daisy	M	Manufacture & supply	RoEU	N	RoUK	Misc - testing potency	£750k
Globe Flower	S	Manufacture	Wales	N	N/K	Misc	N/K
Marjoram	S	Contract manufacture	Wales	N	Swindon & Derby	Sterility, Bioburden, Endotoxin	£5k
Marigold	S	Development & manufacture	RotW	Y	Cardiff	Misc	N/K
Narcissus	L	Development & manufacture	RoUK	N	County Durham & Reading (Used to use a company in Bridgend, too expensive)	Sterility & Endotoxin (Co Durham), Bioburden, Reading	£56k
Nasturtium	S	Development & manufacture	Wales	N	Derbyshire & Hampshire	Misc	£10k
Orchid	L	Development & manufacture of diagnostics	RoUK	N	Sunbury-on-Thames & Middlesex	Misc	£24k

Table 7.17 - The Total Requirements Identified for Contract Testing & Potential Sources of Supply Satisfaction (Source: The Author)

It can be seen from Table 7.17 that where demand exists within Wales for these services, a source of supply could also exist in Wales. The total requirement within Wales p.a. is approximately £1.359m, based on the requirements of eight sample companies. It would appear that Contract Testing may not be a true SCV in Wales. Three companies have in-house facilities in Wales for Contract Testing and one company has facilities within its parent company in Dublin. Therefore, a local supplier may be an option, if sought and suitable in meeting the requirements of the customer. All eight companies who identified a requirement for Contract Testing make the purchasing decisions on site in Wales. One company also advised that some NHS Trusts in Wales carry out microbiology tests on a commercial basis. However, companies may have to compromise on timescales as such tests could be fit in and around hospital priorities.

Of the 19 companies contacted, five provided information regarding the markets they sell to. The results of this are shown in Table 7.18. It can be witnessed that almost no sales are made within Wales (0 – 2%). Those percentages highlighted in yellow demonstrate that markets mainly lie in the RoUK, Europe and the RotW. Of the five companies who responded on this, two were small operations HQ'd in Wales and both recorded 50 – 70% of sales within the RoUK. Bluebell's sales were mostly in the RotW, where its HQ lies, with the RoUK market being a close second. This small sample seems to back up the WAG IBW (Meeting 13 Jun 08) that advised markets are not in Wales (see Bioscience SWOT, Appendix O).

Company	Size	Ownership/HQ	Wales %	RoUK %	RoEU %	RotW %
Bluebell	M	RotW	0%	39%	17%	44%
Daffodil	S	RoEU	2%	70%	16%	16%
Marjoram	S	Wales	1%	50%	20%	29%
Narcissus	L	RoUK	0%	40%	50%	10%
Nasturtium	S	Wales	0%	70%	10%	20%

Table 7.18 - The Target Markets of Five Welsh Bioscience Companies (Source: The Author)

7.5.1 VALIDATION OF THE RESULTS OF THE MARKET RESEARCH BY WELSH ASSEMBLY GOVERNMENT SECTOR EXPERTS

Validation by WAG Bioscience sector experts was required to understand these results and discuss possible options for further investigation or SCV resolution.

Discussions with WAG (Williams, 21 Apr 08) identified that care was required in matching these SCVs with potential suppliers and advised that there are three sub-sectors which create difficulties matching exact outsourcing specifications or requirements for both Freeze Drying and Contract Testing:

- For Pharmaceuticals, Therapeutics and Biologicals, there is a very high focus on quality accreditations and validated processes in accordance with the GMP standard. Suppliers become named in the clients licence and so they are inspected frequently. Freeze Drying in particular is very different here from the other two sub-sectors below, as there is a requirement for sterile filling for products that cannot be terminally sterilised. Therefore this is differentiated from the other sub-sectors at the product level for both technological and process requirements. Freeze Drying is carried out in vials (small glass bottles) for this sector.
- Medical Diagnostic Devices and Analytical products and processes have different Contract Testing requirements, often specialised for materials (for example, biocompatability). Whilst quality is still critical in accordance with the GMP standard, the issues are different from those in the Pharmaceuticals/Therapeutic Biologicals above.
- For companies involved in the development and manufacture of food or nutritional supplements including vitamins and minerals, nutritional oils and fatty acids, freeze dried herbal extracts and probiotic products, there is a different regulatory framework, albeit they may comply with GMP and ISO 9000 standards. There are different types of Contract Testing whilst Freeze Drying is a bulk, non-sterile process with huge open tray type freeze driers, as opposed to the freeze drying in vials for the Pharmaceutical/Therapeutic Biologicals above which is appropriate to the SCV case study.

During discussions, it transpired that the Freeze Drying required by Anemone and Marjoram, to GMP standard, could not presently be met by Cornflower, for example, nor any other company in Wales. In addition to Freeze Drying there is a step immediately prior to that in the manufacturing process that requires sterile filling into vials. The freeze drier also needs to be operated within a 'Class A' clean room facility and be able to be steam sterilised pre and post Freeze Drying. There are similar technical issues with some of the Contract Testing.

The review of the results for the case study SCVs and the validation process took almost two months owing to WAG resource capacity issues. A 'transformational change process' was reaching the first stage of organisational restructuring and impacting on job roles, grades and responsibilities. Therefore, access to experts was particularly difficult at this time. During this period, it became clear that one of the constant sources of expertise during the study was leaving the organisation on early retirement, so resources would become tighter.

In summary, the SCVs in this sector remain unresolved and it is for WAG and other stakeholders to target companies for possible diversification, start-up or inward investment opportunities, based on the evidence provided from this case study. Had the author been carrying out action research, as opposed to a case study strategy, further involvement in the attempts to resolve SCVs would have been appropriate. When looking at the MediWales Annual Review and Directory (2008), three potential opportunities for filling Contract Testing SCVs in Wales were identified but no opportunities were identified for Freeze Drying.

Based on the findings from the market research tele-interviews and the PESTEL, SWOT and TOWS analyses, WAG sector managers were charged with investigating potential solutions to the SCVs as part of their normal business. No solutions were identified in the time scale of the study which was impacted by the reorganisation of the WAG and the TOWS analysis indicated possible actions that the WAG could adopt. There may be opportunities to service the broader RoUK/EU/RotW market by

encouraging existing companies in Wales to diversify, for Contract Testing but owing to asset specificity and complexity issues for Freeze Drying, this may remain a SCV.

7.6 PILOT TESTING OF THE PROPOSED SUPPLY CHAIN VOIDS FRAMEWORK

The framework developed in Chapter 6 was pilot tested within this case study as depicted in the four-field plan at Table 7.19.

WHAT - ACTIVITY	HOW - METHOD	WHO - ROLE(S)	STANDARD(S) - Thesis Chapter, WAG, etc.)
Identification of individual product or service related SCVs	Semi-structured interviews	The Author	Ch 2, Ch 6
Recording SCVs	Semi-structured interviews – Microsoft Excel	The Author	Ch 2, Ch 6
Review and validation of identified SCVs	Meeting held 13 Jun 07	WAG sector experts and MediWales Industry Forum	Ch 2, Ch 6
Select appropriate SCV(s) for investigation	Meeting held 13 Jun 07	WAG sector experts and MediWales Industry Forum	Ch 2, Ch 5, Ch 6
Quantify broader sector demand and capabilities for SCV(s) in the region	Market research within other sector based firms in Wales – Structured Tele-Interviews	The Author	Ch 2, Ch 3, Ch 5, Ch 6
Investigate options to resolve SCV(s)	Existing methods, based on findings from market research	WAG sector experts	WAG existing methods, Review of PESTEL, SWOT and TOWS analyses.
Select most suitable option(s) to resolve SCV(s)	Existing methods, based on findings from market research	WAG sector experts	WAG existing methods, Review of PESTEL, SWOT and TOWS anayses.

Decision making	'Catchballs'	The Author, WAG sector experts, MediWales Industry Forum	Ch 2 (WAG Strategies and policies), Ch 6
Review and evaluation - ongoing	Feedback and verification loops - ongoing	The Author, WAG sector experts	Ch 2 (WAG Strategies and policies), Ch 6

Table 7.19 – Four-Field Plan of the Pilot Testing of the Framework Developed in Chapter 6 (Source: The Author)

As the WAG ROI and SDI&AT models were not yet developed, these could not be used within the study. A facilitated solution is not deemed suitable for these cases as data exists for both SCVs and the strategic analyses. The embeddedness and sustainable development assessment tool was developed by the author alongside the case study carried out in Chapter 9, investigating 'potential' SCVs and was not used here.

7.7 CONCLUSIONS AND RELEVANCE TO THE THESIS

This case study has resulted in the identification of 'immediate' SCVs in this Welsh sector, the perceived reasons why they were believed to exist and the investigation of two, partially through the pilot testing of the framework proposed in Chapter 6. It has been proven that these two SCVs remain, owing to various challenges that exist in this complex sector. Although they have not been resolved, the investigations have aided the development of the framework and have identified areas for consideration should the WAG wish to adopt such a framework.

The case is relevant to the thesis as it addresses the Research Questions in line with Table 6.1, updated with column three in Table 7.20 below.

Research Questions	How Addressed by this Case Study	Responses to the Research Questions Based on this Case Study
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	Data gathered and analysed from face to face and telephone interviews.	'Immediate' SCVs identified and quantified. A number of reasons exist relating to why the SCVs are perceived to exist e.g. lack of a supplier.
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Through the development and testing, where possible, of the proposed framework detailed in Chapter 6.	Yes, see Chapter 6.
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?		Through the pilot testing of the framework proposed in Chapter 6 using the WAG SDI&AT and proposed embeddedness and sustainable development assessment criteria tool.

Table 7.20 – Research Questions, How they are Addressed and the Responses for the Bioscience Case Study (Source: The Author)

Chapter 8 now carries out a similar investigation into 'immediate' SCVs for the Financial sector in Wales.

Chapter 8

Case Study

—

Financial Intermediation and Insurance

—

'Immediate' Supply Chain Voids

CHAPTER 8 – CASE STUDIES - FINANCIAL INTERMEDIATION AND INSURANCE – 'IMMEDIATE' SUPPLY CHAIN VOIDS

8.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter contains the results of the case study investigations into 'immediate' SCVs within the Welsh Financial sector. Similar to Chapter 7, firstly, the results of the semi-structured interviews are presented, identifying the SCVs uncovered and the perceived lack of local availability. These are then validated with stakeholders before selecting two to investigate further via structured telephone interviews and analysis, with reference where possible to the framework developed in Chapter 6. PESTEL and SWOT analyses are carried out to link the SCVs to the wider Welsh and external environmental issues prior to TOWS analysis which recommends potential courses of action for Wales. The chapter concludes by aligning the findings to the Research Questions.

8.2 RESULTS OF THE SEMI-STRUCTURED INTERVIEWS – IDENTIFICATION OF 'IMMEDIATE' SUPPLY CHAIN VOIDS

The scope of the case studies is defined in Chapter 6 where Figure 6.3 demonstrates the case study approach across four Stages (i.e. 0 – 3). The following sections report the findings of Stages 1 and 2.

Semi-structured interviews were carried out in this sector between January to May 2007 to address Research Question 1 and this section reports the findings. To maintain anonymity and confidentiality requirements, each company has been given a pseudonym:

- Apple – two business operations
- Banana
- Cherry
- Damson

- Elderberry

8.2.1 RESULTS OF THE COMPANY DATA ANALYSIS

The types of companies interviewed and their key markets are summarised in Table 8.1.

Company/Type	HQ/Branch	Product/Service	Market	No of Employees	No of Years in Wales
Apple - Insurance	Branch/RoUK	General Insurance underwritten by other companies.	Consumer Insurance	> 250	Up to 15 years
Banana - On-line aggregators and product comparison site, including Financial and Insurance	HQ/Wales	Insurance (travel, home, car, life), money (credit cards, loans, mortgages, savings, current accounts) plus other non-financial services e.g. travel.	Consumer Finance and Insurance plus other non-financial services	> 250	Up to 5 years
Cherry - Bank	HQ/Wales	Life insurance, banks and building societies, funds & pensions, corporate loans, equity release, consumer loans.	Business and Consumer Insurance	50 - 250	> 15 years
Damsom - Building Society	HQ/Wales	Banks and building societies, personal finance, contact centre.	Consumer Insurance	> 250	> 15 years
Elderberry - Insurance	HQ/Wales	General insurance direct to consumers.	Consumer Insurance	> 250	Up to 15 years

Table 8.1 - Summary of the Sample Financial Intermediation and Insurance Companies Interviewed (Source: The Author)

Of the five companies interviewed during six interviews, Banana has operated in Wales for up to five years, Apple and Elderberry for up to 15 years and Cherry and Damson for over 15 years. Apple was the subject of a merger in 1995 and Banana started in England in 1999 and moved across the border to Wales in 2003.

Cherry employs 50 – 250 FTEs or equivalents with the other four companies employing over 250, as follows:

- Apple employ approximately 2000 in Insurance
- Banana has approximately 560 and is growing by up to ten new staff per month
- Cherry has 108
- Damson employs approximately 1200 across the group
- Elderberry has approximately 2500 between the Cardiff and Swansea operations, approximately 1500 of which are at the Cardiff site.

Cherry had a turnover of less than or equal to £50m (EU 74m) and the rest of the companies had a turnover of over £50m (EU 74m +).

All companies advised compliance with the Financial Services Authority (FSA) standards or accreditations.

Purchasing responsibilities and budgets varied, as shown in Table 8.2 which lists the breakdown, by company, of what was included and excluded as determined by the respondents. Apple reported on its two strategic supply chains and Elderberry provided information on their most expensive segment of expenditure, which is advertising.

Company	Purchasing £ Includes	Purchasing £ Excludes
Apple (1)	Insurance Claims supply chain	Marketing & IT
Apple (2)	General Insurance supply chain	Marketing & IT
Banana	All	Nil
Cherry	All	Nil
Damson	All	Nil
Elderberry	Advertising	All other goods/services

Table 8.2 Summary of the Purchasing Activities Covered within the Research in Financial Intermediation and Insurance (Source: The Author)

The companies are located in north and south Wales.

8.2.2 RESULTS OF THE PURCHASING AND SUPPLY CHAIN DATA ANALYSIS

Banana did not specify any purchasing budget or spend as the information was classed as 'sensitive'. However, they did state that Marketing, IT and Facilities Management departments in the company did have budgets. Cherry specified expenditure of £5 – 10m p.a. which breaks down as shown in Figure 8.1, confirming that expenditure on purchasing of goods and services is very low when compared to their total annual expenditure:

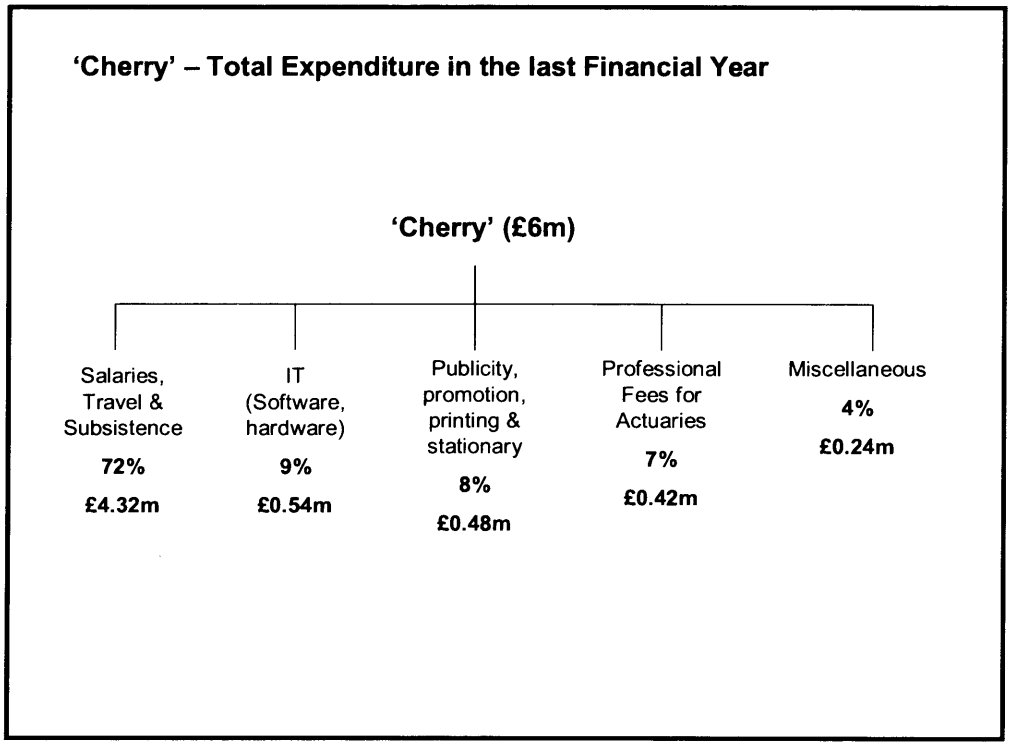


Figure 8.1 - Total Expenditure for 'Cherry' in the Last Financial Year (Source: Cherry)

Apple, Damson and Elderberry reported expenditure of over £10m in the last financial year however, similar details as those provided by Cherry at Figure 8.1 were not forthcoming.

In relation to P & SCM professionalism, Damson's Purchasing Manager is a MCIPS (University of Glamorgan), a Member of the Chartered Institute of Logistics and Transport (MCILT) and he has Higher National Certificate (HNC) in Business and Finance, a Post-Graduate diploma in Management and a Masters in Procurement (from the University of Glamorgan). Damson also has a trainee who is to embark on study for the MCIPS diploma at Glamorgan towards the end of 2007.

One of the Apple respondents has personnel qualified as a MCIPS (studied via distance learning), a Purchasing Degree (Glamorgan) and an MBA in 'lean' SCM (Cardiff University) whereas the other business operation does not have any staff with purchasing qualifications. Banana has a mix of people with and without professional qualifications, not necessarily purchasing qualifications. Cherry and Elderberry do not have professionally qualified purchasing personnel for the sourcing activities explored during the interviews.

Regarding the centralisation or de-centralisation of P & SCM, both Apple and Damson operate a mixed economy whereby some goods and services are authorised on site but others are bought as part of Group or HQ decisions e.g. general goods such as stationary or orders over a specific value (i.e. £10m). Banana and Elderberry operate what they term as a de-centralised system, albeit they are HQs. Cherry is centralised with all purchasing decisions made at their HQ site.

For P & SCM decision making, Apple, Cherry and Elderberry all operate using a multi-disciplinary team approach, whereby physical or virtual teams are formed to put together for example, tender documentation, orders or requirements. Also, Cherry stated that most expenditure is controlled by the directors, over and above approved limits. Banana said it depends on what is being bought as the Chief Executive Officer (CEO) makes the ultimate decisions on major purchases. However, the IT Manager makes the purchasing decisions for servers and other IT related equipment whilst Managing Directors (MDs) and Channel Heads also make purchasing decisions. Finally, Damson uses a combination of the Purchasing Manager or equivalent, a multi-disciplinary team approach and/or other option, depending on what is being sourced. If the goods are low value, the Purchasing Manager and the User Group identify the

requirements and execute the purchase. Their IT department decide to buy some of their own requirements, as do Marketing.

Companies were asked if their suppliers have to comply with standards or accreditations to supply goods or services to them. The FSA accreditation is required by all Financial companies. In addition, for Apple, any third party company must be on their 'Approved Supplier List', which is Group driven to ensure H & S compliance, for example. All suppliers must meet the 'Safe Contracting' standard which is a Group managed initiative. Damson asks for other specifics, depending on what is being purchased e.g. ISO 9000 and for furniture purchases they may ask for compliance with sustainable sources for wood. On one contract, one service provider has been asked to site an office in Cardiff as part of the terms and conditions.

When asked if companies have a policy for the risk assessment of overseas suppliers, all stated that this was not applicable as very little is sourced from outside of the UK e.g. IT from the RoI. However, Apple advised that their Group or HQ do have an off-shore policy.

In relation to P & SCM priorities, Banana stated that these differ depending on what is being sourced. Damson said that all are important with different weightings and as a HQ, they make the purchasing decisions for their site and on behalf of other parts of the Group, based on these priorities. For Apple, Cherry and Elderberry, quality, cost and delivery (on time and in full) were the top three priorities, although not in the same order.

Apple operates a mixed economy in relation to its purchasing activities as they make decisions on site and are subject to Group procedures. This can be demonstrated to an extent as the two interviewees at Apple identified slightly different priorities, based on the different supply chains they are responsible for: One Purchasing Manager prefers quality and delivery whilst the other cites cost, quality, delivery and flexibility in order of preference. In these cases, delivery relates to the achievement of customer service levels. Cherry are an HQ site so these priorities are for company requirements and

whilst Elderberry are also an HQ site, they specified that they operate a de-centralised system for purchasing within the company.

Regarding the number of suppliers on 'supplier databases', Banana did not know how many suppliers it has and stated that the list is still growing as the business develops. Apple has a total of 58 suppliers split across the two supply chains whilst Cherry has less than 50. Damson has 900 suppliers on the ledger, of which 500 are 'live' in the current year and this is being actively reduced. Finally, Elderberry has two key suppliers (advertising agencies).

When asked to identify the location (i.e. Wales, RoUK, Europe or Other) of suppliers who are used regularly, the companies responded as follows:

Company	Country	<10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 100	>100
Apple	Wales	■						
	RoUK						■	
	Europe							
	Other							
Banana	Wales	Not Known						
	RoUK							
	Europe							
	Other							
Cherry	Wales				■			
	RoUK		■					
	Europe							
	Other							
Damson	Wales							■
	RoUK							■
	Europe							
	Other							
Elderberry	Wales							
	RoUK	■						
	Europe							
	Other							

Table 8.3 – Summary of Locations of Key Suppliers (Source: The Author)

- Of the 58 suppliers used by Apple less than ten (4) are in Wales and the remainder are from the RoUK i.e. 54 in England and Scotland. For one

supply chain, selection is predicated on quality and delivery whilst the other is on cost, quality, delivery and flexibility.

- Banana did not specify.
- Cherry advised that Welsh suppliers number 31 - 40, RoUK between 11 – 20, based on the supply chain priorities of quality, cost and delivery.
- For Damson, it was believed to be a 50/50 split between Wales and the RoUK with over 100 suppliers for each. They have up to 900 suppliers in total with up to 500 contracted within the current year. These are selected based on all supply chain priorities with various weightings.
- Elderberry stated that the two advertising agencies are in the RoUK i.e. Manchester and London, determined by the supply chain priorities of cost, quality and delivery.

In summary, the RoUK is the major source of supply, followed by Wales. Nothing is bought from outside the UK.

Companies were asked if they are concerned about sourcing items locally to reduce logistics costs. Apple said that these are not applicable to them. Banana and Cherry said it isn't really an issue as costs are low but Damson was addressing the high costs of postal services. Elderberry spends a significant amount p.a. with local suppliers for the printing of leaflets, as they could maintain contact easily.

In relation to reducing environmental impacts, this was not applicable to Apple although they do ask potential suppliers to respond to an environmental schedule in tender documentation. Banana said that although it is not a big issue, they do have carbon-neutral targets to achieve as part of their business plan. Cherry stated that they source locally wherever possible and Damson stated they have an environmental policy. Finally, Elderberry was investigating the supply of recycled paper for their operation.

When asked if there were any comments the companies would like to make about the research, Apple stated that whilst supportive, they acknowledged that the key issue is to contract with suppliers who are capable of delivering national coverage for their services. Therefore, they may not easily be able to source products and services from companies based in Wales, if they do not have the capability to deliver on time to the

required service levels, all over the UK. They also highlighted a lack of skills or suitable applicants available in Wales to act as e.g. Account Managers for the management of insurance providers selling their products via the Apple distribution channel or brand. There also appears to be a lack of skills or suitable applicants to carry out the legal activities associated with the 'contracting arrangements between the company and the insurance companies and underwriters'. Work has gone to Bristol to cater for this lack of legal capability.

This research is not addressing skills shortages as 'capabilities'. However, information identified within the interviews has been noted and referred to the DCELLS in Wales and the UK Sector Skills Councils as evidence for their investigations.

Damson was concerned at the current high level of interest in 'buy local' initiatives, for example 'Value Wales' and this research project. Their Purchasing Manager thought this seemed more prevalent since the devolution of Scotland and Wales. He believed it could have a negative effect on how the rest of the UK perceives Wales, for example. Elderberry volunteered information about their target market in London and the south east of England in response to this question.

A supplementary question was added over the timescale of the interviews and where companies had already been interviewed, this question was asked as a follow-up question, via e-mail or telephone call. It was added owing to the type of data being collected during the initial interviews, as a potential theme was being identified. Companies were asked if they have Disaster Recovery or Data Centre contracts and if so, where are the suppliers and how much do they spend p.a.? Responses have been included in Table 8.4 (i.e. High-value SCVs).

Apple has an in-house solution within the Group. Banana does have Disaster Recovery cover, stating that the main web servers, rather than back-up servers, are hosted north of the site (approx 100 miles away). Cost and location were not divulged as this would be considered sensitive information. However, the company pointed out that in their location within Flintshire, there is a lack of multiple telecoms providers (only BT servicing the area), thereby creating a single point of failure at BT's local network.

This is a big concern emphasised in the Western Mail on the 6 June, 2007 (Blake, icwales web site, accessed 13 Jun 07).

Cherry responded positively stating that the Disaster Recovery site in Bristol that the company use costs approx £30k p.a. for the rental of an office comprising 50 desks, PCs, servers, phones etc. that can be used in the event of the closure or destruction of their offices in Cardiff. The idea is that they simply move their staff and back up tapes (data and programmes) to Bristol, restore everything and be operational in Bristol within 48 hours (i.e. business continuity). Cherry advised that there are many variations on this theme depending on how much money you wish to spend e.g. the optimum solution adopted by some firms is to maintain 'mirrored sites' where all data and programmes are mirrored in two (or more) locations so if one is lost due say a fire, the other simply takes over with no downtime at all. Their Purchasing Manager believes that financial services firms (governed by the FSA) are more aware of this issue than say manufacturing operations, which may seem reasonable based on the level of responses from the Bioscience companies sampled in this research and their level of expenditure, where identified.

Damson's Disaster Recovery is provided by ICM in Bristol and by Unisys in Milton Keynes. (They also use BT's facility in Cardiff Bay). The Purchasing Manager stated that one of the key issues around Disaster Recovery is that it is quite good for the company not to have such a service close to their operating location. This is all about being a certain distance away from wherever the disaster occurs. If there was one in Wales, outside of Cardiff, the company would consider it but the cost of change would be large. (The company understand that Logica CMG has a facility in Bridgend). Expenditure is not huge, but necessary for Damson. As technology advances so does a company's reliance on Disaster Recovery sites. However, as an example, Damson recently invested in their Wide Area Network (WAN) infrastructure to such an extent that they were able to half the Disaster Recovery requirement just by bouncing more of their data around their own network. As band width becomes cheaper and wider, they plan to do the same again. Their Purchasing Manager suggested that as part of the SCV research, it may be worth considering how changes in technology might affect the need for Disaster Recovery sites in the first place. He also thought that a lot of Disaster

Recovery sites double up as serviced Data Centres for hosting other peoples systems and wondered if this is the real need (salisburyhouse consulting Ltd, 2007 reports on such developments).

Elderberry responded positively stating that Disaster Recovery is covered by them at their two Welsh sites but did not divulge any in-house costs p.a. Their printing requirement is also covered as the supplier (DCC) has set up a sister site in Llanishen which is a 'cold start' site, regularly tested for operational use, if required.

In total, over £130k p.a. was spent on Disaster Recovery by three of the companies within the nine interviewed across both the Bioscience and Financial sectors (see Chapter 7, Anemone's requirement). Banana for example identified a Disaster Recovery requirement but did not divulge the value of the contract. Apple and Elderberry both have in-house solutions.

8.2.3 IDENTIFICATION OF THE HIGH AND LOW-VALUE 'IMMEDIATE' SUPPLY CHAIN VOIDS

To discover and quantify 'immediate' SCVs, companies were asked to identify by value p.a. (£), the top ten products and/or services bought from outside of Wales and which companies/locations are they bought from. As with the Bioscience companies in Chapter 7, a prepared form was completed during the interviews, or data was provided by individual companies, which was subsequently put into the format by the author and agreed with the interviewees.

Of the 60 'immediate' high-value SCVs identified for Financial services, respondents stated that the majority were owing to the lack of local availability in Wales, with some further qualified by a lack of technical competence, quality and the service levels required. In addition, skills gaps were reported particularly in ICT, supply chain account management and legal or contracting. Infrastructure weaknesses were identified for example, utilities, telecommunications and transportation links.

On analysing and grouping the 'immediate' SCVs and aggregating the values in £ spent by companies interviewed, the results have been summarised in Table 8.4 which highlights loss adjusting services in blue, IT in green and Disaster Recovery and Data Centre services in yellow.

Product/Service Description	Country/ Location of Supply	Reason(s) why bought from outside Wales	Total Value in £ p.a.	Comments
Loss Adjusting (General Adjusting i.e. basic household claims - fire, theft, escape of water, floods, etc)	RoUK	Lack of local availability	£75.2m (£5.2m covers fees. £70m spend is split between other companies who carry out repairs/replacement etc. These include contracted suppliers e.g. 'Rainbow', the customer's own suppliers and cash settlements *)	Companies are required to deliver national coverage for such services. Companies used are based in UK – e.g. Midlands or Leeds and can provide UK wide coverage.
Building Repairs	RoUK	----------"---------- --	£23.8m (£5.4m fees plus £18.4m spend on building repairs *)	----------"----------
Loss Adjusting (Subsidence)	RoUK	----------"---------- --	£13.2m (£3.2m fees plus £10.0m spend *)	----------"----------
Large Loss	RoUK	----------"---------- --	£11.7m (£0.7m fees plus £11.0m spend *)	----------"----------
Glazing	RoUK	----------"---------- --	£6.0m	----------"----------
Electrical	RoUK	----------"---------- --	£3.4m	----------"----------
IT	RoUK	----------"---------- --	£3.0m	----------"----------
Loss Adjusting (Drainage)	RoUK (England)	----------"---------- --	£2.5m (£0.2m fees plus £2.3m spend *)	----------"----------
Jewellery	RoUK	----------"---------- --	£1.7m	----------"----------
Entertainment	RoUK	----------"---------- --	£1.0m	----------"----------
Fraud	RoUK	----------"---------- --	£0.7m	----------"----------
Photography	RoUK	----------"---------- --	£0.5m	----------"----------
Bikes	RoUK	----------"---------- --	£0.5m	----------"----------
Spectacles	RoUK	----------"---------- --	£0.4m	----------"----------

Golf	RoUK	----------"----------	£0.4m	----------"----------
Creditors	RoUK	----------"----------	£0.3m	----------"----------
Angling	RoUK	----------"----------	£0.3m	----------"----------
Validation for Electrical, Mobiles, Camcorders	RoUK	----------"----------	£0.2m	----------"----------
Claims 'Sweep up'	RoUK	----------"----------	£0.1m	----------"----------
Loan Protection (e.g. against insurance products) for long term disability	RoUK	Lack of local supplier	Approx £400m	
Card Protection (against credit cards)	RoUK	---------- " ----------	Approx £200 - £220m	
Motor Insurance	RoUK	---------- " ----------	Approx £160m	
Travel Insurance	RoUK	---------- " ----------	Approx £40m	
Small Business & Commercial Insurance	RoUK	---------- " ----------	Approx £40m	
Home Insurance	RoUK	---------- " ----------	Approx £105m	
Software	RoUK/ Birmingham, Surrey	No Availability	Over £826,745	
Disaster Recovery/main servers	England	Lack of local availability/ capability	N/K	Flintshire BT network incapable of supporting such a service
IT software & hardware	RoUK/ RoI	Lack of Local Availability	0.51m	Banking software systems and hardware
Professional Actuaries	RoUK	Lack of Local Availability	0.42m	
Disaster Recovery/servers and office facilities	RoUK/Bristol	Lack of local availability	£30k	
IT Services	RoUK/Bristol	No availability/Quality and Service Levels	£950,481	Other companies outside of Wales also provide IT services, to a lesser value
Not specifed	RoUK/N/K	No availability	£497,177	Lawyers? UK?

Power generating systems	RoUK/ Sheffield	No availability/Service Levels	£378,131	
Not specified	N/K	No availability	£261,825	
Tele-communications	RoUK/Bristol	No availability/Service Levels	£247,972	
IT Hardware/ Maintenance	RoUK/Bristol	No availability/Quality/ Service Levels	£213,771	
Facilities Management	RoUK	No availability/Service Levels	£212,457	
Specialist (consultancy) services for regulated businesses	RoUK/ Cheadle Hulme	No availability	£211,741	
Office supplies	RoUK	No availability	£201,666	
Disaster Recovery	RoUK/Bristol & Milton Keynes	No availability/Service Levels	£95k	
Advertising Space (Various Media) On-Line and Off-Line	RoUK/ Manchester & London	Lack of local availability of capable supplier in relation to value, knowledge, wider reach for advertising	Over £25m	

Table 8.4 – 'Immediate' High-Value Supply Chain Voids Identified During the Semi-Structured Interviews with Financial Intermediation and Insurance Companies in Wales (Source: The Author)

These total approximately £1139.5m, all of the 41 SCVs are sourced from the UK and the reasons cited by the companies for this are as follows:

- 33 lack local availability or suppliers in Wales who can provide the service. Apple stated that for their insurance and claims services companies with national coverage are required to service the UK market effectively. They assert that no companies in Wales can deliver such coverage.
- four have no local suppliers that can meet the service levels required e.g. Disaster Recovery.
- two lack local availability and capability.

- two have no availability in Wales that can achieve the required quality and service levels demanded.

The top five 'immediate' SCVs for the Financial sector are shown in Table 8.5 and were derived following the aggregation of those voids identified for the same product or service by individual companies.

Product/Service Description	Supplier Country/Location	Total Value in £ p.a.
Insurance services including general consumer insurance, card protection, loan protection and small business insurance	RoUK	Over £100m
Loan Protection services	RoUK	Over £100m
Card Protection services	RoUK	Over £100m
Loss Adjusting (General Adjusting i.e. basic household claims - fire, theft, escape of water, floods, etc.)	RoUK	£75.2m (£5.2m fees plus £70m spend on repairs)
Advertising Space (Various Media) On-Line & Off-Line	RoUK - Manchester & London	Over £25m

Table 8.5 - The Aggregated Top Five 'Immediate' High-Value Supply Chain Voids Identified During the Semi-Structured Interviews with Financial Intermediation and Insurance Companies in Wales (Source: The Author)

Whilst national coverage is cited by Apple as a major requirement for the delivery of their services, Elderberry assert that advertising demands specialist knowledge and the wider reach of the supplier to obtain value for money by aggregating requirements with those of other customers. This capability is not believed to exist within Wales. When asked if a Welsh supplier was available, would they use them, all five companies said 'yes' providing that the service levels, quality and costs could be achieved by Welsh companies. Interestingly, none of these companies selected 'local' as a priority from

their supply chains in a previous question. Damson expressed a preference in using Welsh companies wherever possible. Elderberry stated that the expertise and economies of scale for advertising reside outside of Wales in e.g. London and Manchester.

As a catch all question, companies were asked if there are any other products or services that they buy from outside of Wales, that are not high-value and they would prefer to buy locally. Apple and Elderberry said 'no' and Cherry and Damson said 'yes'. Whilst Banana could not specify anything in particular, they stated that skills shortages in home grown IT graduates to aid their software development capabilities are lacking in Wales and that more telephone networks are required to operate more efficiently. Cherry would welcome the opportunity to outsource IT generally but they believe there are not large enough companies in Wales who could provide such a capability. These low value purchases are identified in Table 8.6.

Product/Service Description	Country/Location	Reason(s) why bought from outside Wales (See below)	Total Value in £ p.a.
IT outsourcing (Firms that host server farms, run overnight batches, provide licencing and buying power, disaster recovery etc. so a company does not require its own IT dept)	Not specified	(Lack of) Local Availability	N/K
Toner cartridges	RoUK	Too expensive in Wales	N/K

Table 8.6 – Low-Value Supply Chain Voids Identified During the Semi-Structured Interviews with Financial Intermediation and Insurance Companies in Wales (Source: The Author)

In summary of this section, the 'immediate' SCVs identified have been assigned reasons or perceptions, by the respondents, as to why they believe these voids exist in Wales, thereby addressing Research Question 1. Other 'immediate' SCVs are identified for the

Bioscience sector in Chapter 7 and 'potential' SCVs for Unmanned Systems in Chapter 9.

8.3 THE SUPPLY CHAIN VOIDS VALIDATION AND SELECTION PROCESS

The next stage of the research was to validate the 'immediate' SCVs identified here and to agree on one or two to progress into a detailed investigative phase, aiding the development and testing of a framework, where possible, in alignment to Research Questions 2 and 3. Figure 6.5 details the validation and selection process determined by the 'success criteria' detailed in Section 6.3.1 relating to alignment with WAG strategies and policies.

A meeting was held 18 June 2007 with WAG DE & T and IBW sector experts in order to assess the SCVs. All the SCVs identified during the semi-structured interviews were reviewed during the meeting. However, it was agreed that whilst SCVs should be assessed and prioritised against their value, other factors should be considered, including strategic alignment and market developments. The top five 'immediate' SCVs for the Financial sector are shown in Table 8.5 whilst Table 8.7 shows the validation assessment of the immediate high-value SCVs in this sector, along with Disaster Recovery, Data Centre and Business Continuity Services (abbreviated to 'Data Centre Services' within this thesis) which were added based on their perceived importance to Wales.

Supporting WAG Strategies/Policies/Plans etc.	Key Elements of WAG Strategies etc.	Insurance Services	Loan Protection Services	Card Protection Services	Loss Adjusting	Advertising (On & Off Line)	Disaster Recovery/Data Centres/Business Continuity
One Wales **(WAG, 2007)**	Economy, number and quality of jobs, skills enhancement, communities, transport, sustainable development.	Y	Y	Y	Y	Y	Y
IBW Operations Plan **(WAG IBW, 2007)**	Financial sector-based priorities including banking, insurance, pensions, financial intermediation, back office activities.	Y	Y	Y	Y	N	Y
Market Review of Data Centres (salisburyhouse consulting Ltd, 2007 (Commissioned by WAG)	Disaster Recovery & Data Centre opportunities for Wales	Y	Y	Y	N	N	Y
WAG PASC, 2007	Disaster Recovery & Data Centre opportunities for Wales	Y	Y	Y	N	N	Y
Environment Strategy for Wales **(WAG, 2006)**	Sustainable development use of resources, environmental hazards. Underpins other strategies e.g. *Wales: A Vibrant Economy.*	Y	Y	Y	Y	Y	Y

***Broadband Wales* (WAG, 2005)**	Broadband, pan-Wales connectivity, business and communities.	Y	Y	Y	Y	Y	Y
***Wales: A Vibrant Economy* (WAG, 2005)**	Sector-based priorities, increase number and quality of jobs.	Y	Y	Y	Y	Y	Y
Spatial Plan (WAG, 2004)	Sustainable development of the economy and environment.	Y	Y	Y	Y	Y	Y
***Sustainable Development Action Plan* (WAG, 2004)**	Economic, environmental and social aspects. Focuses on e.g. energy, sustainable development of production of goods and services, minimising the effect on people and the environment, quality jobs, entrepreneurship and innovation, R & D.	Y	Y	Y	Y	Y	Y
***WDA Business Plan 2005 – 2008* (WDA, 2004)**	Sector-based priorities. Emphasis on R & D, innovation and entrepreneurship. Improved ICT systems and infrastructure. Supply chains and networks.	Y	Y	Y	Y	Y	Y

Future Technologies **(WDA, 2004)**	Technologies	Possibly	Possibly	Possibly	Possibly	Possibly	Possibly
Wales: A Better Country **(WAG, 2003)**	High-value and quality jobs, skills, 'Knowledge Bank' focus on high growth businesses, broadband, infrastructure, business support, minimum environmental impact.	Y	Y	Y	Y	Y	Y
A Winning Wales **(WAG, 2002)**	High-value jobs and skills, innovation, business friendly environment, ICT, e-commerce, infrastructure and transport, sustainable development, specific measures to develop financial and business services by 2010.	Y	Y	Y	Y	Y	Y

Table 8.7 - The 'Success Criteria' Assessment of the Top Five 'Immediate' High-Value Supply Chain Voids Plus Disaster Recovery/Data Centre/Business Continuity Services Identified During the Semi-Structured Interviews with Financial Intermediation and Insurance Companies in Wales (Source: The Author)

As with the Bioscience sector, alignment of SCVs with these strategies have been assessed as 'yes', 'no', or 'possibly'. Table 8.7 shows that whilst all SCVs are well supported, those least supported are Loss Adjusting and Advertising, although the latter is the highest value SCV identified in the study. Two specific strategy documents support Data Centre Services which bolster support for this SCV.

8.3.1 SELECTION OF CASE STUDY SUPPLY CHAIN VOIDS

Based on the findings from Table 8.7, it was agreed that Advertising (Media Buying) should be pursued because of the significant value and the feasibility of further investigation within the Financial sector in Wales. Also, Advertising is relevant to more than one sector and little investigation into this activity has been carried out in Wales prior to this study and interested parties within WAG were keen to understand what opportunities could be explored for Wales, if any.

Low-value Data Centre Services were added to the top five high-value SCVs, owing to strategic investigations being pursued by WAG and the potential for growth. It is worth noting that whilst both Advertising and Data Centre Services are identified as SCVs within the Financial sector, Advertising is classified within the Creative Industries sector and Data Centre Services within the ICT technology sector. (Both SCVs investigated for Biosciences are within that sector).

The other high-value voids were eliminated in favour of a lower value SCV but one that has applicability across a number of sectors, including Biosciences and not just Financial. The main reason for the exclusion of the other high-value SCVs was the fact that ownership of the large financial companies who deliver such services is inevitably in the RoUK or elsewhere. The selection of Data Centre Services is also aligned to government policy and was deemed more suitable to investigate further as a report had been commissioned by the WAG into its feasibility to develop such a capability in Wales. The report (salisburyhouse consulting Ltd, 2007) identifies an increase in the requirement for this service and potential opportunities for WAG to consider to fill such a void. Therefore, the SCVs study complemented the work being carried out elsewhere in WAG.

The semi-structured interviews had identified a total £25m plus for Advertising (On and Off Line) being bought from the rest of the UK as shown in Figure 8.2.

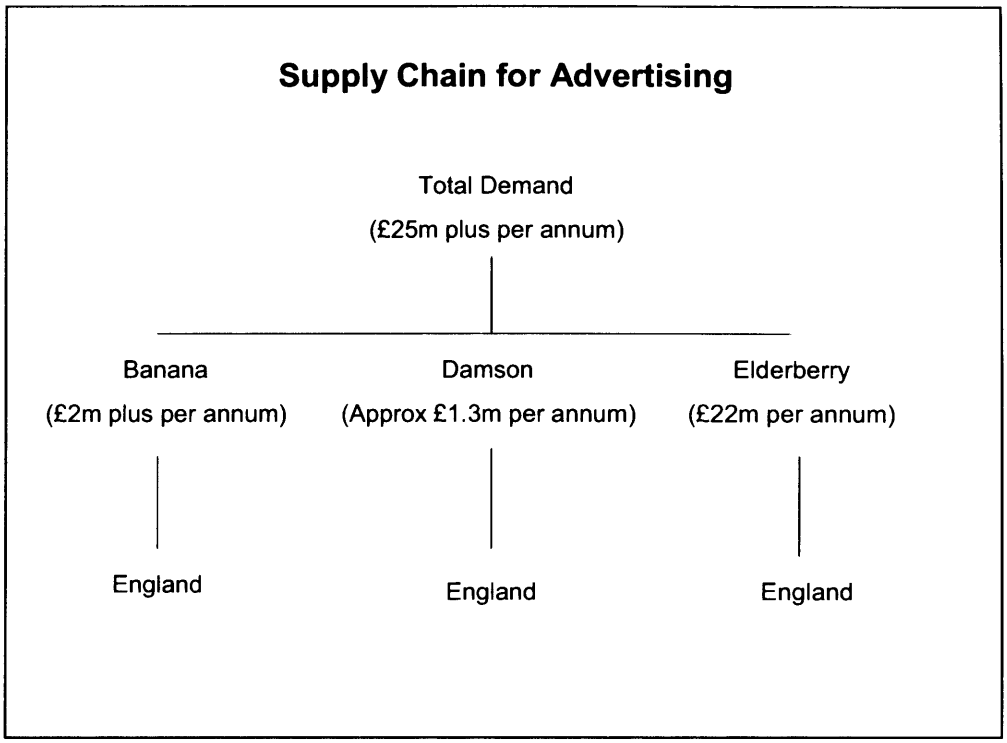


Figure 8.2 - The Supply Chain for Advertising (On and Off Line) (Source: The Author)

The supply chain identified for Data Centre Services is identified at Figure 8.3.

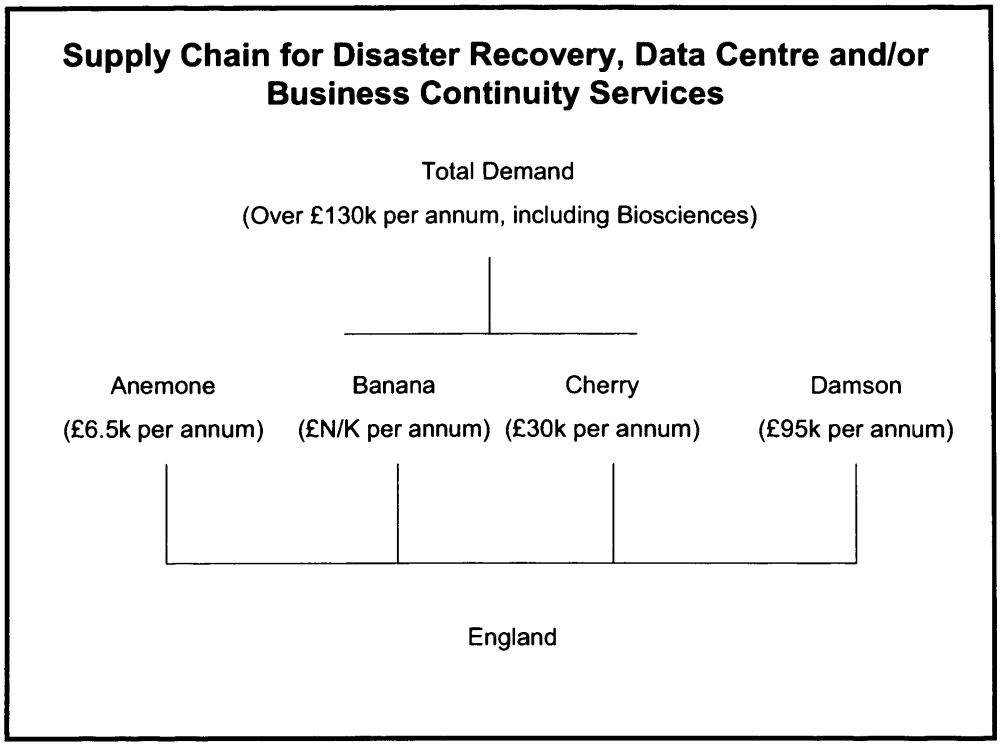


Figure 8.3 - The Supply Chain for Disaster Recovery, Data Centre and/or Business Continuity Services (Source: The Author)

8.4 REGIONAL ECONOMIC DEVELOPMENT OPPORTUNITIES FOR THE FINANCIAL INTERMEDIATION AND INSURANCE SECTOR – PESTEL, SWOT AND TOWS ANALYSES

This section covers the creation and analysis of the external and internal business environment for Wales in relation to this sector.

8.4.1 PESTEL ANALYSIS

A comprehensive PESTEL analysis was carried out for the sector to identify the macro environmental issues, in particular those that may have an impact on the Welsh sector. It also assisted the enhancement of the author's knowledge of this area. The full PESTEL was refined, based on the sector priorities identified by WAG (Meeting with Maniatt, 1 July 2008) which are the 'credit crunch' and its impacts on the Welsh Financial sector and increasing energy costs. The refined PESTEL is summarised in Appendix P which is dominated by the credit crunch and associated factors.

8.4.2 **SWOT ANALYSES**

SWOT analyses were then carried out for the Welsh sector and for both case study SCVs i.e. Advertising and Data Centre Services, to understand if these really were SCVs in Wales. As the SCVs identified are from sectors other than that under investigation, this activity was more complex and time consuming than for Biosciences, for example, data search activities and communication was required with Welsh-based companies to scope the regional 'supply potential'. Only one Data Centre Services company was identified in Wales with a total of 29 Advertising companies found using Yell.com and of these, three are referenced in the forthcoming SWOT analyses:

- Granada
- Sevilla
- Cordoba.

The prioritised SWOT for this sector is at Appendix Q for the Financial sector which shows that strengths, opportunities and threats outweigh the weaknesses. The TOWS analysis at Table 8.8 shows how these help to recommend solutions for WAG in relation to this sector and its SCVs.

With respect to Advertising, as little was known by the sponsors, prior to this study, the SWOT is carried out at a low level for example, numbers of companies in Wales. Of the 29 companies identified from Yell.com, only seven agencies carry out any level of media buying, with only one being recognised by other companies interviewed as capable of competing with London or Manchester. This company has its HQ in Cardiff and typically deals with accounts up to £2.5m per client, p.a. However, it was still stated by two companies that London and Manchester are the media advertising centres in the UK because of the costs and economies of scale that can be benefited from. All seven agencies targeted the Welsh market, in various sectors and had many Welsh customers with different scales of advertising budgets. Only one company purposely targeted Welsh Financial companies, albeit small ones. This SWOT is converted into a TOWS analysis at Table 8.9 and identifies possible options to address this SCV.

Wales has three strengths, five weaknesses, four threats and 11 opportunities and these are converted into a TOWS analysis for Data Centre Services in Table 8.10 to identify options for addressing the SCV.

8.4.3 **TOWS ANALYSES**

This section uses the SWOT analyses to carry out detailed TOWS analyses, resulting in recommendations for addressing SCVs in Wales.

The TOWS for the Financial sector in Wales is at Table 8.8 with specific TOWS for Advertising and Data Centre Services at Tables 8.9 and 8.10 respectively.

		Internal Factors	
		Strengths	***Weaknesses***
		• Wales' proximity to London	• A number of Contact Centres established within SE Wales, as a result of WDA/IBW activity (in the Financial and other sectors e.g. utilities) (Average salary is low but job numbers are significant).
		• Skills and staff retention rates	• High energy costs in UK (and elsewhere) in 2008
		• Lower staff costs and property costs in Wales	
		• Strong University links in Wales (IBW, 1 May 07)	
		• Growing diversity and community of established Financial sector in Wales including e.g. Zurich, ING, HSBC, Lloyds TSB	
		• Price comparison web sites creating increased competition in the retail sector (Wales has at least 2 of these)	
		• Global companies delivering more profitability and productivity by greater use of technology and business solutions from Wales e.g. growth potential and cost efficiencies	
	Opportunities	***(SO) Strategic Options***	***(WO) Strategic Options***
	• Turner Report in the UK set to create new demand for services providing Financial Advice and Life and Pensions providers (Several in Wales)	Diversify to offer new products and services e.g. target and support potential growth in debt management/consolidation, equity release, various insurance and products for female customers etc. and emphasise	Develop and improve quality of contact centre service staff/skills to fend off competition from low cost countries
	• Inflation, interest rates and expiry of fixed rate mortgages in 2008 could lead to opportunities for debt management/ consolidation (1 or 2 companies in Wales), equity release (1 company in Wales)		

	• Inflation, interest rates and expiry of fixed rate mortgages in 2008 could lead to an increase in repossessions.	(UK government has made and continues to make political, economic decisions to aid recovery of the economy e.g. interest rate changes, VAT reductions etc.)	
	• Relative strength of the £ could lead to companies transferring low-cost/low-value jobs to low-cost countries.	WAG need to help companies to develop stronger links with universities to nurture highly skilled graduates for the software/IT sector in e.g. comparator web site companies etc. Welsh differentiators need to be emphasised to retain and attract companies.	
	• Increasing number of price comparison sites in the market. These could impact Welsh companies and jobs as skills are available in low-cost economies.		

Table 8.8 - TOWS Analysis for the Financial Intermediation and Insurance Sector in Wales (Source: The Author)

The TOWS analysis for the Welsh Financial sector shows that by applying strengths to opportunities, companies need to diversify to offer new products and services e.g. target and support potential growth in debt management and consolidation, equity release and various insurance and products targeting for example, female customers. WAG needs to emphasise the strengths in the sector to differentiate Wales over low cost competitors, for example. In addition, WAG could focus sales and marketing activities to attract customers for the new Data Centre in Newport whilst recognising that potential customers would not just be within this target sector.

By applying weaknesses and opportunities, Wales needs to develop and improve the quality of contact centre staff and their skills to fend off competition from low cost countries, for example. WAG could also help companies develop product and service offerings and skills of contact centre staff to meet higher levels of customer expectations. In addition, green solutions must be employed in Data Centres to minimise environmental issues and energy costs.

Further analysis relating to strengths and threats emphasises that WAG could continue to develop and improve the quality and skills at contact centres and comparator web site companies to fend off low cost competitors, as indicated above. The reputation of London as a centre for Financial Services' excellence has been tarnished during the credit crunch, therefore, Wales may need to dis-associate from London and focus on indigenous and other Welsh based companies for job retention or potential growth. Companies need to offer excellent customer service, value for money, cost effective products and services to encourage take-up in difficult times and need to develop stronger links with universities to develop highly skilled graduates for the software and IT sector that supports e.g. comparator web site companies. In addition, Welsh differentiators need to be emphasised to retain and attract jobs and companies.

Finally, on applying weaknesses and threats, WAG should nurture key companies to prevent the loss or transfer of jobs to low cost economies, for example. It also needs to focus on the retention of companies, jobs and skills throughout the credit crunch and recession, concentrating on Welsh indigenous companies, where possible to retain the few HQ functions here.

In summary, this is a much more defensive set of proposals owing to the domination of the credit crunch and to counter weaknesses and threats, WAG must emphasise the differentiators on offer including skills where strong, property and incentives.

		Internal Factors	
		Strengths	***Weaknesses***
		• Finance & Insurance is a priority sector in Wales. Creative Industries (includes Advertising) is also a priority sector (WAG, WAVE, Nov 2005).	• Only 1 Advertising Agency in Wales is understood to possibly carry out the level/value of media buying required by large Financial companies (Granada) (Accounts up to £2.5m p.a.) (Elderberry annual requirement is £22m)
		• The 1 'capable' Agency for media buying is HQ'd in Wales (Cardiff) and has up to 10 other regional offices (Granada). Individual clients spend up to £2.5m p.a.	• 90% of DMUs are not in Wales, but in Group HQs for large Financial companies.
		• Creative work is cheaper in Wales, when compared to London	• The majority of Advertising Agencies in Wales are small, 1-off offices/family businesses
		• Regional advertising is very good value and competitive	• The majority of Advertising Agencies in Wales carry out 'basic' services including design, print, annual reports, recruitment, marketing, web site creation/maintenance
		• Financial companies have significant advertising budgets.	
		• Welsh companies (various sectors) and some smaller/Welsh Financial companies do use the Welsh Advertising Agencies, mainly for regional advertising for the Welsh market	
	Opportunities	***(SO) Strategic Options***	***(WO) Strategic Options***
	• Welsh companies whose HQ is in Wales could use e.g. Granada or Sevilla for media buying.	WAG Relationship Managers should encourage big Welsh companies to consider e.g. Granada for their advertising needs.	Difficult to encourage Financial companies to buy in Wales owing to HQs and DMUs residing outside of Wales. However, in current economic times, Wales may offer competitive alternatives to London and Manchester.
	• Basic services could be recommended to Welsh companies and their HQs as there are many companies in Wales with these capabilities.		
	• Creative services required as mergers and acquisitions are leading to re-branding e.g. Santander.	WAG Relationship Managers should encourage companies to buy creative and design services in Wales as they are	Granada and Sevilla may have insufficient capacity to meet the demands of large companies such as Elderberry.
	• Creative services required as banks re-		

The TOWS analysis for Advertising shows that by applying strengths to opportunities, WAG Relationship Managers should encourage the big Welsh Financial companies to consider e.g. Granada, for their advertising needs. Also, WAG Relationship Managers should encourage any of their companies to buy creative and design services in Wales as they are understood to be cheaper than e.g. London and Manchester. In addition, WAG should organise a Creative Industries/Advertising show case for Financial companies to promote what is on offer across the Welsh sector i.e. large and small companies where some of the small companies could provide extra capacity for the larger ones.

By applying weaknesses and opportunities, it is recognised that it is difficult to encourage Financial companies to consider other suppliers, owing to HQs and DMUs residing outside of Wales even though in current economic times, Wales may offer competitive alternatives to London and Manchester. In addition, even the bigger Welsh companies such as Granada and Sevilla may have insufficient capacity to meet the demands of large companies such as Elderberry, whose HQ is in Cardiff.

Further analysis relating to strengths and threats shows that Welsh capabilities and differentiators should be emphasised and advertised to change the perception of London and Manchester being the best. There may even be an opportunity to get a piggy back from 'Dr Who' and its Welsh creativity. As advertising budgets may be reduced in the credit crunch, Wales could be promoted as more competitive. Reduced demand for media advertising may be able to make use of the capabilities and capacity of the main Welsh companies i.e. Granada and Sevilla.

Finally, on applying weaknesses and threats, it is recognised that existing advertising agencies will be retained by Financial companies as they have long relationships. This is difficult for WAG and Welsh agencies to compete with, hence differentiators and competitive pricing are important to emphasise. Granada and Sevilla may have insufficient capacity to meet the demands of large companies such as Elderberry. However, the credit crunch may reduce advertising spend and make (Welsh) Financial companies look for more competitive options.

In summary, now that the WAG has a better understanding of Advertising companies and capabilities in Wales, its Creative Industries team may be able to market it better, both internally within Wales and externally to the HQs of large Financial companies, for example.

To counter weaknesses and threats, WAG must emphasise the differentiators on offer including the cheaper creative work, for example.

		Internal Factors	
		Strengths	***Weaknesses***
		• WAG has recognised the gap in Data Centre capability and capacity in Wales to service a broader market	• Capability and capacity shortages in Wales (& UK) - e.g. only 1 public Data Centre of any size in Wales operated by a company in Cardiff Bay
		• A Data Centre established in Newport 2008 - believed to be the largest in Europe.	• In the absence of competition in Wales, managed services in Wales are up to 232% more expensive than like-for-like services elsewhere in the UK
		• Finance & Insurance is a priority sector in Wales	• SMEs and larger Welsh companies utilise Data Centre services from outside of Wales e.g. North West, Bristol.
			• All international connectivity from Wales is via London which is seen as a dis-incentive to many potential inward investors for e.g. overseas Financial companies looking for off-shore data back-up.
			• Limited low-value demand identified in the Financial and Biosciences sectors in Wales.
	Opportunities	***(SO) Strategic Options***	***(WO) Strategic Options***
	• Global demand for Data Centre services is accelerating owing to the growth of e-business & FSA requirements.		Target SMEs and other companies and public sector organisations to transfer or put business to Newport Data Centre.
	• In 2004/5 UK Data Centre space grew by 32% (although this was taken up extremely quickly)		Increased capability and capacity in Wales should increase services and could reduce the price for customers.
	• Data Centre revenues across Western Europe more than doubled between 2003 and 2007		
	• Intense competition for hosting and connectivity mean that pricing for co-		

	• WAG to ensure that any commercial Data Centres developed in Wales have a direct link to global telecommunications networks		fibrespeed, connectivity to global communications systems etc.
	Threats	***(ST) Strategic Options***	***(WT) Strategic Options***
	• Regions where a competitive Data Centre market exists are able to attract and retain significant inward investment from international corporates requiring managed hosting services	WAG to blanket market the Newport Data Centre, emphasising differentiators in Wales and the capabilities etc. of the Data Centre.	
	• Data Centre set-up and operating costs have increased in recent years		
	• Challenging pre-requisites drive up costs and render many sites unsuitable: Physical resilience and security, power and connectivity required		
	• High energy costs in the UK may affect opportunities for Data Centres in Wales.		

Table 8.10 - TOWS Analysis for Disaster Recovery, Data Centre and Business Continuity Services in Wales (Source: The Author)

The overall issue identified in the TOWS analysis for Data Centre Services is that now that a Data Centre has been opened in Newport in 2008, the WAG must market its services to attract businesses to utilise its capabilities and capacity. All industries in Wales and the UK, all companies, public sector organisations and inward investors should be targeted as the services are not limited to Financial customers. WAG could utilise Welsh advertising agencies to carry out this activity. Those differentiators that help Wales stand out to potential customers should be emphasised within an advertising campaign including connection to fibrespeed, global tele-communications systems, Data Centre capabilities and capacity. However, during the interviews, Damson stated that the costs associated with switching suppliers may be prohibitive, thereby retaining existing suppliers outside Wales.

By applying weaknesses and opportunities, increased capability and capacity in Wales should increase the services on offer and could reduce prices for customers.

8.5 RESULTS OF THE TELE-INTERVIEWS – MARKET RESEARCH

Complementary to the environmental analyses, the next stage was to investigate the market demand in the rest of the Financial companies in Wales to discover the broader demand and its source(s) of supply. The sample companies were identified using the WAG IBW CD Rom (2005). A total of 58 companies were identified for the purposive sample. Contact names, telephone numbers and e-mails, where available, were obtained for each company from WAG Integrated Client Information System (ICIS) and company web sites to carry out structured tele-interviews. Where available, the number of FTEs for each company was also obtained from these sources.

The purpose of the tele-questions was to identify if purchasing decisions were being made in Wales and where services such as Data Centre Services and Advertising are being sourced from. Therefore, where purchasing decisions were not in Wales, purchasing activities and sources of supply were not pursued with HQs situated elsewhere.

The tele-interview questions for Data Centre Services and Advertising were agreed with WAG sector advisors (Meeting 18 Jun 07).

Of the 58 companies identified in the sample:

- three were eliminated because they were no longer operating in Wales.
- four were eliminated as they provided IT support services to the sector and were not in Financial services as such.
- one was eliminated as it provided niche advertising services to the Financial sector, however it was noted for Advertising capabilities.
- one was eliminated as it was an academic research institution, sponsored by the UK Financial sector.

The final sample size was 49 companies.

The method used for the investigation was telephone interviews to Purchasing Managers or equivalents in these companies. In some cases, the tele-questions were e-mailed to companies, at their request, for them to review and complete as appropriate. The interviews were carried out between mid Nov 07 and mid Jan 08. This was challenging as from mid December, some companies struggled to answer telephones or e-mails or make time available to answer questions. The reasons for this seemed to vary:

- Too busy (two companies i.e. Cranberry and Satsuma)
- High profile projects that took priority over assisting with the research (Tangerine who helped later but provided little information)
- Christmas

Two companies (Yellow Plum and Avocado) were suspicious of being contacted over the telephone and required a lot of information regarding the author, supervisors, sponsors, the research centre at Cardiff University and the research project. One of these did not provide any information as they were concerned about confidentiality, although all companies were assured that no individuals or companies taking part would be named within the thesis.

Of the 49 companies contacted in Wales:

Location of HQ	No	%	Size of Company
Wales	5	10%	1 small; 3 medium; 1 large
RoUK	39	80%	16 small; 4 medium; 19 large
RoEU	4	8%	1 small; 2 medium; 1 large
RotW	1	2%	1 large

Table 8.11 – Tele-Interviews – Companies Contacted (Source: The Author)

- Five had their HQ in Wales
- 39 had their HQ in the RoUK
- four had their HQ in the RoEU
- one had their HQ in the RotW i.e. USA

Of the 39 companies with HQs in the RoUK, 11 of these are owned by parent companies from outside the UK, in either Europe or RotW.

Of the 49 companies contacted:

Respondents	No	%
Information Provided	38	78%
No Information Provided – too busy	2	4%
Same Group – no research policy	4	8%
Difficult to contact – Nil response	5	10%

Table 8.12 – Tele-Interviews – Information Provided (Source: The Author)

- 38 responded with some information
- two said they could not help as they were too busy
- four were part of the same group (Raspberry) and the author was advised that this company does not take part in any research. (The credit crunch subsequently highlighted this group as having to be bailed out by the tax payer).
- the remaining five were difficult to contact (i.e. 0870 business numbers only) and did not return calls or e-mails

A total of 17 companies contacted were part of larger Financial companies. This broke down as follows:

- two were part of Strawberry whose HQ is in Europe
- three were part of Lime whose HQ is in the RoUK
- two were part of Lemon whose HQ is in the RoUK
- four were part of the Raspberry group whose HQ is in the RoUK
- three were part of Grapefruit whose HQ is in the RoUK
- three were part of the Gala Apple group whose HQ is in the RoUK

Of the 38 companies that responded with some information:

Purchasing activities	No of Companies	%
Centralised in HQ (ROUK)	30	79%
Welsh HQ	4	10.5%
Welsh site (HQs: 3 ROEU; 1 ROTW)	4	10.5%

Table 8.13 – Tele-Interviews – HQ Locations and Purchasing Activities (Source: The Author)

- 30 had centralised all their purchasing at their HQ, in the RoUK
- four had their HQ in Wales and made decisions locally
- three had their HQ and decision making in Europe, one had an HQ in the RotW but made the purchasing decisions in Wales

For those companies operating centralised purchasing, it was understood that for many, Data Centre Services are an in-house solution. No Welsh suppliers were identified. For Advertising, again, no Welsh suppliers were identified.

Up to five companies who make sourcing decisions in Wales provided information relating to Advertising and Data Centre Services.

The Advertising requirements identified by four companies are summarised below:

Requirement for Advertising	No of Companies	Value of Requirement (£) pa
On Line Requirement	1	£750k
Off-line Requirement	3	£170k

Table 8.14 – Tele-Interviews – Advertising Requirements (Source: The Author)

The Data Centre Services requirements identified by these five companies are summarised below:

Requirements for Disaster Recovery/Data Centre/Business Continuity Services	No of Companies	Value of Requirement (£) pa
In-house	3	N/K
Service Providers	2	£105k

Table 8.15 – Tele-Interviews – Disaster Recovery/Data Centre/Business Continuity Services (Source: The Author)

The requirements identified during the tele-interviews were added to those discovered during the semi-structured interviews at Stage 1. The results for Advertising are summarised in Table 8.16 and for Data Centre Services in Table 8.17.

Companies	Size	Main Activity	HQ Location	Ad Agency used	Ad Agency Location	Type of Advertising	Value (£) p.a.
Banana	L	On-line aggregator	Wales	N/K	Manchester & England	On-Line & Off-Line	> £2m
Damson	L	Building society	Wales	Yes	UK	Off-Line	> £1.3m
Elderberry	L	General insurance and contact centre	Wales	Yes	London & Manchester	On-Line & Off-Line	£22m
Melon	M	Building society	Wales	No	Wales	Off-Line (Local Radio Stations, Local Newspaper)	£120k
Strawberry	M	Credit information services	RoEU	Yes	London	Off-Line	£40k
Tomato	M	Insurance brokers	Wales	Yes	Cardiff	Off-Line	£10k
Yellow Plum	L	Loans	Wales	No	UK	On-Line	£750k

Table 8.16 - The Total Requirements Identified for Advertising and Sources of Supply (Source: The Author)

It can be seen from Table 8.16 that where demand exists within Wales for Advertising, albeit limited in this sample and skewed by the Elderberry demand, Welsh suppliers exist. The total requirement within Wales p.a. is approximately £26.2m, based on the requirements of seven sample companies. It would appear that Advertising agencies are not a true SCV in Wales, based on the evidence from the SWOT and the fact that Tomato uses an advertising agency in Cardiff, albeit for a small requirement. Therefore, a local supplier could be found, if sought and suitable in terms of meeting customer priorities. However, competition may mean that prices are too expensive or that service levels demanded by customers are not met locally. It may also be that the one capable agency in Wales (Granada) may have insufficient capacity as their usual demand is up to £2.5m per client, p.a. and Elderberry's annual demand for media

buying is approximately £22m. For all seven companies, the purchasing decision is made on site.

Companies	Size	Main Activity	HQ Location	Supplier Location	Services Required	Value (£) p.a.
Anemone	M	Biopharm manufacture	RoUK	England	Restore, hardware, mobile server	£6.5k
Apple	L	General Insurance & contact centre	RoUK	In-House	Disaster Recovery services	N/K
Banana	L	On-line aggregator	Wales	North West England	Main servers and systems	N/K
Cherry	M	Financial intermediation and insurance	Wales	Bristol	Office facilities, IT, telephones	£30k
Damson	L	Building society	Wales	Bristol & Milton Keynes	Disaster Recovery services	£95k
Elderberry	L	General Insurance & contact centre	Wales	In-House	Disaster Recovery services	N/K
Melon	M	Building society	Wales	In-House	Data back-up services	N/K
Peach	L	Loans	RotW	Cardiff (sub-contracted to a company in Bristol & Hounslow)	Disaster Recovery for all core systems and a standby site for offices	£35 - 45k
Strawberry	M	Credit information services	RoEU	Cardiff	All web site and critical IT systems	£60k
Tomato	M	Insurance broker	Wales	In-House	Data back-up services	N/K
Yellow Plum	L	Loans	Wales	In-House	Data back-up services	N/K

Table 8.17 - The Total Requirements Identified for Disaster Recovery, Data Centre and Business Continuity Services and Sources of Supply (Source: The Author)

It can be seen from Table 8.17 that where demand exists within Wales for these services, a source of supply also exists in Wales. However, as stated in the SWOT, demand is increasing and capacity has been limited within Wales. A new Data Centre providing a suite of services opened in Newport early 2008. This is understood to be the largest Data Centre in Europe, creating up to 100 jobs over time. The total requirement within Wales p.a. is approximately £236.5k, based on the requirements of 11 sample companies from two sectors (i.e. Bioscience and Finance). Five companies use in-house solutions. It would appear that Data Centre Services have been a SCV but owing to developments in Newport, Disaster Recovery, Data Centre and possibly Business Continuity services are no longer a SCV in Wales.

In summary, a local supplier could be found, if sought and suitable in terms of the priorities demanded by customers. However, competition may mean that prices are too expensive or that service levels demanded by customers are not met locally. Of the eleven companies identifying a requirement for Data Centre Services, nine make the purchasing decisions on site in Wales.

8.5.1 VALIDATION OF THE RESULTS OF THE TELE-INTERVIEWS BY WELSH ASSEMBLY GOVERNMENT SECTOR EXPERTS

Validation by WAG Financial sector experts was required to understand the results of the tele-interviews and discuss possible options for further investigation or SCV resolution. Validation of the PESTEL, SWOT and TOWS analyses was also required.

The validation process took almost three months owing to WAG resource capacity issues. A 'transformational change process' was reaching the stage of organisational restructuring and impacting on job roles, grades and responsibilities. Therefore, access to experts was particularly difficult at this time.

Unfortunately, owing to other pressures, the sector experts who had been involved in the research were not able to meet. However, when asked to advise any concerns, they did not, so it was accepted by the author and other WAG officials that the findings were valid.

Based on the findings of the tele-interviews and the SWOT and TOWS analyses, it seems that the best options to exploit are the synergies with existing companies in Wales, for both Advertising and Data Centre Services, providing that customer organisations can be assured that their supply chain priorities of e.g. cost, quality and delivery can be met. Therefore, WAG Relationship Managers and sector experts need to assist in matching the customers with potential suppliers.

8.6 PILOT TESTING OF THE PROPOSED SUPPLY CHAIN VOIDS FRAMEWORK

The framework developed in Chapter 6 was subjected to pilot testing within this case study as depicted in the four-field plan at Table 8.18.

WHAT - ACTIVITY	HOW - METHOD	WHO - ROLE(S)	STANDARD(S) - Thesis Chapter, WAG, etc.)
Identification of individual product or service related SCVs	Semi-structured interviews	The Author	Ch 2, Ch 6
Recording SCVs	Semi-structured interviews – Microsoft Excel	The Author	Ch 2, Ch 6
Review and validation of identified SCVs	Meeting held 18 Jun 07	WAG sector experts	Ch 2, Ch 6
Select appropriate SCV(s) for investigation	Meeting held 18 Jun 07	WAG sector experts	Ch 2, Ch 5, Ch 6
Quantify broader sector demand and capabilities for SCV(s) in the region	Market research within other sector based firms in Wales – Structured Tele-Interviews	The Author	Ch 2, Ch 3, Ch 5, Ch 6
Investigate options to resolve SCV(s)	Existing methods, based on findings from market research	WAG sector experts	WAG existing methods, Review of PESTEL, SWOT and TOWS

Select most suitable option(s) to resolve SCV(s)	Existing methods, based on findings from market research	WAG sector experts	WAG existing methods, Review of PESTEL, SWOT and TOWS
Decision making	'Catchballs'	The Author, WAG sector experts	Ch 2 (WAG Strategies and policies), Ch 6
Review and evaluation - ongoing	Feedback and verification loops - ongoing	The Author, WAG sector experts	Ch 2 (WAG Strategies and policies), Ch 6

Table 8.18 – Four-Field Plan of the Pilot Testing of the Framework Developed in Chapter 6 (Source: The Author)

As the WAG ROI and SDI&AT models were not yet developed, these could not be used within the study. The sustainable development and embeddedness criteria tool was developed by the author alongside the case study carried out in Chapter 9, investigating 'potential' SCVs.

As with the Bioscience case, WAG sector managers were provided with these findings to assist in finding potential solutions to the SCVs. WAG sector managers utilised their existing methods for the further investigation of these SCVs, where possible, as part of their normal business. No solutions were identified in the time scale of the study which was impacted by the reorganisation of the WAG.

8.7 CONCLUSION AND RELEVANCE TO THE THESIS

This case study has resulted in the identification of 'immediate' SCVs in this Welsh sector, the perceived reasons why they were believed to exist and the investigation of two, partially through the pilot testing of the framework proposed in Chapter 6. It has been proven that these two SCVs could potentially be filled within the region. The investigations have aided the development of the framework and the TOWS analysis recommends actions that could be adopted by the WAG. The results of this case were presented at ISL 2009 (Whitehead and Found, 2009).

The case is relevant to the thesis as it addresses the Research Questions in line with Table 6.1, updated with column three in Table 8.19 below.

Research Questions	How Addressed by this Case Study	Responses to the Research Questions Based on this Case Study
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	Data gathered and analysed from face to face and telephone interviews.	'Immediate' SCVs identified and quantified. A number of reasons found relating to why the SCVs are perceived to exist e.g. lack of a local supplier, capability.
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Through the development and testing, where possible, of the proposed framework detailed in Chapter 6.	Yes - See Chapter 6.
3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?		Through the pilot testing of the framework proposed in Chapter 6 using the WAG SDI&AT and proposed embeddedness and sustainable development assessment criteria tool.

Table 8.19 – Research Questions, How they are Addressed and the Responses for the Financial Intermediation and Insurance Case Study (Source: The Author)

Chapter 9 now carries out an investigation into 'potential' SCVs for Parc Aberporth and Unmanned Systems.

Chapter 9

Case Study

—

Unmanned Systems

—

'Potential' Supply Chain Voids

—

Parc Aberporth

CHAPTER 9 – CASE STUDIES – UNMANNED SYSTEMS – 'POTENTIAL' SUPPLY CHAIN VOIDS – PARC ABERPORTH

9.1 INTRODUCTION

This chapter reports the results of the case study investigations into 'potential' SCVs for Unmanned Systems companies who are exploring opportunities to use the facilities and services of Parc Aberporth in West Wales. The scope of the case studies is defined in Section 6.2 where Figure 6.3 demonstrates the case study approach across four Stages (i.e. 0 – 3). This chapter reports the findings of Stages 1 and 2 whilst addressing Research Question 1 for this sector.

9.1.1 STRUCTURE OF THE CHAPTER

The background to Unmanned Systems and Parc Aberporth is provided before the clarification of the scope of the case study and the reiteration of the Research Questions being addressed. Strategic benchmarking analyses are then carried out to compare a high profile, high technology sector and global competitors in the Unmanned Systems sector to the services offered by Parc Aberporth. This analysis results in a proposed template for the creation of a comprehensive web site for Parc Aberporth for the tri-party team to advertise jointly their offering. Next, the results of the semi-structured interviews are presented, identifying the 'potential' SCVs uncovered that may indicate a lack of local availability. These 'potential' SCVs are reviewed with stakeholders to see if possible suppliers exist in the region, with reference where possible to the framework developed in Chapter 6. Finally, the findings of this case study are presented and aligned to the relevant Research Questions before the chapter is concluded.

9.2 BACKROUND TO THE CASE OF UNMANNED SYSTEMS AT PARC ABERPORTH

Unmanned Systems include for example, unmanned air systems (UAS) consisting of an unmanned air vehicle (UAV) and a ground control system. Whilst the aerospace sector in the UK is facing a number of challenges (DTI, AEIGT, 2003; DTI, AEIGT, 2004), Unmanned Systems are understood to present significant opportunities for potential growth for both defence and civil operations (Ministry of Defence (MoD), 2005; Sandiford, 2006).

The Parc Aberporth technology site was established in 2005 based on a 'push' strategy by the WDA and offers support services for flying operations within restricted airspace. This is being enhanced to enable routine flying in Cardigan Bay for both civil and military systems and extended air space over land, which will become a significant enabling asset to the sector in achieving air certification of assets to operate in Europe and elsewhere. It is managed through a tri-party arrangement between the WAG IBW (e.g. buildings and offices), QinetiQ and the West Wales Airport who are partners in the operation of the West Wales UAV Centre (WWUAVC). Establishment costs to date are in excess of £15m and the airport site is to be developed at an additional cost of approximately £12m (WAG, 2007a).

The WWUAVC was designed to enable collaboration between companies, university research centres, government departments and the military by acting as the first point of contact for organisations seeking collaborative opportunities.

The vision for Parc Aberporth (WAG, 2007a) is to create a centre of excellence and flight test facility in the UK for Unmanned Systems through a cluster based approach. The critical success factors identified by WAG in achievement of the vision are:

- Wales is globally recognised for its expertise, capability and infrastructure for the industry under a sustainable Parc Aberporth brand.
- The sector in Wales delivers GDP equivalence of at least 20% of the total aerospace market today

- A well developed infrastructure, housing, education, transport network, health provision and other services, for example, which support the sector and benefits the broader community.
- A globally recognised cluster and flight test centre with routine operations.
- A strong Welsh supply chain providing components and services into the sector, in Wales and international markets. (This relates to the case study and Research Question 1).
- A leading edge science and engineering centre promoting collaborative research.
- The environment is sustainable at Parc Aberporth and requires little or no special sector involvement from WAG.

In early 2009, half of the buildings await occupancy by companies requiring the integrated services offered by Parc Aberporth, although a major UK military programme ('Watchkeeper') is to commence. Two issues are therefore presented:

- the possible occupation of Parc Aberporth on a full-time or campaign basis leading to
- the creation of demand for potential supply chain opportunities or SCVs in Wales, particularly locally to Parc Aberporth, where possible. This is the primary focus of the case study and aligns to Research Question 1. It is also useful to understand the challenges of getting companies to use the Parc Aberporth capabilities and establish themselves as customers of potential Welsh suppliers.

The latest draft strategy for aerospace and defence in Wales (WAG, 2009) states that SMEs in this sector are not sufficiently proficient or proactive in responding to the needs of OEMs or Tier one companies, therefore assistance is required in helping to identify supply chain opportunities for SMEs. In addition, a SWOT analysis identifies for example:

- Strengths in Parc Aberporth's capabilities and facilities and the academic base in Wales.
- Weaknesses in the poor infrastructure links in Wales i.e. roads and no mechanism to fund R & D collaboration between industry and academic partners.

- Opportunities include the move from Manned to Unmanned Systems within military environments, working with other RDAs in niche areas of strength and the development of supply chain opportunities for SMEs via collaborative R & D in Unmanned Systems.
- Threats highlight the poor abilities of SMEs to meet Tier one requirements.

9.3 BENCHMARKING ANALYSIS FOR PARC ABERPORTH AND UNMANNED SYSTEMS

'Immediate' SCVs in both the Bioscience and Financial sectors were subjected to PESTEL and SWOT analyses in Chapters 7 and 8 respectively. For Unmanned Systems, much analysis has been carried out by trade (e.g. UVS International, 2007; UVS International, 2008), specialist research organisations (e.g. Frost and Sullivan, 2008a, b, and c) and others (e.g. AEIGT, 2006; Sandiford, 2006; WAG, 2007b and 2009) relating to developing markets, technologies and specific capabilities demanded by customers, hence negating a need to carry out PESTEL, SWOT and TOWS here. However, such factors have been borne in mind in this case study, leading to a different approach being adopted for Parc Aberporth and Unmanned Systems to support the investigation of 'potential' SCVs.

Owing to the lack of engagement at Parc Aberporth, there are few customers demanding products and services from Welsh suppliers. Therefore, the author sought to establish the competitors to Parc Aberporth and benchmark their services in comparison to those offered in Wales to identify any gaps that Parc Aberporth may be able to pursue in relation to encouraging more companies to locate or carry out part-time, campaign operations in Wales, thereby creating potential demand for Welsh suppliers.

9.3.1 BENCHMARKING PARC ABERPORTH UNMANNED SYSTEMS SUPPORT SERVICES WITH FORMULA 1 TEST AND RACE CIRCUITS

The author elected to benchmark world class Formula 1 (F1) race circuits used to test and evaluate technologically advanced cars and motor bikes with Parc Aberporth's offering. This is because the competitiveness and secrecy, R & D process and technologies for sensors, communications systems, composite materials (e.g. carbon fibre, kevlar, thermoplastic and thermoset), telemetry and the test and evaluation activities and dedicated facilities are similar between F1, Moto-GP and Unmanned Systems. Therefore, a number of circuits were investigated to see what they offer to customers.

F1 Circuit/Name	Location/Country	Services Offered	Pricing Mechanism	Booking Mechanism	N
Bahrain International Circuit (http://www.bahraingp.com/ accessed 3 March 2008)	Sakhir, Bahrain	4 circuit layouts. Experiences. Events. Cars, motorbikes, karts.	Not stated on web site	No information.	I
Circuit de Catalunya (http://www.circuitcat.com/ingles/index.asp accessed 3 March 2008)	Barcelona, Spain	Circuit rental including hospital and medical assistance, marshalls, boxes, private security, closed circuit TV. Testing Feb, Apr, Jun, Jul, Nov. 3 circuits. F1, cars, motorcycles.	Not stated on web site	Registration form by E-mail. Telephone/Fax .	C
Circuito de Jerez (http://www.circuitodejerez.com/en/home.htm accessed 3 March 2008)	Jerez, Spain	Track booking. Use based on High Season - Nov - March. Medium Season - Apr, May, Jun, Sep, Oct. Low Season - Jul & Aug. F1, cars, motor cycles	Not stated on web site	E-mail via template on 'contact' page. Telephone or Fax.	T

Comunitat Valenciana Ricardo Tormo Circuit (http://www.circuitvalencia.com accessed 3 March 2008)	Cheste, Valencia, Spain	Circuit rental. 3 circuits. Technologic Support Centre - research centre from the Valencia University. Timekeeping. Cars, karts, motocycles. (Not F1)	Not stated on web site	E-ma Telep Fax. I to 6 n advar
Fiorano (Ferrari's own circuit)	Marinello, Italy	No information on Ferrari web site. Ferrari web site refers to Mugello circuit.	No information on Ferrari web site.	No inforr
Mugello (http://mugellocircuit.it/english/index.htm accessed 3 March 2008)	Mugello, Italy	20 pits, safety - closed ciruit TV, airfence, run-off areas, medical centre, track. F1, cars, motocycles.	Not stated on web site	E-ma Telep Fax. (name
Sepang Circuit (http://malaysiangp.com accessed 3 March 2008)	Sepang, Malaysia	5 circuit layouts, circuit calendar (Track days, races, private bookings. No F1 testing shown on calendar). Cars, karts, motocycles.	Not stated on web site	Telep E-mai contac contac calenc on we

Silverstone (http://www.silverstone.co.uk/php/home.html accessed 3 March 2008)	Northamptonshire, England	5 circuit layouts, general test days, track hire. Cars and motocycles. (No F1 testing shown on events calendar).	General Test Days - daily rates and dates in a 'menu'. No information for track hire.	Track hire - Telephone and E-mail named contact.	Race calen days, moto acad

Table 9.1 – Summary of Example Formula 1 Test and Race Tracks used for Campaign Development and Testing Ser

Table 9.1 shows that these circuits are operated on a part-time, campaign basis, where companies travel to use the unique facilities and services on offer, on a temporary basis. Pricing mechanisms are not on-line, suggesting that packages are different for each customer, depending on what is required. Miscellaneous information such as tourist information, school visits etc. is also provided.

R & D for example, is mainly carried out at company sites, i.e. Brawn GP in Brackley, Northamptonshire, McLaren Mercedes at Woking, Surrey, Red Bull Racing and Torro Rosso at Milton Keynes and Williams-Toyota at Wantage, Oxfordshire. Whilst these companies are within reasonably close proximity to e.g. Silverstone, only Force India is based at the circuit. Nevertheless, such companies are collaborating or being referred to as part of the UK motor sport cluster (Motor Sport Development web site, sponsored by DBERR and SEEDA). Jenkins *et al.* (2005; 2009) state that F1 teams use complex networks of high technology suppliers, often partners based on brand synergies and reciprocal marketing (e.g. Red Bull use Renault engines from France and Bridgestone tyres from Japan). Parc Aberporth has been established with the view that companies will locate on a full-time basis, rather than a campaign or project basis.

9.3.2 BENCHMARKING PARC ABERPORTH'S SERVICES AGAINST AIRCRAFT TESTING SERVICE PROVIDERS

In an attempt to look for something closer to Parc Aberporth and its particular capabilities, a small number of aircraft testing operations were identified and these are summarised along with their services at Table 9.2.

The results of this analysis show the types of test & evaluation services offered to the aerospace sector and the accreditations required. Again, pricing information is not on-line indicating that services vary and are contingent upon customer or project requirements.

Web Site/Company	Location/Country	Target Customers	Air Space	Runway	Conditions/Climate	Types of Aircraft/Weapons
Aircraft Research Association (ARA) (http://www.ara.co.uk/ accessed 6 March 2008)	Bedford, UK	Business jet, civil and regional aircraft customers, military aircraft and missile customers.	Not stated on web site	Not stated on web site	UK seasonal	Business jet, civil and regional aircraft, military aircraft & missiles.
Baker Aviation Services (http://www.bakerav.com/ accessed 6 March 2008)	Kansas, USA	Small & propeller driven aircraft customers, new and modified aircraft. Fixed not rotary wing.	Not stated on web site	Not stated on web site	USA seasonal	Based on the pictures on the web site, large aircraft and as stated, small and propeller driven aircraft. Fixed not rotary wing.
Marshall Aerospace Test Services (http://www.marshallaerospace.com/ accessed 6 March 2008)	Cambridge, UK	e.g. Boeing, EADS/Airbus.	(Cambridge airport)	(Cambridge airport)	UK seasonal	Large fixed wing, based on projects and customers identified on web site.

Table 9.2 – Summary of Example Aircraft Testing Services (Source: The Author)

9.3.3 BENCHMARKING PARC ABERPORTH'S SERVICES AGAINST THOSE OF GLOBAL COMPETITORS

A number of competitors to Parc Aberporth were identified in the trade press (e.g. North European Aerospace Test (NEAT) range, Baddeley in *Defence Director*, Sept 2007). These were investigated via their web sites, where available, to assess their locations, facilities and services on offer, climate, unique selling points (USPs) and supplementary information to aid selection for use by prospective customers. The results of this analysis are shown in Table 9.3.

Web Site/Company	Location/Country	Target Customers	Air Space	Runway	Conditions/Climate	Types of Unmanned Systems	Services O
Cambeltown, BAE Systems (http://baesystems.com/, http://hial.co.uk, http://eurousc.com/opsites/opsites/aspx accessed 3 March 2008)	Scotland, UK	Not known	Not known	Runway is 3,049 m long. (http://www.hial.co.uk/campbeltown-airport.html accessed 3 March 2008)	Scotland - seasonal	Not stated on web site.	Nothing on Highlands web site. (Campbelto operations'
Canadian Centre for Unmanned Vehicle Systems (CCUVS) (http://www.ccuvs.com/ accessed 4 March 2008)	Medicine Hat, Canada	Not stated on web site	Suffield range is 2,690 km2 (1,039 mi2). DRDC Suffield can negotiate access to the entire Suffield range and has primary access to a 430 km2 (166 mi2) area, the Experimental Proving Grounds. The entire airspace is restricted but some areas on the extremities of the range have access restrictions.	Not Stated on web site	Varied terrain and weather conditions. (Similar issues to those at NEAT and Robonic i.e. hours of daylight in Summer and Winter).	Medium Altitude Long Endurance unmanned air vehicle (MALE UAV) and smaller UAVs.	Range spac Forces Bas and Develc to other Ca Cold Lake. design, test commercia systems (ai vehicles). meet R&D support for
NEAT (http://www.neat.se/ accessed 3 March 2008)	Kiruna, Sweden	Military & commercial (civil) customers.	2 ranges over land: Esrange Space Centre & Vidsel Test Range and both can be linked temporarily giving 350 km one way long distance flight. 2,000 km sq of airspace, 3,000 km sq of ground space, ground to unlimited air space, live weapons firing, high availability, secure.	Kiruna and Vidsel airfields with 2500 m and 2300 m runways respectively.	Subarctic climate enabling testing all year. (like Robonic - 20 hrs of daylight in Summer and 20 hours of night in Winter!) Land not sea.	Unmanned vehicles, UCAV	Recovery c helicopter commercia telemetry. and techni Capability for space s tests. Chas also be use for photogr help prepar operations.

Web Site/Company	Location/Country	Target Customers	Air Space	Runway	Conditions/Climate	Types of Unmanne Systems
Robonic Arctic Test Flight Centre (http://www.robonic.fi /ratufc/index.html; http://www.airforce-technology.com/contractors/uav/robonic/accessed 3 March 2008)	Kemijarvi, Finland	Civil and military	The range area comprises 11,000 km² of air space which is uncontrolled i.e. class G airspace. UAV test flights conducted in segregated airspace.	1,200 m runway	20 hours daylight in Summer. (Conversely 20 hours of night in Winter! Cold weather testing). Supports all year round flying operations.	Support for both catapult and runway launched UAVs. Tactical UAVs.
Various	Spain	Not known	Not known	Not known	Good all year round conditions	Not known
Various Military ranges - USA (NRL - http://www.nrl.navy.mil/aic/ and Andersen - http://www.andersen.af.mil/ acessed 6 March 08)	Naval Research Laboratory (NRL), Washington, USA; Andersen Airforce Base, Guam, Pacific;	Not stated on NRL or Andersen web sites.	NRL - laboratory. Andersen - not stated on web site.	NRL - laborarory. Andersen - not stated on web site.	NRL - indoor, laboratory. Andersen - varied weather conditions.	Not stated.
Various, QinetiQ (http://www.qinetiq.com/ accessed 6 March 08)	Outer Hebrides, Various sites & ranges in the UK	Military projects quoted on web site (e.g. Watchkeeper)	Parc Aberporth quoted in relation to Watchkeeper contract.	Parc Aberporth quoted in relation to Watchkeeper contract.	UK seasonal climate.	Not known
West Wales Airport Ltd (http://www.wwaa.co.uk/ accessed 10 March 09)	Next to Parc Aberporth, Ceredigion, West Wales, UK	Not stated	Not stated	Not stated	UK seasonal climate.	Not known
West Wales UAV Centre (WWUAVC) (http://ibwales.com/server.php?show=nav.5944, http://www.ibwales.com/server.phpshow=nav.5912 accessed 3 March 2008)	Parc Aberporth, Ceredigion, West Wales, UK	No WWUAVC web site. Not known.	No WWUAVC web site. (Also, not stated by WAG IBW).	No WWUAVC web site. (WAG IBW state runway extending to 1199m).	UK seasonal climate.	Not stated by WAG IBW.

Web Site/Company	Location/Country	Target Customers	Air Space	Runway	Conditions/Climate	Types of Unmanned Systems	Services Offered
WWUAVC (Based on WWUAV slide show Jul 08)	Parc Aberporth, Ceredigion, West Wales, UK	Unmanned Systems industry	6 Nautical miles (Nm) Restricted Airspace (RA) Temporary (T), D201 area (75 x 45 miles (3375 sq miles)) being developed for routine access and managed access, extended in-land airspace (Area Control Procedural (ACP)). (Dedicated air space plus special arrangements for acess to Cardigan Bay).	1,199 m tarmac run way under development (West Wales airport)	Land, sea and coastal features, UK/Wales seasonal climate (can get windy e.g. PAUS 2008!)	Civil (e.g. police, fire, agricultural, oil and gas companies, environmental agencies) and Military UAVs. Size/weight - not stated.	Comprehensive - A and operating envi operation, access t environmental, cor evaluation facilitie meteorological ser technical and opera provision of platfo demonstration, test safety case analysi safety/airworthines expertise, risk redu design and advice, software certificati frequency safeguar unmanned systems Civil Aviation Aut regulations, demor civil application in systems and pilots. be developed inclu hotel, longer runw training school air tower, fuelling ser
White Sands Missile Range (http://wsmr.army.mil accessed 3 March 2008. Some of the information has not been updated since 2006)	New Mexico (Owned by the US military)	Military and domestic contractors (civil).	Range is 40 x 100 miles (4,000 sq miles) in size.	Not Stated on web site	Desert conditions.	Not stated on web site.	Military installatio and assessment ser
Woomera, BAES (http://www.woomera.com/au/range/woomera_airfield.htm accessed 3 March 2008).	Australia	Civil and military.	Largest land based range in the world. 127,000 km sq.	Woomera airfield main sealed runway measures 2372 x 45 m.	Desert climate. All year round trials in desert conditions.	Small and large UAVs.	Runway, hangars, passenger terminal refuelling, loading operations, 24 hr s services can be arr workshops close b Nurungar and Mar ranges, test ranges large hangars with sq m, together witl passenger terminal

Table 9.3 – Summary of Competitor Benchmarking Analysis in Relation to Parc Aberporth (Source: The Author)

Table 9.3 shows that the majority of competitors have web sites where prospective customers can investigate the offering and make contact. Also, some provide comprehensive information regarding facilities and services (e.g. CCUVS, NEAT, Robonic and Woomera) and enabling services such as travel and accommodation (e.g. Robonic and Woomera). Having benchmarked the services on offer by competitors with those identified by the WWUAVC (Jul, 08), it appears that Parc Aberporth and tri-party offering has comprehensive services and more USPs than its competitors. It also has its problems, for example, during the Parc Aberporth Unmanned Systems (PAUS) 2008 event, the flying schedule was cancelled owing to bad, windy weather.

A key issue is that Parc Aberporth does not have a dedicated web site detailing the integrated services offered by the tri-party partners. WAG IBW has web pages detailing the availability of buildings and the annual flying event, PAUS 2008, for example, whereas QinetiQ have a web page with limited information about Parc Aberporth, reflecting press releases. The West Wales Airport has its own web page but it only contains contact details (i.e. telephone number, fax and e-mail). No integrated information regarding the joint offering by the three partners for the site is available on the internet. On clarification of this anomaly with the WWUAVC (Davies, 28 Feb 08) the author was advised that industry insiders are well aware of the services on offer because of networking at international shows and the PAUS annual event. However, it was confirmed that a small marketing budget would be available from 1 Apr 08 to fund the development of a basic web site for the WWUAVC.

The WAG commissioned Experian (2007) to benchmark the global awareness of Parc Aberporth with 100 senior industry representatives working globally within the sector. Findings reported that awareness of both Wales and the sector was strong, but just under a third of those engaged were aware of Parc Aberporth or the PAUS event, where 9% of respondents had previously attended this, reinforcing the need for improved advertising. A high level of workforce skills, government incentives and a good economic climate were identified as the most important factors considered by respondents when looking to locate their businesses.

There are a number of slide shows available within WAG (e.g. Feb 2007, WAG, 2007b) and the WWUAVC (Jul, 2008) which clearly communicate the offering and benefits of using Parc Aberporth and this information may need to be made more widely available.

Learning from benchmarking the F1 and aircraft testing companies, along with the competitors to Parc Aberporth, an integrated web site to advertise the comprehensive and USP services offered by all three parties is proposed at Figure 11.1. Although this was offered for consideration via a key WAG stakeholder (Cremin, 5 Mar 08), who agreed that it would be preferred to other options, and needed to be discussed with all parties, no integrated web site for Parc Aberporth or the WWUAVC exists 30 Jun 09.

Without companies utilising the Parc Aberporth facilities and services, there is no demand for goods and services from the Welsh supply chain which explains why, to an extent, 'potential' SCVs may exist, thereby addressing Research Question 1. Hence the importance of attending to the lack of use of the site prior to the assessment of 'potential' SCVs with those companies expressing an interest in locating at Parc Aberporth.

9.4 SEMI-STRUCTURED INTERVIEWS – IDENTIFICATION OF 'POTENTIAL' SUPPLY CHAIN VOIDS

In recent years, the WAG has hosted annual events at Parc Aberporth to promote the site to UK and international businesses that have an interest in Unmanned Systems (i.e. PAUS 2008). At PAUS 2007, companies were asked to complete questionnaires for the WAG, to indicate their possible interest in using Parc Aberporth in the future. Based on the feedback of those expressing positive responses, the author identified a purposive sample to interview at the 2008 event, held 25 and 26 June, to identify 'potential' SCVs. Out of ten companies targeted, four agreed to take part in the research. Although the semi-structured interview questions identified at Appendix H were based on a 'theoretical' view of a company locating at Parc Aberporth, one of the respondents was in serious negotiations with the WAG in relation to a possible re-location to Parc Aberporth.

The purpose of the semi-structured interviews was to address Research Question 1 to see if 'potential' SCVs exist in Wales and why. Also, Research Questions 2 and 3 are dealt with in relation to the development of the framework, particularly the embeddedness and sustainable development assessment criteria tool introduced in Chapter 6, as elements from this were included in the interview questions.

Interviews were carried out with either the Owner, Technical or R & D Manager, Trials Manager or equivalent at each company.

Companies operating in this sector are very aware of potential competition with other companies and technological developments. Maintenance of security and secrecy are paramount. Therefore, to maintain ethical and confidentiality requirements, each company has been given a pseudonym;

- Red Kite
- Sparrow Hawk
- Osprey
- Buzzard.

The majority of interview questions were grouped by the key themes from the embeddedness, P & SCM and linkage literature under key headings:

- General company information
- Potential activities at Parc Aberporth to help scope the context of any SCVs
- P & SCM requirements at Parc Aberporth
- Other requirements at Parc Aberporth.

The final section relates to specific sourcing requirements and respondents perceptions of Parc Aberporth. Company representatives were asked to respond based on their best knowledge of any potential move to Wales.

9.4.1 RESULTS OF THE COMPANY DATA ANALYSIS

The types of companies interviewed and their key products and markets are summarised in Table 9.4. The 'country' shows if the company's HQ is in Wales, RoUK, Europe or elsewhere.

Company	Size of Company	Country of HQ	Key Products/Services	Sectors
Red Kite	Small	Other	Rotor UAVs and complete helicopter UASs.	Aerospace
Sparrow Hawk	Small	Europe	VTOL and fixed wing UAVs, remote control system, mobile cockpit, surveillance solutions	Defence, Civil - Environmental
Osprey	Large	RoUK/Europe	Defence and security systems - software information and communication systems	Defence, Civil
Buzzard	Medium	Other	Ceramic composite materials, Fixed wing UAVs, tracking antenna, portable launching system	Defence - aerospace with interests in civil applications.

Table 9.4 - Summary of the Sample Unmanned Systems Companies Interviewed (Source: The Author)

There is a mix of small, medium, and large companies, none of which have a HQ in Wales. Defence seems to have driven developments in this sector with three of the four companies operating in the defence environment. Aerospace is also popular with Red Kite and Buzzard. Three companies also have an interest in the civil application of UASs.

In relation to when the companies may use or locate at Parc Aberporth, replies are summarised in Table 9.5.

Company	Estimated Timescale for use/location at Parc Aberporth
Red Kite	2008/2009 (for 2 air frames – 1 large and 1 small under 7kg)
Sparrow Hawk	Autumn 2008
Osprey	Using Parc Aberporth from 2009/2010.
Buzzard	Any time in the future when the opportunity is right

Table 9.5 – Estimated Timescales for Potential Use of Parc Aberporth (Source: The Author)

Sparrow Hawk had been discussing the possibility of moving to Parc Aberporth with the WAG and their plans were fairly well developed. (Although they seemed quite clear on their timescales when interviewed, as of March 2009, they had not located at Parc Aberporth. The reasons for this are understood to relate to the credit crunch and the lack of investment funding from financial institutions (Bricknell, 11 Mar 09) to support such a move). Red Kite representatives were to have discussions with WAG but no firm plans relating to timescales had been formed. The remaining two companies were less clear about any potential use or move to Parc Aberporth.

Representatives were asked how they thought they may use Parc Aberporth and responses are at Table 9.6.

Company	Estimated Use of Parc Aberporth
Red Kite	Permanent R & D facility, ad-hoc demonstration facility
Sparrow Hawk	Permanent – for 5 years and possibly more
Osprey	Semi-permanent basis
Buzzard	Probably ad-hoc, short term demonstrations unless we enter into a larger UK involvement – then might be semi-permanent

Table 9.6 – Potential Use of Parc Aberporth (Source: The Author)

Whilst Red Kite was not clear on timescales, there was a definite idea of how they could use Parc Aberporth. As Sparrow Hawk's plans were developing well, they could specify a longer term commitment on a permanent basis. Osprey and Buzzard's estimates were less well defined at this early stage.

Interviewees were asked about their company's position on the 'Life Cycle', as an indicator of growth (Hanks *et al.*, 1993). Three companies are expanding their business either into or within the Unmanned Systems sector whilst Sparrow Hawk is in a late start-up phase. For information, target markets for these companies are reported in Table 9.16.

Regarding type(s) of assistance, if any, that may be sought from the WAG, all four companies stated that grants were of interest in considering the use or location at Parc Aberporth. Red Kite also cited assistance and contact with the CAA as very important. Sparrow Hawk estimates that local sourcing and supply chain opportunities will assist their potential move to Parc Aberporth. Cooperation with local farmers and land owners appeared to be a concern for Osprey's respondent as he had some local knowledge of the area. Buzzard was seeking potential opportunities in relation to government contracts and other commercial ventures.

9.4.2 RESULTS OF THE POTENTIAL ACTIVITIES WHICH COMPANIES MAY CARRY OUT AT PARC ABERPORTH

In relation to the types of products or services that might be produced at Parc Aberporth, replies are at Table 9.7.

Company	Possible Activities at Parc Aberporth
Red Kite	R & D, bringing customers to the area to demonstrate the products, European support and service centre for the UAV/aircraft. The UAV/aircraft, ground system, integrated systems, generate auto-pilots.
Sparrow Hawk	UAV Platform at all 3 levels i.e. Platform/aircraft, control systems and sub-systems e.g. cameras, sensors. (Used for intelligence gathering)
Osprey	R & D
Buzzard	Probably gather data and write reports at first. Later would be to develop a capability that could be utilised in the UK – i.e. emergency response or agricultural assessment

Table 9.7 – Potential Products or Services at Parc Aberporth (Source: The Author)

Both Red Kite and Osprey stated that R & D could feature at Parc Aberporth whilst reference to Table 9.10 reports that all four companies would be doing R & D, along with other activities. Red Kite could also foresee other activities such as demonstrating products to potential customers, along with the development and integration of systems and auto-pilots and the situating of a European support and service centre which shows a strategic vision for the potential use of Parc Aberporth. However, Red Kite also has some concerns relating to Parc Aberporth which are reported later as 'issues'. The potential Sparrow Hawk and Buzzard activities seem to be more tactical and operational.

Regarding placement of products or services may be positioned on the 'life cycle', Sparrow Hawk and their products and services are at the same position i.e. late start-up. Whereas Red Kite as a company is expanding, their products and services are between expansion and maturity. Osprey may be expanding as a company but the UAS activities are seen as pre-start-up, as early R & D. Buzzard is expanding but their products and services are between start-up and expansion.

Interviewees were asked the possible number and type of full time jobs to be created to assess the quality and skills required. This was based on an average salary in Wales of £27,447 p.a. (Welsh jobs web site accessed 1 May 2008). They were asked to specify average salaries per job type and to detail the typical qualifications they may require for such jobs. The replies to these questions are summarised in Table 9.8.

Company	Possible Nos/Type of Jobs to be Created	Possible Quality of Jobs	Possible Qualifications for Jobs
Red Kite	The R & D Director plus 5 – 8 R & D/Tech Engineering staff. Sales & Marketing – 5 – 8. For P & SCM and admin – possibly 1 or 2.	R & D/Tech Engineering – approx £30 - £40k p.a. per person. Sales & Marketing on commission (Average £15k p.a. per person plus commission). Going rate in Wales for P & SCM and admin.	R & D – Degree level. Post-grad. Experience for all others.
Sparrow Hawk	Initially – R & D & Technical/Engineering – 12 – 15 staff. These will also do the P & SCM activities.	Approximately double the average salary in Wales i.e. £55k per person p.a.	Ranges from GCSE to post-grad level
Osprey	Difficult to assess at this stage. As the operation could be of a semi-permanent nature, they would not necessarily have their personnel based at Parc Aberporth full time. Company may employ contractor(s).	Again, difficult to specify. Contractor(s) could be required to man the office/look after the office. Estimated salary not known.	Company policy is to employ post-grad level personnel. However, because of the potential nature of this, may employ equivalents, not necessarily post grads.
Buzzard	R&D possibly 2/year Technical and engineering possibly 4/year	Not familiar with wages in Wales but would expect these to be average or above	Graduate or postgrad for R&D and GCSE or degree for Tech/eng

Table 9.8 - Summary of the Possible Number, Type, Quality and Qualifications of Jobs at Parc Aberporth (Source: The Author)

Based on the information provided by Red Kite, Sparrow Hawk and Buzzard, Table 9.9 summarises the value in £ for possible jobs at Parc Aberporth with green indicating minimum values and yellow, maximum.

Company	Possible No of Jobs p.a.	Estimated £ Salaries per annum	Total Value in £ Salaries per annum of Possible Jobs at Parc Aberporth
Red Kite	1 x R & D Director	£ Not Known	Not Known
	Min x 5 Tech/Eng	Min of £30k	£150k
	Min x 5 Tech/Eng	Max of £40k	£200k
	Max x 8 Tech/Eng	Min £30k	£240k
	Max x 8 Tech/Eng	Max of £40k	£320k
	Min x 5 Sales & Mktg	£15k plus Commission	£75k
	Max x 8 Sales & Mktg	£15k plus Commission	£120k
	Min x 1 Admin/Purchasing & SCM	(Going Rate Min approx £12k)	£12k
	Min x 1 Admin/Purchasing & SCM	(Going Rate Max £20k)	£20k
	Max 2 Admin/Purchasing & SCM	(Going Rate Min approx £12k)	£24k
	Max 2 Admin/Purchasing & SCM	(Going Rate Max £20k)	£40k
	Total No of Jobs (Min) 12 incl R & D Director		Total Salaries (Min) £237k plus R & D Director
	Total No of Jobs (Max) 19 incl R & D Director		Total Salaries (Max) £480k plus R & D Director
Sparrow Hawk	Min x 12 R & D & Tech Eng	£55k	£660k
	Max x 15 R & D & Tech Eng	£55k	£825k
Osprey	Not Known	Not Known	Not Known
Buzzard	2 x R & D	Wales average salary or above	Approx £55k
	4 x Tech Eng	Wales average salary or above	Approx £110k
Totals per annum	**Min No of Jobs = 30**		**Total Salaries = £1.062M**
Totals per annum	**Max No of Jobs = 40**		**Total Salaries = £1.470M**

Table 9.9 - Summary of the Possible Number/Type and Value in £ of Jobs per annum at Parc Aberporth (Source: The Author)

Job values, stated as 'going rate' are based on data for average salaries for administrative and purchasing jobs in Wales obtained from the 'Total Jobs' web site. R & D and Technical/Engineering roles are of higher value than the average Welsh salary whilst P & SCM and Marketing are much lower. As Table 9.9 shows, the worst case scenario, based on a minimum number of jobs and minimum salaries could create 30 jobs at Parc Aberporth with a potential salary bill of £1.062m p.a., whilst the maximum could be up to 40 jobs with an annual salary value of £1.470m. The quality of such jobs is also of a high calibre with R & D and engineering dominating. Sparrow Hawk is firming up plans for Parc Aberporth and represents a strong case for locating their operation from Autumn 2008 onwards. Their estimated job numbers and quality of jobs are significant, representing a minimum of 12 R & D and Technical or Engineering personnel with annual salaries totalling £660k and up to a maximum of 15 such professionals totalling up to £825k p.a. Red Kite also represents a potentially significant skills and salary investment in Parc Aberporth and as the company are in discussions with the WAG, there is a possibility that these figures will strengthen as their discussions progress. With potential plans for both Osprey and Buzzard being less clear, their figures are more of a 'wet finger in the air' at this stage, representing a best guess.

Companies were canvassed about other potential activities that may be carried out at Parc Aberporth i.e. clarification of R & D and other activities. Table 9.10 summarises their replies.

Company	**R & D activities to be carried out at Parc Aberporth**	**Other Possible activities to be carried out at Parc Aberporth**
Red Kite	Yes	Sales & Marketing, limited P & SCM/Logistics and admin. Manufacture would remain in the USA.
Sparrow Hawk	Yes	Possibly manufacture in years 4 – 5.
Osprey	Yes	In addition to R & D - testing, trials for sensors/payloads.
Buzzard	Yes	Possibly manufacture and quality as well

Table 9.10 - Summary of Feedback Relating to Possible Activities at Parc Aberporth (Source: The Author)

All four companies stated that R & D would be carried out at Parc Aberporth. In addition, Red Kite may carry out sales and marketing, administrative and P & SCM activities, whilst manufacturing would remain in the USA. Sparrow Hawk identified that manufacture may follow in later years. Osprey may include testing and trials activities for sensors and payloads. Finally, Buzzard may add manufacturing and quality activities to R & D.

9.4.3 RESULTS OF THE PURCHASING AND SUPPLY CHAIN MANAGEMENT DATA ANALYSIS

This section relates to potential P & SCM activities that may be enacted by companies at Parc Aberporth including decision making, sourcing policy and procedures and their estimated annual Purchasing Budget (£). A summary of responses are shown at Table 9.11.

Company	Possibility of Autonomous P & SCM Decisions	Possible Sourcing Policy and Procedures	Possible Estimated Annual Purchasing Budget
Red Kite	Yes and no. R & D requirements – locally. Service and support spend would be centrally managed from the HQ.	Follow HQ guidelines first but make decisions locally.	R & D - £150k p.a.
Sparrow Hawk	Joint activity between Parc Aberporth operation and the HQ	HQ	£150k – 500k over 3 years
Osprey	Yes	Follow guidelines from HQ in UK but may need to modify to meet the needs of the Parc Aberporth activities	Difficult to estimate. Depends on the activities and R & D progress.
Buzzard	Yes	HQ probably	Maybe £1M

Table 9.11 - Summary of the Possible Autonomy of Purchasing and Supply Chain Management Decisions, Use of Sourcing Policies and Procedures and the Estimated Purchasing Budgets Relevant to Parc Aberporth (Source: The Author)

In relation to purchasing autonomy, both Osprey and Buzzard stated that decisions would be made locally. Red Kite would have autonomy for R & D expenditure but would need to refer to the HQ for service and support activities. Sparrow Hawk would make joint decisions based on discussions between Parc Aberporth personnel and the HQ.

For sourcing procedures and policies, both Sparrow Hawk and Buzzard reported that HQ regulations would be followed. Red Kite stated that HQ procedures would be referred to but decisions on purchases made locally. Finally, Osprey replied that HQ guidelines would be followed but may require modification to support any possible Parc Aberporth requirements.

Purchasing budgets varied between respondent companies. Both Red Kite and Sparrow Hawk were reasonably close at approximately £150k p.a. Osprey was unclear at this stage on the budget whilst Buzzard reported that theirs may represent up to £1m p.a.

Regarding the potential for local activities including sourcing, collaboration with SMEs and opportunities to collaborate with a Science & Research Centre at Parc Aberporth, Table 9.12 summarises the responses.

Company	**Requirement - Goods/Services to be bought locally**	**Possible collaboration with local SMEs**	**Possible collaboration with a Science & Research Centre at Parc Aberporth**
Red Kite	Yes – composites, mechanical engineering	Depends on what is on offer locally e.g. composites	Yes. Unmanned systems group at Aberystwyth has shared research goals.
Sparrow Hawk	Yes	Yes. Specifically - UAV aircraft construction, sensor and imaging equipment, testing facilities (i.e. wind tunnels)	Yes. Specifically - UAV aircraft construction, sensor and imaging equipment, mapping and data transfer
Osprey	Yes	Yes. Osprey hope to set up some SME activities. They also want to work with Aberystwyth University.	Yes – particularly Aberystwyth University

Buzzard	Yes	Yes – Universities and technical facilities. Local critical agencies (police, fire etc.,) transportation, and coastal	Yes – Aberystwyth University for agricultural, coastal or fisheries, resource data gathering – crops wind etc.

Table 9.12 - Summary of the Possible Requirement for Goods or Services to be Bought Locally and Collaboration with Local SMEs and Universities (Source: The Author)

At this stage, only Red Kite could specify the types of goods and services they may require to source locally and these were composites and engineering work. The other three companies would like to source locally but did not specify exact requirements.

In regard to collaboration with local SMEs, more clarity was forthcoming. Red Kite would be keen to collaborate on composites whereas Sparrow Hawk was clear in regard to UAV aircraft construction, sensor and imaging equipment and testing facilities (i.e. wind tunnels). Osprey would like to set up some SME activities and Buzzard were interested in collaboration with universities and technical facilities, local critical agencies (police, fire, etc.), transportation, and coastal, for example. Red Kite, Osprey and Buzzard would like to collaborate with Aberystwyth University (The Centre for Advanced Software and Intelligent Systems (CASIS)) whilst Sparrow Hawk would welcome the opportunity to collaborate with universities in relation to UAV aircraft construction, sensor and imaging equipment, mapping and data transfer capabilities. The potential for collaboration with local universities is a USP on Table 9.3.

Companies were asked from which countries, if any, do they currently source from, estimating % per country, based on the value of the annual purchasing budget. To demonstrate how this may change, they were invited to estimate how they saw purchasing profiles changing over the next five to ten years, with any reasons for this. Responses are listed at Table 9.13.

Company	Current Sourcing Activities by Country and % of annual Purchasing Budget	Estimate of how the purchasing profile may change over the next 5 - 10 years.
Red Kite	Approx 80% from the USA; approx 20% from EU and China	Volume to increase but % split between USA/EU/China to stay the same
Sparrow Hawk	Austria, Switzerland, Italy, UK, Spain, Germany	Not known
Osprey	Europe – various including Germany	Not known at this early stage.
Buzzard	Australia, USA, Canada, Israel	Better to buy from other countries such as the UK once new markets are established. International Traffic in Arms Regulations (ITAR) may be an issue if products are fabricated inside the USA.

Table 9.13 - Summary of the Current Sourcing Activities, by Country, % of Annual Purchasing Budget and How This May Change over the Next 5 – 10 years (Source: The Author)

The countries from which the participant companies purchase goods and services differ considerably. For both Red Kite and Buzzard who are currently located in 'other' countries, USA features for both, along with China and Europe for Red Kite and Australia, Canada and Israel for Buzzard. For the two European based companies, both Sparrow Hawk and Osprey source from European countries.

In regard to how this may change, both Sparrow Hawk and Osprey were unclear at this stage. However, Red Kite stated that the split between the USA, EU and China may not change but that the volume of purchases was expected to increase. Buzzard reported that other markets like the UK could be sources of supply, once established, but that ITAR may be an issue for products fabricated within the USA.

Interviewees were asked about their supply chain priorities and if they consider environmental implications when sourcing products and services. Replies are shown in Table 9.14.

Company	Key Priorities from Supply Chain(s)	Consideration of environmental implications when sourcing
Red Kite	1 – Quality and Cost; 2 - Flexibility	No – small quantities therefore costs. May consider depending on goods i.e. batteries. (Red Kite make approx 100 UAVs or aircraft p.a.).
Sparrow Hawk	1 – Quality; 2 – Flexibility; 3 - Cost	Yes – require suppliers to be as close as possible to the Parc Aberporth operation in Wales/UK
Osprey	1 - Quality 2 - Cost 3 - Local Then the rest	Yes – environmental issues are important.
Buzzard	1 - Quality, 2 - on time delivery, 3 - responsive feedback	Yes – company policy

Table 9.14 - Summary of the Key Priorities Required from Company Supply Chains and the Consideration of Environmental Issues (Source: The Author)

All four companies rated quality as the top priority from their suppliers. Cost was also a top priority along with quality for Red Kite. Cost was the second priority for Osprey and a third priority for Sparrow Hawk. Flexibility was cited by both Red Kite and Sparrow Hawk as a second priority. Local was identified as a third priority by Osprey, the only company to value local supply as a priority. Buzzard valued on time delivery and responsive feedback as priorities, after quality.

Environmental issues were considered by three of the four companies, when sourcing goods and services. For Buzzard, environmental issues are included within the company policy. Whilst Red Kite stated that environmental issues were not considered because of the low volume of current activities and associated cost issues, the interviewee did give examples where it may be appropriate, e.g. batteries.

In relation to accreditations or certifications that may be required of suppliers, Table 9.15 shows replies.

Company	Accreditations that must be used by Suppliers
Red Kite	ISO 9000 for some components. Others for e.g. specific aerospace materials e.g. aluminium.
Sparrowhawk	ISO 9000
Osprey	Various ISO accreditations in relation to aerospace/air safety specifications.
Buzzard	Yes (None specified)

Table 9.15 – Supplier Accreditations and Certifications (Source: The Author)

All companies expressed the need to use suppliers who had specific accreditations, whether ISO or aerospace industry standards.

With regard to the potential length of contacts with suppliers, these varied in timescales for each company. Buzzard expressed the most possible commitment by stating that contracts may be let for five years. Red Kite stated that ad-hoc contracts would be used. Both Sparrow Hawk and Osprey found it difficult to specify at this stage, citing 'one year' or 'short term'. This is interesting for Sparrow Hawk as they are the closest to committing to Parc Aberporth in Autumn 2008. Table 9.7 indicates that they may not know if suppliers exist in Wales or UK as these markets are not known.

9.4.4 RESULTS OF THE SALES DATA ANALYSIS

This section relates to the projected sales activities from the Parc Aberporth operation. First, companies were asked which sectors do they sell, or intend to sell to and how this may change over the next five to ten years. Responses are summarised in Table 9.16.

Company	Sales activities by % per sector	Possible % changes in sales activities by % per sector
Red Kite	Pipelines – 10% Mining – 20% Universities – 25% Military – 25% Agriculture – 10% Survey – 10%	Increase in Police and mining markets.
Sparrow Hawk	40% - Defence 60% - Civil Environmental	Defence to reduce to 30% and Civil environmental to increase to 70%.
Osprey	Defence security, Civil i.e. Police, ambulance.	Not known. R & D activity only at this stage.
Buzzard	Defence 50% Civil 50% This would depend on the opportunities that arise.	Defence will fall by 20% over the next 5 years – reasons that they will consolidate their activities once they are established. Agriculture and emergency will increase by 50% - reason is that they are emerging markets with significant potential. Coastal efforts increase by 20% - emerging markets again

Table 9.16 - Summary of Feedback Relating to Possible Sales Activities at Parc Aberporth and How These May Change Over the Next 5 – 10 years (Source: Author)

All four companies provided a view on potential sales activities to different market sectors. Generally, sales were split between defence and civil activities. Red Kite was very specific in relation to current markets and could see increases in both mining and police opportunities in the future. Sparrow Hawk foresaw a reduction in defence and an increase in civil markets. Osprey could not determine future sales at this stage and Buzzard could foresee a reduction in defence, falling by 20% over the next five years, whilst agriculture, emergency and coastal activities would increase significantly as they are emerging markets with significant potential.

9.4.5 IDENTIFICATION OF 'POTENTIAL' SUPPLY CHAIN VOIDS FOR UNMANNED SYSTEMS

This part of the interview sought to identify specific goods and services required by the companies.

Companies were canvassed on which key high-value inputs might be required from local or Welsh suppliers whilst identifying existing countries of supply. The responses from all companies are shown in Table 9.17. The annual purchasing budget for Red Kite was identified at Table 9.11 to be approximately £150k p.a. for R & D activities. Of this, they identified high cost drivers of machining services, printing and electronics work that they would prefer to source locally or in Wales, at a total in excess of £22k p.a. As machining services are currently carried in house it was difficult to estimate a value for these. The reasons for wanting to source locally vary, depending on the goods or services. Red Kite stated that machining services are of high importance to source locally because they require the ability to work closely with a company or university to ensure that the correct standards are achieved. For printing services, the requirement is classed as medium because of the need to 'anglicise' the American English and proof read any sales and marketing literature, for example. For electronics capabilities, the requirement is medium because Red Kite sought the ability to maintain contact with the supplier through design to prototype testing and to achieve a fast turn around for such activities.

Sparrow Hawk reported in excess of £100k p.a. for a variety of goods and services they would prefer to source locally/in Wales. They specified a requirement of high importance, for a small fixed wing aircraft, as the logistics costs to source it from elsewhere would be high. Other capabilities that they would prefer to source locally are of medium importance, based on their current lack of knowledge of potential suppliers in Wales or the RoUK. These requirements include cameras, infra-red sensors, temperature sensors, mapping systems and control systems, which are the highlighted as high cost drivers.

Osprey identified two requirements of high importance including high technology engineering and design and fit engineering to gain close proximity to the supplier and to achieve fast turn around times, to maintain the R & D programme.

Finally, Buzzard identified R & D skills, technical and engineering and collaborative work, totalling £5.5m p.a. which differs from the annual purchasing budget of approximately £1m p.a. identified at Table 9.11. R & D skills and technical engineering services are seen as of medium importance to Buzzard, with no specific reasons stated. Collaborative work is seen as high importance to develop local relationships with suppliers and achieve involvement in local communities for demonstration and capability initiation.

An estimated total of £5.622m of high-value purchases currently made outside of Wales or the RoUK are identified in Table 9.17, the majority of which is represented by Buzzard's requirements. Currently, all of these, with the exception of temperature sensors are sourced from outside of Wales and the RoUK. Five items are highlighted as high importance to source locally, with the remaining nine as medium. Reasons for these requirements include close proximity to R & D, local suppliers and collaborators, logistics issues and the lack of knowledge of the market in Wales, or the RoUK.

Company	Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source locally/in Wales (H/M/L)	Reasons why is it important to source locally?
Red Kite	Machining services (to aerospace grade)	In-house USA	N/K as in-house	H	Ability to work closely with a local company/university to ensure standards are met
	Printing services	USA	£12k per annum	M	See proofs etc. 'Anglicised' instead of USA English.
	Electronics work	Denver USA (was the Republic of Ireland for a quick turnaround but shipping was too long)	£10k per annum	M	Fast turnaround required from design to prototype to testing. Ongoing discussion with supplier.
Sparrow Hawk	Cameras	Germany, RoUK, Spain		M	Market in Wales/RoUK N/K
	Infra red sensors	Germany, RoUK, Spain		M	Market in Wales/RoUK N/K
	Control systems	Switzerland	Most important as 40% of costs	M	Market in Wales/RoUK N/K
	Mapping systems	Switzerland		M	Market in Wales/RoUK N/K
	Temperature sensors	Germany, RoUK, Spain		M	Market in Wales/RoUK N/K
	Small Fixed Wing aircraft	Switzerland	£100k per annum	H	Logistics reasons (long way from Switzerland)
Osprey	High technology engineering	Germany	N/K	H	Close proximity to R & D activities. Emergency or short-term fixed to keep R & D programme on track.
	Design and fit engineering	Germany	N/K	H	Close proximity to R & D activities. Emergency or short-term fixed to keep R & D programme on track.
Buzzard	R&D skills	USA	£1.5M	M	Not stated
	Tech and Engineering	USA	£2.5M	M	Not stated
	Collaborative work	USA	£1.5M	H	Get involvement with local community for demonstration and capability initiation

Table 9.17 - Summary of the Key High-value Inputs that Might be Required to be Sourced from Local or Welsh Suppliers (Source: The Author)

Companies were then asked which key high-value inputs might be sourced from elsewhere in recognition that some technologies or products may be specific to certain companies in specific countries. Table 9.18 shows the replies.

Company	Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source elsewhere (H/M/L)	Reasons why is it important to source from elsewhere?
Red Kite	Manufacturing facility	USA	N/K	H	Institutional knowledge, skills etc of existing staff
	Specific R & D	USA	N/K	H	Export reasons ie 'Made in the USA', technology is 'strategic' to the USA'/'ITAR' regulations.
Sparrow Hawk	Mapping systems	Switzerland	Not specified.	H	Critical component
Osprey	Sensor development and manufacture	Germany	Difficult to specify.	H	Air safety issues.
Buzzard	Purchase of sensors	Anywhere – Australia, Israel, USA	£2M	L	Don't have knowledge of what Wales produces
	Autopilot	USA	£1M	H	Don't think Wales makes any
	Engines	USA/RoUK	£1M	M	Don't know what Wales makes

Table 9.18 - Summary of the Key High-value Inputs that Might be Required to be Sourced from Elsewhere (Source: Author)

All four companies identified high-value products and services that they would need to source from outside of Wales, totalling approximately £4m. The majority of items are of high importance to the companies to source from these countries. Also, a lack of knowledge of the market in Wales or the RoUK is an issue. Red Kite would retain manufacturing and specific R & D capabilities in the USA because of its high importance in relation to the retention of skills and knowledge, and ITAR regulations. Sparrow Hawk identified that mapping systems may still need to be sourced in Switzerland as they are a critical component. Coincidently, during the interview with Osprey, the interviewee advised that mapping capability is to be developed as an in-house capability. Osprey has a number of large companies in their portfolio whose

products and services could be sold to other companies looking at locating at Parc Aberporth. Therefore, there may be a linkage here between the two companies.

Osprey stated that sensor development and manufacture may have to remain in Germany as it is of high importance for air safety reasons. Finally, Buzzard identified sensors, autopilot and engines as continuing to be sourced from elsewhere, at a total of up to £4m p.a. It is of low importance to purchase sensors from other countries and Buzzard state that this is because they are not aware of suppliers in Wales. Therefore, if a supplier could be found that met Buzzard's criteria, this may be an opportunity for Wales. Auto pilot equipment is of high importance to maintain a USA supplier as no Welsh suppliers are known about, if they exist. Engines are of medium importance and are currently supplied from the USA or the UK, which may have to be maintained. Again, no Welsh suppliers are known about, if they exist.

Interviewees were asked about low-value inputs that may be required to be sourced locally or from within Wales. Table 9.19 summarises these requirements.

Company	Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source locally/in Wales (H/M/L)	Reasons why is it important to source locally?
Red Kite	Administration	USA	N/K	M	Convenience
	Cleaning services	USA	N/K	M	Convenience
	Misc services	USA	N/K	M	Convenience
Osprey	Food	Germany	N/K	H	Close proximity to R & D.
	Fuel	Germany	N/K	H	Close proximity to R & D.
	Administrative staff/skills	Germany	N/K	H	Close proximity to R & D.
	Workshops at Parc Aberporth/West Wales Airport etc	Germany	N/K	H	Close proximity to R & D.
	Testing	Germany	N/K	H	Close proximity to R & D.
	These responses may suggest that Osprey do a lot of business with Germany, and are moving to Aberporth, whereas Osprey think they may be adding Parc Aberporth activity to the portfolio, if they go there at all.				
Buzzard	Nuts, bolts, electrical connections, batteries, etc.	USA	£1M	H	Rapid supply and ease of relationship

Table 9.19 - Summary of the Low-value Inputs that May be Required to be Sourced Locally or Within Wales (Source: The Author)

All but Sparrow Hawk identified low-value inputs that they may want to source locally or in Wales. Red Kite stated that for reasons of convenience, they would like to source administration services, cleaning and miscellaneous services locally. Osprey stated that they would require food, fuel, administrative skills, workshops and testing facilities. These were of high importance to maintain close proximity to R & D activities. No values were attributed to these, but they are believed to be of low value. Finally, Buzzard identified miscellaneous items such as nuts, bolts, connectors, batteries for up to a total of £1m p.a. that they would prefer to source locally and they specified it would be of high importance to do this to achieve rapid supply and develop or maintain local relationships. Of the nine requirements, six are high and three are of medium importance to source locally.

9.4.6 PERCEPTIONS OF PARC ABERPORTH

This section relates to respondents' perceptions of Parc Aberporth, its location and services and the experience to date of the WWUAVC or the WAG, if any. Experian (2007) had previously benchmarked the awareness of industry informants of Parc Aberporth.

Interviewees were asked what the three key motivators are for their companies to use or locate at Parc Aberporth. Table 9.20 summarises their responses.

Company	Motivators for companies using/locating at Parc Aberporth
Red Kite	1 - WWUAVC and the CAA permissions to operate aircraft on an almost 'paper free' basis is a huge benefit. 2 - Efficient R & D facility from testing in a lab to real scenarios in minutes at the Parc Aberporth site. 3 - UK base of operations for service and support centre.
Sparrow Hawk	1 - Understanding the CAA requirements for certification and working with the WWUAVC & QinetiQ are very important. 2 - Wide range of test areas i.e. the geography includes seam land (e.g. coal) and forest areas. 3 - Location is good for the EU and North America – being part of the Parc Aberporth community/centre for UAVs and UAS's.

Osprey	1 - Only site in Wales. (Only a few sites in the rest of the UK) 2 - Association with research partners at e.g. Aberystwyth University. 3 - Remoteness of the site enables flying and security of R & D assets.
Buzzard	1 - Test facility is up and running and supported by the local community. 2 - Have the attitude to develop and evaluate the technology by seeing how it works and taking a supportive interest in helping rather than hindering. 3 - Flight certification seems reasonably well sorted out and the facility has the respect of the CAA.

Table 9.20 - Summary of the Motivations to Use/Locate at Parc Aberporth (Source: The Author)

Motivators appear to vary for each company, based on their requirements. However, key themes include contact with or permissions to fly from the CAA, working with the WWUAVC and universities, facilities, location and different terrains over which to fly Unmanned Systems. Some of these are identified as USPs for Parc Aberporth in Table 9.4.

As a balancing question, company representatives were also asked for the three issues they perceive in using or locating to Parc Aberporth. Their replies are reported in Table 9.21.

Company	Issues relating to using/locating at Parc Aberporth
Red Kite	1 - Location: Wales is appealing because of its proximity to Red Kite's European market and so they would hope to have many visitors from the continent come to the facility for demos etc, but driving through the country in the UK can be challenging. As an alternative to driving, air service would be a good option, but the interviewee assumes that will be a few years in coming to Parc Aberporth, and success for small air line carriers is not guaranteed. An easier near term solution would be to improve the rail service. Research online indicates that Arriva TrainsWales is the company managing the rail service, and that nearly everyone who has reviewed their service describes carriages in disrepair and safety concerns, grime and rubbish on the trains, and an unreliable service. The timetables show that it is much faster to drive than to take the train. If it were easier to reach the facility, both for employees and customers, it would be much more attractive. 2 - Weak US dollar: Red Kite is a start-up looking to expand, and it is not clear whether they can afford to move to the UK with the pound as strong as it is. This is certain to change over time, but for now it is a significant hurdle for them. 3 - Attracting talent: As a start-up looking to expand and re-locate specifically the R & D department, Red Kite will be looking for creative and motivated employees who are genuinely interested in computing, aviation, flight control software, etc. and who enjoy the tinkering and experimentation that leads to innovation. There are a few people like this in the current location, and they fear that the situation may be similar in Wales. Start-up hubs in the US like San Francisco, Boston, Austin, etc. have the employee talent and attract that talent by virtue of being full of start-ups, but are also very expensive and do not offer the guaranteed airspace like the WWUAVC. Anything that West Wales can do to keep the talent from leaving the area upon graduation and to attract new talent to the area would be helpful for small high tech businesses like Red Kite.
Sparrow Hawk	1 - The perception of the difficult roads and long distance to travel for potential clients. 2 - The UK CAA requirements regarding radio communications frequencies. 3 - The weather, especially the wind, and its effect on flight test schedules.
Osprey	1 - Moving equipment around Europe is already an issue for Osprey but the remoteness of Parc Aberporth poses other problems. 2 – Perceived local hostility from locals at Parc Aberporth to flying activities, 'people with money' etc. 3 – Up to a third of the year's flying could be lost to the weather/wind conditions.
Buzzard	1 - Need to establish initial funding from outside UK to provide demonstrations and perform experiments there. 2 - Need to start early to develop relationships with end users of the technology that need to be "brought in" at an early stage. 3 - Initial testing would initiate additional concepts and opportunities

Table 9.21 - Summary of the Issues Relating to the Use or Location at Parc Aberporth (Source: The Author).

Issues include some of the main motivators identified in Table 9.20 e.g. the location has strengths and weaknesses. The logistics associated with getting to and from Parc Aberporth was cited by Red Kite, Sparrow Hawk and Osprey. The weather is also identified as a problem by Sparrow Hawk and Osprey. Other concerns are attracting skilled talent to the area, radio frequencies, the weak US dollar, funding, potential local hostility to flying activities and the opportunities to collaborate with end users of technologies.

Interviewees were then asked about their experience of any dealings with WAG or the WWUAVC. Replies are recorded in Table 9.22.

Company	Views on WAG and/or the WWUAVC
Red Kite	This is the 3rd show that Red Kite has attended. WWUAVC very helpful with the flying operations etc. The paperwork for the CAA has its usual headaches associated with a US company working in a foreign country (Wales) – again – WWUAVC – (named individuals) very helpful. (Named individual) from WAG very helpful.
Sparrow Hawk	Very positive, helpful, good guidance.
Osprey	No direct contact with WAG or WWUAVC.
Buzzard	Excellent. They appear to be very supportive and genuinely interested in the establishment of the Parc Aberporth facility

Table 9.22 - Summary of the Experience of Dealings with the Welsh Assembly Government and/or the West Wales UAC Centre (WWUAVC) (Source: The Author).

In general, the comments about both the WAG and the WWUAVC were very positive. Only the representative from Osprey had not yet had any contact with either organisation.

Finally, interviewees were asked if they had any other comments to make about Parc Aberporth and replies are recorded in Table 9.23.

Company	Any other Comments about Parc Aberporth
Red Kite	The location!
Sparrowhawk	No
Osprey	Could foresee some issues with locals if/when Parc Aberporth becomes fully operational because of flying activity.
Buzzard	It is well located in the remote SW corner of Wales. The flight facilities there offer all the main environments you might want – off shore, coastal and inland.

Table 9.23 - Summary of Any Other Comments Relating to Parc Aberporth (Source: The Author).

These comments echo those made for motivations and issues with the Parc Aberporth site and location. Clearly the location is the biggest advantage and disadvantage!

In the margins of the interview process, two respondents were candid about their reasons for attending the PAUS 2008 event or considering opportunities to use the Parc Aberporth site. For example, the Red Kite Director of R &D and the founder of the company had previously attended the event, accompanied by his wife, who really likes Wales and the UK and would like to re-locate. Also, The CEO of Buzzard works closely with a contact in the USA Department of Defence (DoD) whose wife is from Wales and insisted he should visit the event. Hence, such motivations above may be coloured by needs other than business requirements and as such are difficult to uncover, quantify or indeed base potential government support on.

In summary of this section, 'potential' SCVs have been identified, addressing Research Question 1. They now required validation to see if they exist in Wales or if possible suppliers could be found.

9.5 VALIDATION AND ASSESSMENT OF 'POTENTIAL' SUPPLY CHAIN VOIDS

The Aerospace Wales Forum was consulted as they host capability data for their member companies and could assess the SCVs, with a view to identification of potential suppliers in Wales. The Aerospace Wales Forum also host 'Aerolink' on an annual basis, including a 'meet the buyer' facilitated event where buyers from within or outside

Wales can meet potential Welsh based suppliers as well as other meetings with their constituents, therefore it was believed they were best placed to provide the validation and assessment role.

A meeting was held with the Aerospace Wales Forum 28 Aug 08 to review the 'potential' high-value SCVs which resulted in the updated version of Table 9.17 at Table 9.24 below, which shows potential suppliers in Wales for a number of the SCVs.

Company	**Products/services**	**Current source of Supply (Country)**	**Possible Suppliers in Wales as advised by Aerospace Wales Forum**
Red Kite	Machining services (to aerospace grade)	In-house USA	Gardners Aerospace Wales Ltd, CAV Aerospace Ltd, Magellan, Neath Precision Engineering (part of the Bodycote group)
	Printing services	USA	Infographics plus many others in Wales
	Electronics work	Denver USA (was RoI for a quick turnaround but shipping was too long)	Axiom, ACW Technology Ltd, TT Electronics Integrated Manufacturing Services (Ttems)
Sparrow Hawk	Cameras	Germany, RoUK, Spain	Sony UK
	Infra red sensors	Germany, RoUK, Spain	N/K
	Control systems	Switzerland	Saygrove Electronics
	Mapping systems	Switzerland	N/K
	Temperature sensors	Germany, RoUK, Spain	ESI Technology Ltd
	Small Fixed Wing aircraft	Switzerland	N/K
Osprey	High technology engineering	Germany	N/K
	Design and fit engineering	Germany	N/K

Buzzard	R&D skills	USA	N/K
	Tech and Engineering	USA	N/K
	Collaborative work	USA	N/K

Table 9.24 - Results of the Review of 'Potential' Supply Chain Voids with Aerospace Wales Forum Showing Possible Sources of Supply in Wales (Source: The Author)

Table 9.24 shows that of the 14 'potential' high-value SCVs identified, one of which is skills based (i.e. R & D skills), possible Welsh suppliers could be identified for six (i.e. approximately 43%).

To better scope the wider demand for 'immediate' SCVs, other companies in the Bioscience and Financial sectors were contacted for specific SCVs. However, it is difficult to scope the broader market for Unmanned Systems requirements as companies are outside Wales. Two large UK defence contractors were asked to take part in the study at PAUS 2008 but were unable to because of time constraints. The MoD was contacted to identify the types of requirements for the 'Watchkeeper' programme but these were being managed by the two UK defence contractors who could not help.

Regarding the high-value items identified at Table 9.18 which companies presume would continue to be sourced from outside Wales, only the manufacturing facility may be found in Wales, possibly at Parc Aberporth.

Therefore, in this sector, a different investigative approach is required for 'potential' SCVs. Once a company expresses interest in using or locating at Parc Aberporth, there is a need to get them to Wales and invite potential suppliers to meet with them and discuss specifics. The people who need to be involved in such activities are WAG sector experts, Welsh aerospace and other appropriate companies, including SMEs and possibly representatives from CASIS and other Welsh universities. The author recognises the expertise of the Aerospace Wales Forum in convening such activities as they already organise and host the annual 'Aerolink' event in Wales.

It is therefore proposed that for 'potential' SCVs, such an activity is coordinated by the Aerospace Wales Forum (or a similar organisation in the future) which is currently funded by the WAG. It could be added to 'Aerolink' or convened separately, depending on the level of interest from companies looking to use or locate at Parc Aberporth. In discussions with the Aerospace Wales Forum and the WAG, they agreed that this was the most sensible way ahead to address such issues.

9.6 PILOT TESTING OF THE PROPOSED SUPPLY CHAIN VOIDS FRAMEWORK

The framework developed in Chapter 6 was pilot tested within this case study as depicted in the four-field plan at Table 9.25.

WHAT - ACTIVITY	HOW - METHOD	WHO - ROLE(S)	STANDARD(S) - Thesis Chapter, WAG, etc.)
Identification of individual product or service related SCVs	Semi-structured interviews	The Author	Ch 2, Ch 6
Recording SCVs	Semi-structured interviews – Microsoft Excel	The Author	Ch 2, Ch 6
Review and validation of identified SCVs	Meeting held 28 Aug 08	Aerospace Wales Forum	Ch 6
Understand how to select appropriate SCV(s) for investigation	Meeting held 28 Aug 08	Aerospace Wales Forum	Ch 2, Ch 6
Investigate options to resolve SCV(s)	Proposed meeting(s) convened by Aerospace Wales Forum ('Aerolink' model i.e. meet the buyer).	Aerospace Wales Forum, WAG sector experts, Welsh companies including SMEs, University representatives	Ch 6

Select most suitable option(s) to resolve SCV(s)	Proposed meeting(s) convened by Aerospace Wales Forum ('Aerolink' model i.e. 'meet the buyer').	Aerospace Wales Forum, WAG sector experts, Welsh companies including SMEs, University representatives	Ch 6
Decision making	Proposed 'Catchballs'	WAG sector experts, Aerospace Wales Forum	Ch 6
Review and evaluation	Proposed feedback and verification loops	WAG sector experts, Aerospace Wales Forum	Ch 2 (WAG Strategies and policies), Ch 6

Table 9.25 – Four-Field Plan of the Pilot Testing of the Framework Developed in Chapter 6 (Source: The Author)

Based on the findings from the interviews, WAG sector managers and the Aerospace Wales Forum agreed with the proposals to investigate 'potential' SCVs in the future.

As the WAG ROI and SDI&AT models were not yet developed, these could not be used within this case study but it is proposed in Chapter 6 that they would be suitable. The embeddedness and sustainable development criteria tool was developed alongside this case study.

WAG sector managers continue to utilise their existing methods for the further investigation of these 'potential' SCVs, as part of their normal business. No solutions were identified in the time scale of the study which was impacted by the reorganisation of the WAG and environmental factors such as the credit crunch which delayed companies such as Sparrow Hawk in their re-location plans.

9.7 CONCLUSIONS AND RELEVANCE TO THE THESIS

This case study has resulted in the identification of 'potential' SCVs in this sector and reasons why they may exist (e.g. the under utilisation of Parc Aberporth). The framework proposed in Chapter 6 has been developed and pilot tested during the investigation of 'potential' SCVs concurrently with this case study. Whilst possible solutions in Wales were identified for six of the 'potential' SCVs, these remain owing to the various challenges that exist in this complex sector. Although they have not been resolved, the investigations have aided the development of the framework and have identified areas for consideration should the WAG wish to adopt such a framework.

The case is relevant to the thesis as it addresses the Research Questions as shown in Table 9.26.

<table>
<tr><th>Research Questions</th><th>How Addressed by this Case Study</th><th>Responses to the Research Questions Based on this Case Study</th></tr>
<tr><td>1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?</td><td>'Potential' SCVs data gathered and analysed from face to face interviews. The demand for products and services based on occupancy levels at Parc Aberporth.</td><td>'Potential' SCVs identified and quantified. A number of reasons exist relating to why they may exist e.g. lack of utilisation of Parc Aberporth, clarification required about the requirement.</td></tr>
<tr><td>2. Can a generic framework be developed to address supply chain voids in capability within the sectors?</td><td rowspan="2">Through the development and testing, where possible, of the proposed framework detailed in Chapter 6, including the generation and partial application of the embeddedness and sustainable development assessment criteria tool.</td><td>Yes - See Chapter 6.</td></tr>
<tr><td>3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?</td><td>Through the pilot testing of the framework proposed in Chapter 6 considering for e.g. the WAG SDI&AT and proposed embeddedness and sustainable development assessment criteria tool.</td></tr>
</table>

Table 9.26 – Research Questions, How they are Addressed and the Responses for Unmanned Systems at Parc Aberporth (Source: The Author)

Chapter 10 now draws together the results from the three case studies, comparing and contrasting these with the literature to summarise the findings from the study.

Chapter 10

Discussion of Findings and Cross-Case Comparisons

CHAPTER 10 – DISCUSSION OF FINDINGS AND CROSS-CASE COMPARISONS

10.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter serves to discuss the application of the framework through the cases detailed in Chapters 7, 8 and 9, identifying similarities and differences between the sectors and the SCVs whilst analysing the findings against the literature reviewed in Chapters 2, 3 and 4.

An initial comparison of the sectors and those companies engaged in the study at Stage 1 are summarised, before the results are compared and contrasted against each literature theme to describe and explain the findings. Finally, the chapter concludes with a summary of the discussion in relation to the Research Questions and relevance to the thesis.

10.2 RESULTS - SECTORS AND COMPANIES

Table 10.1 summarises the key characteristics of those companies interviewed in Stage 1 of the research.

Criteria/ Characteristics	**Biosciences (No of companies/Info)**	**Financial Intermediation & Insurance (No of companies/Info)**	**Unmanned Systems (No of companies/Info)**
Semi-structured interviews	**4**	**5**	**4**
Welsh HQ	1	4	Nil
RoUK HQ	2	1	1 (or RoEU)
RoEU HQ	1	Nil	1
RotW HQ	Nil	Nil	2
Company size			
Small	Nil	Nil	2
Medium	4	1	1
Large	Nil	4	1

Time in Wales			
Up to 5 years	Nil	1	Nil
Up to 15 years	Nil	2	Nil
Over 15 years	4	2	Nil
Annual T/O			
Up to 10m euro (£6,750,000).	1	Nil	N/A
Up to 50m euro (£33,750,000)	3	Nil	N/A
Up to 74m euro (£50m)	Nil	1	N/A
Over 74m euro (£50m +)	Nil	4	N/A
Tele-Interviews	**12 (responses)**	**49 (contacted)**	**Nil**
Welsh HQ	5	5	
RoUK HQ	3	39 (i.e. 80%) (Of these, 11 have parent companies in RoEU or RotW)	
RoEU HQ	2	4	
RotW HQ	2	1	
Company Size			
Small	7	18	
Medium	2	9	
Large	3	22	
Markets	5 of the telephoned companies reported: RoUK, then RoEU and RotW. (Wales is not the focus).	RoUK, North America, Australia, Japan, Netherlands and Germany (IBW, 1 May 07)	Markets are by sector, not location but are understood to be global.

Table 10.1 – Comparison of Key Data for Companies (Source: The Author)

For Biosciences, most companies have an HQ in Wales, closely followed by the RoUK, whereas for Financial, over 80% of HQs, hence strategic decision making responsibilities are outside of Wales. For Unmanned Systems, all companies have HQs outside of Wales. In relation to company size, a total of seven in Biosciences are small, six medium and three large whilst Financial companies are dominated by large, followed by small then medium. Unmanned Systems includes two small, one medium and one large company.

All four Bioscience companies engaged for the semi-structured interviews have operated in Wales, for over 15 years, albeit in three of the companies, under different

ownership and names whereas most Financial companies have been in Wales for up to or over 15 years. None of the Unmanned Systems companies yet reside at Parc Aberporth.

In relation to annual T/O, the Financial companies out perform those in Biosciences. No data was collected from Unmanned Systems companies for annual T/O. Priority markets for both Biosciences and Financial are the RoUK. Unmanned Systems markets are reported by sector, rather than location but are understood to be global.

Annual purchasing budgets or expenditure are listed in Table 10.2.

Sector/Company	**< £250k**	**£250k to £1m**	**£1m to £5m**	**£5m to £10m**	**Over £10m**	**Not Stated/ Known**
Biosciences	Based on total purchasing activities					
Anemone						
Buttercup						
Clover						
Daisy						
Financial Intermediation & Insurance	Based on Apple reporting on its 2 strategic supply chains, Elderberry on their most expensive segment (advertising) and the rest on total purchasing activities.					
Apple						
Banana						
Cherry						
Damson						
Elderberry						
Unmanned Systems	Based on potential budget for operations at Parc Aberporth i.e. mainly R & D					
Red Kite						
Sparrow Hawk						
Osprey						
Buzzard						

Table 10.2 – Comparison of Annual Purchasing Budgets/Expenditure for the Sectors (Source: The Author)

Table 10.2 shows that the biggest budgets reside with the Financial companies and the smallest with Unmanned Systems, which reflects their size and activities. The Bioscience companies have a spread, with Daisy, investing to expand into the USA market, spending the most.

This section shows that the contingent factors of companies and sectors differ leading to the need for a SCVs framework that is adaptable and not prescriptive.

10.3 RESULTS - COMPARISONS TO THE BACKGROUND COGNITIVE THEORY LITERATURE

This section discusses the SCVs framework and compares results of the case studies to each other through the cognitive theories reviewed in Chapter 3.

10.3.1 BACKGROUND COGNITIVE THEORIES – SEARCH THEORY

This sub section compares the results of the case studies to the search theory literature where three elements are relevant:

- the search for suppliers by customers, based on specific criteria. Whilst companies were not asked to explain their search process, they were asked, on what basis suppliers are sought which relates to Research Question 1 and why SCVs may exist.
- the search by WAG for PESTEL type factors and regional sector based information to help identify options to fill SCVs. A proposal for how this can be achieved in the future is included in Chapter 6 within the SCVs framework addressing Research Questions 2 and 3.
- The author's experience during the search for literature and suitable sample companies, aligning to the application of research methods.

10.3.1.1 THE SEARCH FOR SUPPLIERS BY CUSTOMERS - CONTINGENCY THEORY

This study shows that the search for a suitable supplier is contingent upon criteria such as industry accreditations and P & SCM priorities such as cost, quality and delivery (see Chapters 7, 8 and 9 and sub section 10.3.1.1.3). Proctor (1978) asserts that when exercising choice between alternatives, firms set minimum values to be achieved by objective, selecting the strategy to achieve such objectives. Therefore, the search for suppliers or solutions to SCVs is contingent upon specific criteria or strategies of an organisation.

10.3.1.1.1 GENERAL SEARCH ACTIVITIES – PURCHASING AND SUPPLY CHAIN MANAGEMENT

Across the three case studies, two Financial companies are noticeable. Banana reported that they have an increasing number of suppliers selected by various members of the management team indicating that a combination of Decision Making Unit (DMU) roles (Webster and Wind, 1972) may be enacted by one person, based on a particular buying decision (Robinson *et al.*, 1967), although the CEO is the 'approver' on major purchases. The growth in the number of suppliers may also be a feature of a search based on exploration of the most attractive possibilities first (Salop, 1973). If suitable suppliers are not found, selection criteria may become less stringent. Banana's supply chain priorities or location of suppliers were not specified. Stigler (1961) identifies that wealthy customers search less than poor customers whilst Rothschild (1974) asserts that companies who fail to find low prices during initial searches become more willing to accept higher ones. In an organisation buying context, with tight budgets, it may be unlikely that P & SCM decisions would generally be made in this manner (see Kotler *et al.*, 1999) although Banana's rapid growth and a lack of clarity of priorities could result in the application of a number of search activities highlighted here.

For Advertising, Elderberry relies upon known sources in London and Manchester and do not seek alternative suppliers. This could relate to the Dellaert and Haubl (2004) finding where searchers over-rely on recently encountered information.

In relation to the study, the results indicate that Banana has few criteria in place against which to search for and select suppliers and the process seems to be ad-hoc, resulting in a growing supply base without spatial boundaries whereas Elderberry appears to rely on trusted sources so are failing to search the market for newer, more competitive solutions which may be local and meet supply chain criteria of quality, cost and delivery.

This sub section shows that the way companies search for suppliers can impact their business (i.e. cost and complexity) and implicate SCVs.

10.3.1.1.2 SEARCH THEORY AND PURCHASING AND SUPPLY CHAIN MANAGEMENT PROFESSIONALISM

Levels of P & SCM professionalism (Carr-Saunders, 1928, cited by Lysons and Farrington, 2006; Lysons and Gillingham, 2003, pp 22 – 24; Quale, 2006) in companies may impact the ability of staff to search for and select the best suppliers. Manning (1976) states that specialists will attempt to find out everything they need to know when operating in the market.

Table 10.3 shows the comparison between the Bioscience and Financial companies in relation to professional purchasing qualifications. As some of the questions for Unmanned Systems companies related to potential staffing levels and roles, they were not canvassed about this.

Sector/Company	Professional Qualifications (Y/N)	Types of Purchasing Qualifications
Biosciences		
Anemone	Y	MCIPS, Institute of Industrial Management Diploma, Certificate of Production and Inventory Management
Buttercup	N	(Specialist PhD or Degree relating to microbiology).
Clover	Y	MCIPS
Daisy	Y	MCIPS
Financial Intermediation & Insurance		
Apple	Y	1 of the Apple respondents – MCIPS, Purchasing Degree and an MBA in 'lean' SCM. The other business operation does not have any staff with purchasing qualifications.
Banana	Not Clear	Various qualifications, not necessarily purchasing.
Cherry	N	None
Damson	Y	Purchasing Manager – MCIPS, MCILT, HNC in Business and Finance, Post-graduate diploma in Management, Masters in Procurement.
Elderberry	N	None

Table 10.3 – Comparison of Levels of Professionalism Between the Biosciences and Financial Sectors (Source: The Author)

Bioscience companies are relatively more qualified in purchasing related activities than the Financial companies. The technical nature of Biosciences may value more specialised and qualified personnel (Manning, 1976; Quale, 2006). MCIPS support continual professional development which allies to Carr-Saunders and Wilson (1928, cited by Lysons and Farrington, 2006) and Quale (2006) whilst ethical P & SCM is supported by Lysons and Gillingham (2003, pp 22 – 24). The complexity and dynamism of the external environment in which sectors operate indicates that a plethora of skills are required in changing organisations, including those relating to P & SCM (Handfield, 2006).

Manning (1976) also highlights that many markets are characterised by non-specialists who will be less capable than specialists. In the Financial sector, only two respondents employed professionally qualified P & SCM staff. Maybe this is a less technical sector where specialist qualifications are not as highly valued. However, in Banana's case, some P & SCM professionalism may assist in the company's supply chain development, to align with Handfield (2006).

P & SCM personnel are individuals and the search theory literature identifies issues associated with decision making. Soelberg (1967) suggests that the choice processes of individuals are key to management decision making whilst Belich and Dubinsky (1995) contest that internal firm factors such as managerial processes, organisational structures and capabilities can impact upon successful information search. Palich and Bagby (1995) assert that search behaviours are bounded by the decision maker's knowledge and experience, Schmidt and Spreng (1996) state that successful search depends upon an individual's ability and motivation whereas Ioannides and Loury (2004) advise that access to information is heavily influenced by social structures and networks. Finally, Yeoh (2005) states that whilst large companies have the resources to obtain and process greater amounts of information, smaller firms may need to trade between the efficiency of data processing and the need to take action. Therefore, they may adopt a solution from an option that was recently accessed (Dellaert and Haubl, 2004).

Levels of purchasing professionalism could implicate the number of suppliers each company has on their respective supplier databases. The comparison between Biosciences and Financial sectors is shown at Table 10.4.

Sector/Company	No of Suppliers on 'Database'	Comments
Biosciences		
Anemone	440	Of these, 160 are key suppliers
Buttercup	Not stated	
Clover	75	
Daisy	1900	The number of suppliers has been reduced and continues to be reviewed
Financial Intermediation & Insurance		
Apple	58	Split across 2 supply chains – strategic suppliers
Banana	Not Known	Business is growing quickly
Cherry	<50	
Damson	900	500 are 'live' and the database is being reduced
Elderberry	2	Advertising Agencies only

Table 10.4 – A Comparison Between The Number of Suppliers on Respective 'Supplier Databases' (Source: The Author)

For Biosciences, all four companies are medium sized and have operated in Wales for over 15 years. Table 10.2 shows that Daisy, with the largest purchasing budget for the sector, has to review and rationalise (e.g. Poirier, 1999) its supply base as it may have grown over time. Anemone has the second largest budget, 160 key suppliers plus 280 others which may require rationalisation. Anemone, Clover and Daisy have MCIPS qualified personnel so it can be implicated that they are managing their supplier databases (Carr-Saunders and Wilson, 1928, cited by Lysons and Farrington, 2006; Quale, 2006).

For the Financial sector, Banana is expanding quickly, has no professionally qualified staff for P & SCM (Axelsson and Wynstra, 2002), cannot specify a purchasing budget or the number of suppliers it uses. Damson seems to be the company with the challenge of rationalising its supply base whilst Apple, Cherry and Elderberry appear to be in control, albeit only Apple reports having professional qualifications within one business unit.

All of these will have an affect on companies' P & SCM personnel's ability, whether professionally developed or not, to make decisions based on the search for suitable suppliers. They will also affect the way that WAG or RDA personnel operate the SCVs framework. Whilst the study did not focus on individual or organisational behavioural theories, such factors cannot be ignored although Guinipero *et al.* (2008) identify that only 2% of P & SCM articles include 'buyer behaviour'.

10.3.1.1.3 SEARCH AND CONTINGENCY THEORIES AND PURCHASING AND SUPPLY CHAIN MANAGEMENT PRIORITIES OR PERFORMANCE MEASURES

This section relates to the search for suppliers based upon priorities or performance measures demanded by customers in relation to Research Question 1. Table 10.5 summarises the supply chain priorities reported by companies in all sectors.

Sector/ Company	Cost	Quality	Delivery	Flexibility	Local	Other
Biosciences						
Anemone	**1**	**2**	**3**	**4**		
Buttercup		**1**	**2**	**3**		
Clover	**5**	**1**	**2**	**3**	**4**	
Daisy		**1 =**	**1 =**			
Financial Intermediation and Insurance						
Apple SC1		**1**	**2**			
Apple SC2	**1**	**2**	**3**	**4**		
Banana	**It depends on what is being bought**					
Cherry	**2**	**1**	**3**			
Damson	**All with various weightings**					
Elderberry	**1**	**2**	**3**			
Unmanned Systems						
Red Kite	**1 =**	**1 =**		**2**		
Sparrow Hawk	**3**	**1**		**2**		
Osprey	**2**	**1**	**4 =**	**4 =**	**3**	
Buzzard		**1**	**2**			**3 – responsive feedback**

Table 10.5 – A Comparison Between The Supply Chain Priorities of the Companies in the Sectors (Source: The Author)

For Biosciences, quality is either priority one or two for all companies, followed by delivery and flexibility. Quality related issues dominate supplier evaluation and selection in the Greek pharmaceuticals sector (i.e. Kirytopoulos *et al.*, 2008). A number of supplier performance models commence with quality (e.g. Simpson *et al.*, 2002; Heriot, 1996; Medori, 1999). Local supply was only rated at priority four, by Clover.

For the Financial companies, quality, cost and delivery are in the top three for most companies as supported by Simpson *et al.* (2002), Heriot (1996), Day (2002), Baily *et al.* (2005) and Jacoby (2005) for sourcing, and Slack *et al.* (2001), Buffa (1983) and Hill (1985) for operations management. Flexibility was also cited but local supply was not prioritised by any companies.

For Unmanned Systems, quality is again the top priority, similar to Biosciences, followed by either cost or flexibility in most cases. Remaining priorities include delivery, local supply and responsive feedback. These are supported by Simpson *et al.* (2002), Varmazis (2006), Heriot (1996), Day (2002), Baily *et al.* (2005), Jacoby (2005) for sourcing, Slack *et al.* (2001), Buffa (1983), Hayes and Wheelwright (1984) and Hill (1985) for operations management and within Medori (1999) and Saad and Patel (2006).

Across the three sectors, cost is not paramount, thereby quelling Beamon's (1999) concerns regarding supply chain measures dominated by cost.

Owing to the need for regulation and accreditation in Biosciences and Unmanned Systems, quality was cited as the most important priority from the supply chain (see Heriot, 1996, for example). Therefore, such companies are unlikely to expend effort, using for example a sequential search process (i.e. Axell, 1974; Rothschild, 1974) to seek out lowest prices (Rothschild, 1974). For example, Daisy advised that if an item is required for a heavily regulated Good Manufacturing Practice (GMP) product, once a supplier is found and approved, then generally the company would stick with them as it is expensive to search for other suppliers. (The author acknowledges that this also supports TCE (Coase, 1937; Williamson, 1985). Gronau (1971) and Rothschild (1974)

identify that the cost of search increases as time passes, hence the amount of search may decrease. Therefore, in Biosciences for example, the Fixed Sample Size (FSS) strategy proposed by Manning and Morgan (1982) may be more appropriate.

In the Financial sector, there was more of a split between cost and quality indicating that companies may balance the cost of search with achieving a lower cost, providing that quality standards are achieved (Axell, 1974; Rothschild, 1974; Dellaert and Haubl, 2004).

Wilson *et al.*, (1989) investigate mathematical models of group choice concluding that one does not meet all buying requirements as contingency factors such as price, quality, delivery and service or maintenance influence the choice of model. Wilson *et al.*, (1991) furthers the 1989 study testing the situational factors of buying tasks and perceived risk to see how these contingencies affect the types of models used by DMUs. Heriot (1996) suggests contingency factors for use in decision making of sourcing activities within manufacturing organisations in the USA. In this Study, Bioscience companies all carry out some scale of manufacture whilst Unmanned Systems companies are involved in R & D and/or manufacture. This study extends Heriot (1996) in that a service sector in the UK has been investigated.

Crone (1999) discovered that there is a need for world class accreditations and standards to be achieved and complied with. He suggests that RDAs should establish supplier development initiatives for such things. Certainly, under the residual of the 'Source Wales' initiative there remains a policy to help companies attain quality accreditations e.g. ISO 9000 whereas standards and accreditations appropriate to specific sectors are now promoted via Industry Forums in many cases. There have also been WAG assisted activities to achieve e.g. ISO 9000. In this study, both Biosciences and Financial companies reported that they and their suppliers have to comply with industry specific standards and accreditations and for a couple of Bioscience companies, with more generic quality standards i.e. ISO 9001. For Unmanned Systems companies, all reported the need to use suppliers who had specific accreditations, whether ISO or aerospace industry standards.

This sub section demonstrates that supplier search and selection activities are contingent upon the purchasing requirement relating to a new task, straight re-buy or modified re-buy (Robinson *et al.*, 1967), the priorities demanded by the customer such as cost, quality and delivery (e.g. Heriot, 1996; Day, 2002; Baily *et al.*, 2005; Jacoby, 2005) and industry specific accreditations (Crone, 1999) as identified by different companies in different sectors. It is therefore important for the WAG to understand such requirements to see if they can be addressed as SCVs.

10.3.1.2 SEARCH FOR INFORMATION BY THE AUTHOR

Throughout the study, the author searched for secondary data, literature and suitable companies to interview in line with the methodology detailed in Chapter 5. Many of the features of search theory relate to the author's own experience, in particular that of serendipity (Foster and Ford, 2003) and the surprising location of key papers across disciplinary areas, use of resources and the need to balance search time with research milestones (Gronau, 1971; Rothschild, 1974), whether to terminate the search based on findings to date (Axell, 1974; Rothschild, 1974) and ability and motivation at different times during the study (Palich and Bagby, 1995; Manning, 1976; Salop, 1973; Rothschild, 1974; Schmidt and Spreng, 1996). In addition, Zhang *et al.* (2006) and Johnson *et al.* (2004) report that consumers search between 1.2 to 3.3 web sites before making purchases. In relation to this study, the author searched in excess of these parameters for literature, secondary data and suitable companies.

10.3.2 BACKGROUND COGNITIVE THEORIES – CONTINGENCY THEORY

This sub section compares the literature to the Hoshin Kanri framework and its application to the case studies whilst addressing Research Questions 2 and 3.

10.3.2.1 CONTINGENCY THEORY AND THE HOSHIN KANRI FRAMEWORK PROPOSED FOR USE BY THE WELSH ASSEMBLY GOVERNMENT

The author proposes a Hoshin Kanri policy deployment framework for use to investigate SCVs which was developed using the cognitive theory literature. The design was based on the author's experience of working with a relatively small number of people from departments within WAG and recognises Kast and Rosenzweig's (1985, pp 116 – 119) findings that the environment and internal sub-systems of organisations are almost unique, providing a basis for the design and management of specific organisations. Hence, whilst every effort was made to ensure a fit between the WAG and the SCVs framework, it requires further testing and possibly modification for the WAGor other RDAs.

There are a number of contingencies seen to be relevant to the operation of this framework. Chandler (1962) identifies a contingent relationship between strategy and structure and the environment and performance whilst Child (1984) and Schein (1965) suggest that the importance of 'management choice' (planning) and policy deployment has been highlighted as critical to high organisational performance. These aspects are reflected within the framework through the adoption of a Hoshin Kanri approach, suggestions on who should carry out investigations into SCVs (i.e. sector teams), PESTEL, SWOT and TOWS (Johnson *et al.*, 2006) analyses and the need to align daily activities to the strategies from planning through implementation, evaluation and feedback (e.g. Lethbridge *et al.*, 2007; Daneke, 1980) to guide the WAG. Environmental uncertainty is the most influential contingency factor (Duncan, 1972) hence a PESTEL is never complete.

Burns and Stalker (1961) identify that technological and market changes affect organisational structure. The framework recognises the need for teams consisting of different (organic and participatory) membership, for different sectors, based on technologies, for example, Biosciences are complex and require levels of expertise and involvement that other sectors such as Tourism may not. Pennings (1992) also recognises that the environment affects organisational structure. The existing

hierarchical and departmental structure of the WAG has not enabled cross-functional team working but the reorganisation may go some way towards this.

Groff and Muth (1972) recommend that capabilities should be developed based on their fit with the requirements of the firm as determined by the environment in which it operates. The inclusion of this element in the framework recognises the imperative for the alignment of SCV investigations with the broader business and economic development environment and WAG strategies.

By way of observation, Blau (1970) and Pugh and Hickson (1976) state that the size of an organisation determines if it is 'bureaucratic' or 'decentralised'. Within the framework, it is recommended that to overcome 'standardised bureaucracy' (Child, 1973; Child, 1975; Weber, 1968), empowered roles and responsibilities should be allocated to those investigating SCVs in a contingent manner. In support of this, Child (1984) asserts that structured design relates to the allocation of roles and responsibilities, grouping of functions, decision making, coordination, control and reward. However, Child (1972) states that whilst organisational structures are partially determined by size, they are also shaped by people, their perceptions, values and beliefs and Robbins (1990) reminds us that bureaucracies are efficient in large organisations.

Chandler (1962) and Galbraith (1973) for example, assert that strategy affects structure. The framework depends upon a diversified structure to investigate SCVs, rather than a functional or departmental approach. In addition, Quale (2006) states that organisational strategy determines a purchasing department's structure and activities.

Woodward (1965) defines technological determinism asserting that it influences operational methods and organisational structure. She also states that the production system predicts organisational requirements (hence possible sector or regional needs), thus the purchasing requirements which could result in the identification of a SCV. This is supported by Perrow (1967 and 1970) who identifies that technology also determines decision making. In addition, technology is recognised as an important contingency in relation to management planning (Schein, 1965). Manning (1976) identifies the importance of specialists and non-specialists in relation to search

activities. In the framework, it is proposed that technologies associated with SCVs implicate the roles or personnel involved in their investigation, and the search criteria and model used. Therefore, the technological contingency is important to the SCVs investigation process.

Criticisms have been made about technological determinism as technological variables are only related to organisational structure in specific cases (Child and Mansfield, 1972) and Mansfield (1986). However, it is supported in this study e.g. Biosciences companies.

The classical schools of management theory (Taylor, 1947; Fayol, 1949) promote universal principles for best management practice or 'one best way' of dealing with a given problem. Alford and Hughes (2008) dismiss this in relation to the public sector and propose that management depends upon the nature of the task, context, technologies and resources and recommend a decision support framework challenging traditional notions of strategy development and deployment. This approach has been adopted to develop the SCVs framework which is neither prescriptive nor linear in application, but contingent upon the situation (Luthans, 1976).

The variety of contingencies enforce the assertions of Watson (1991), Akao(1991) and Deming (1986) in that Hoshin Kanri should be applied in a contingent manner, hence the design and recommended operation of the SCVs framework.

10.3.2.2 CONTINGENCY THEORY AND PURCHASING AND SUPPLY CHAIN MANAGEMENT

Stonebraker and Afifi (2004) propose a contingency model for SCM. They find that technology defines organisation and supply chain structure, which enlarges the technological determinism literature (Woodward 1965; Perrow, 1967 and 1970; Schein, 1965) to include SCM.

In this study, the strategic P & SCM requirements of each sector are summarised in Table 10.6. Although for Financial services, technology does not figure, for Data Centre Services this contingency would be more relevant.

Sectors	P & SCM Contingencies
Biosciences & Unmanned Systems	Technological requirements, regulatory imperatives, accreditations and supply chain priorities.
Financial	HQ decision making, cost, quality and the need for a pan-UK service

Table 10.6 – Purchasing and Supply Chain Contingencies (Source: The Author)

The supply chain for Contract Testing is simple in comparison to that for Freeze Drying and the market demand in Wales for both SCVs was identified as low (Crone, 1999; NIEC, 1999). Table 7.18 shows that the main markets for those Biosciences companies involved in the tele-interviews are RoUK, RoEU and RotW, not Wales. Similarly, the SWOT analysis shows that principle markets are not in Wales but UK (London, Cambridge and SE England), Europe (France, Germany and Scandinavia), North America, Australia and Japan (IBW, 1 May 07) including those for Freeze Drying and Contact Testing.

For Freeze Drying, Anemone shows an internationally based supply chain as the capabilities required exist elsewhere in Australia and the USA. This is supported by e.g. Alderman (2005) and Rees (2005) in that clusters can be localised and involve collaborators, or complementary suppliers from elsewhere. Also, Kempainen and Vepsalainen (2003) assert that supply chains are developing into 'encapsulated networks'. Similary, UNCTAD (2001) recognises that supply chains are re-structuring as firms retain for example, R & D and contract out other elements of the process. Zucchella (2006) finds that there are both local and global ties between firms of different types.

Existing suppliers of high-value goods and services demanded by the Unmanned Systems companies reside broadly where the companies are located. No Welsh suppliers are used but would be preferred for particular requirements, should the companies re-locate or utilise Parc Aberporth. However, some high-value items would

still be required to be sourced from outside Wales as shown in Table 9.18 owing to the need to maintain skills, ITAR regulations, critical components, air safety issues and a lack of knowledge of the level of availability, if any, of Welsh capabilities for specific items. The latter issue may present an opportunity for a Welsh company.

Rozemeijer *et al.* (2003) propose a contingency model for corporate, synergistic purchasing for use with companies who have been the subject of M & A activity and results show that synergistic purchasing activities in the sample companies were weak. For Biosciences, Daisy reported moves towards group-wide purchasing activities for laboratory consumables for which their site spent £100k p.a and Anemone advised a group approach to Disaster Recovery. For Unmanned Systems, no synergistic purchasing activities were identified. Around 90% of all purchasing in the Financial sector was found to be centralised at HQs, therefore synergistic purchasing seems more common in this sector.

The contingent structures of P & SCM organisations and DMUs, based on the factors determined by the types of buying decisions reported in the case studies are also relevant to the study. Quale (2006) states that the structure of a purchasing department is determined by company strategy. In P & SCM, there are a number of organisational and decision making models relating to the levels of centralisation or decentralisation, for example, Quale (2006, pp 61 – 61), Lyles and Payne (2000) and Lysons and Farrington (2006, pp 168 – 172).

For Biosciences, all companies subjected to semi-structured interviews make on-site decisions which aligns to Quale (2006, pp 61 – 62) and 'complete decentralisation', or in Clover's case, 'complete centralisation' as they are an HQ with two other office sites in the USA and Japan. This could also link to 'centralised purchasing' and 'decentralisation' (Lysons and Farrington, 2006, pp 168 – 172). All four Biosciences companies are medium sized. This indicates that they are not bureaucratic as with large companies, operating decentralised structures (Blau, 1970; Pugh and Hickson, 1976; Child, 1973). Buttercup summarised the types of purchases they typically make and the criteria used as shown in Table 7.6. This can be compared to Robinson *et al.* (1967), for example, where Buttercup identify 'general' items, these could align to 'routine'

purchases; 'commodity' items appear to relate to 'modified-re-buy' and 'high value' requirements could ally to 'modified re-buy' or 'new task', depending on the need.

For Financial services, two companies operate a mixed economy whereby some orders are authorised on site but others are bought as part of Group or HQ decisions e.g. general goods such as stationary, or orders over a specific value (i.e. £10m). This matches the mixed operations defined as 'multi-level' by Quale (2006, pp 61 – 62). Banana and Elderberry operate, what they term as, a 'decentralised' system, albeit they are HQs which allies to 'complete centralisation' (Quale, 2006, pp 61 – 62) or 'centralised purchasing' (Lysons and Farrington, 2006, pp 168 – 172). Cherry is 'centralised' with all purchasing decisions made at their HQ site, aligning to Quale (2006, pp 61 – 62) and Lysons and Farrington (2006, pp 168 – 172). In general, 90% of companies contacted during the study had centralised purchasing at their HQ. Only Cherry is a medium sized company. The others are all large, hence more cases of centralised purchasing and possibly a more bureaucratic structure (Blau, 1970; Pugh and Hickson, 1976; Child, 1975; Weber, 1968).

For Unmanned Systems, both Osprey and Buzzard stated that P & SCM decisions would be made locally which allies to Quale (2006, pp 61 – 62) for 'complete decentralisation', and 'decentralisation' (Lysons and Farrington, 2006, pp 168 – 172). Red Kite would have autonomy for R & D decisions but would defer to HQ for service and support activities, relating to Quale (2006, pp 61 – 62) and 'multi-level' purchasing. Sparrow Hawk would make joint decisions based on discussions between Parc Aberporth based personnel and HQ, thereby supporting the 'consultative' approach proposed by Lyles and Payne (2000).

With reference to sourcing procedures and policies, all Unmanned Systems companies reported that HQ regulations or procedures would be followed, with P & SCM decisions made locally, supporting the 'consultative' approach (Lyles and Payne, 2000). Unmanned Systems companies include two small, one medium and one large organisation with three looking to expand and one in a late start-up phase. The structures for these companies seem to fit with 'decentralised' rather than 'bureaucratic' (Blau, 1970; Pugh and Hickson, 1976) although three of the four rely on advice from

the HQ regarding P & SCM decisions which is akin to larger, bureaucratic organisations (Child, 1973; Child, 1975; Weber, 1968).

The P & SCM DMU was defined by Webster and Wind (1972). For Biosciences, Anemone reported that their Requisitioning Department makes all P & SCM decisions whilst Daisy involves the Purchasing Manager or equivalent, matching with Burns and Stalker (1961) and a 'hierarchical' structure. These DMUs do not appear to include cross-functional representation, for example. Buttercup and Clover both use a multi-disciplinary team approach utilising the expertise of other specialists which aligns more closely to a DMU approach and 'cross-functional purchasing' defined by Lysons and Farrington (2006, pp 168 – 172), using teams of people from across different functions in the organisation. This also seems to link to Burns and Stalker (1961) in relation to a 'participatory' structure and Manning (1976) using specialists in the search for suppliers.

The technological requirements in Biosciences and Unmanned Systems are complex compared to Financial services. However, in relation to the DMUs used in Biosciences, there is a mix of models. For Anemone and Daisy, decision making resides in one area. This may reflect Perrow's assertions (1967 and 1970) that structure is a function of the predictability of technology. Anemone carries out analysis and manufacture whilst Daisy does development, manufacture and supply. Conversely, Buttercup carries out molecular design and manufacture whilst Clover does research, development and manufacture, possibly indicating a more multi-skilled requirement in P & SCM decision making. Woodward (1965) asserts that P & SCM requirements are determined by the production system which may also indicate the differences between the DMUs in these companies. In addition, Kast and Rosenzweig (1985, pp 116 – 119) suggest that the environment and internal sub system of an organisation are unique, providing the basis for design and management of specific organisations.

For Financial services, Apple, Cherry and Elderberry all use a multi-disciplinary team approach (Wilson *et al.*, 1991), in parallel with 'cross-functional purchasing' (Lysons and Farrington, 2006, pp 168 – 172). Cherry states that most expenditure is controlled by their directors (Christopher and McDonald, 1995), over and above approved limits

which fits with 'centralised purchasing' (Lysons and Farrington, 2006, pp 168 – 12) and Burns and Stalker (1961) relating to the 'hierarchical' structure. Banana said it depends on what is being bought as the CEO makes the ultimate decisions on major purchases (Christopher and McDonald, 1995) whilst the IT manager, MDs and Channel Heads also make purchasing decisions which supports Axelsson and Wynstra (2002) where non-purchasing specialists make buying decisions. The Banana operation seems to support 'decentralisation' at the individual level (Lysons and Farrington, 2006, pp 168 – 12). Finally, Damson uses a combination of the Purchasing Manager or equivalent, a multi-disciplinary team approach and/or other option, contingent upon what is being sourced, hence a fit with Lysons and Farrington (2006, pp 168 – 172) at different levels i.e. 'centralised purchasing', 'decentralisation' or 'cross-functional purchasing' which also links to Burns and Stalker (1961) in relation to a 'participatory' structure.

None of the companies in all three sectors include customers or suppliers in P & SCM decision making, thereby failing to meet 'cross-organisational purchasing' (Lysons and Farrington, 2006, pp 168 – 172). The proposed framework in Chapter 6 suggests the inclusion of the Aerospace Wales Forum, or an equivalent organisation as facilitators to help customers and suppliers in the Unmanned Systems sector for example, to have detailed discussions and agree sourcing requirements and potential solutions.

This sub section also appears to support the General Contingency Theory of management offered by Luthans (1976) which asserts that management is not universal but depends on the situation; in this instance, what is being sourced, by whom. Hershey *et al*, (2009) supports this via 'situational leadership'.

This study demonstrates that the theoretical perspectives of search and contingency can underpin P & SCM, contributing to the findings of Burgess *et al.* (2006) in relation to the lack of evidence of this in the literature. In addition, search and selection of suppliers are predicated upon contingent requirements of companies and sectors which can implicate SCVs.

10.3.2.3 CONTINGENCY THEORY AND MATERIAL INPUT OR SUPPLIER LINKAGES

In addition to technology (Woodward, 1965), other contingencies have been identified as determinants of material input or supplier linkages (Crone, 1999), but have not been aligned to contingency theory as Crone did not review this in his thesis:

- 'lean' initiatives at older multinational plants which could relate to strategy or technology contingencies e.g. Chandler (1962) and Woodward (1965).
- the specific nature of a plant's demand for inputs and the 'supply potential' of the regional economy. This is supported by NIEC (1999), UNCTAD (2001) and Blomstrom and Kokko (2001) and could ally with technology contingency (e.g. Woodward, 1965).
- external ownership and control, contradicting Marshall (1979), or autonomy (e.g. Williams, 1997; Giroud and Mirza, 2004). This could align to size contingency (e.g. Blau, 1970).
- different sectors vary in their demand levels and Material Input Linkages (MILs) (e.g Biosciences and technology (Woodward, 1965)).
- multinational plant attributes can affect levels of MILs i.e. age, size (e.g. Blau, 1970), method of establishment (in region), nature of products (i.e. complex, standard etc.), method(s) of production and R & D function (e.g. technology i.e. Woodward, 1965). Size, entry mode and nature of the production network are echoed by Chen *et al.* (2004).
- corporate context e.g. purchasing/sourcing strategies determine if local or global suppliers are to be used, also supported by Phelps (1993a) and aligns to the strategy contingency (e.g. Chandler, 1962).
- strong integration in group wide production systems which may align to size and technology contingencies (e.g. Blau, 1979; Woodward, 1965).
- centralised or pooled procurement and knowledge sharing initiatives supported by Rozemeijer *et al.* (2003).

Marshall (1979) finds that production technologies, environmental certainty and firm size all influence levels of local sourcing, supporting Woodward (1965), Burns and Stalker (1961), Pennings (1992) and Child (1973; 1975).

Scott-Kennel (2007) supports the technology contingency in relation to organisation (e.g. Woodward, 1965) or supply chain structure (Stonebraker and Afifi, 2004), and for linkages, identifying that the smaller the gap in technologies between the domestic and foreign firms, the increasing likelihood of linkages and other spillovers occurring in a region. She also identifies competitiveness as a key to linkage development, which is supported by the cluster literature (e.g. Porter, 1990) and potentially by environmental contingencies such as market changes (e.g. Burns and Stalker, 1961).

Hines (1993), NIEC (1999), UNCTAD (2001) and Blomstrom and Kokko (2001) identify that the quality of local sources of supply, 'supply potential' and availability, geographic proximity and supplier competency all impact levels of local sourcing whilst Dicken (1992) asserts that the nature and characteristics of the host economy influence this. UNCTAD (2001) also cites the host economy's overall policy environment and economic and institutional framework and the market of an FDI firm (i.e. if it is producing for the domestic market the likelihood is its inputs will be sourced domestically. These relate to environmental contingencies (e.g. Groff and Muth, 1972).

Baily *et al.* (2005) state three reasons for finding local suppliers which are technological advances, increasing concentration in supply markets and increased specialisation and relate to technology and environmental contingencies (e.g. Woodward, 1965 and Groff and Muth, 1972).

Chen *et al.* (2004) find that the intensity of local linkages also relates to the FDI location or country and the level of distinctive or inimitable resources available in the region, aligning to environmental contingencies (e.g. Groff and Muth, 1972).

The contingencies identified here can add to those reasons for the lack of supplier linkages, or SCVs, in addition to those identified at Section 10.4.2. Any policy to address regional SCVs will need to take cognisance of these, for each sector, when developing sector priorities.

10.4 RESULTS – COMPARISONS TO THE FOREGROUND LITERATURE

This section compares the results of the study to the foreground literature reviewed in Chapter 4, namely Hoshin Kanri, material or supplier linkages and embeddedness, P & SCM (i.e. clusters) and sustainable development whilst addressing the Research Questions.

10.4.1 HOSHIN KANRI AND POLICY DEPLOYMENT

This sub section compares the Hoshin Kanri literature with the proposed SCVs framework. The discussion relating Hoshin Kanri to the cognitive theories is detailed above in Section 10.3. The framework fills gaps in the literature identified by Crone (1999) and Guinipero *et al.* (2008) as no framework currently exists to address this issue in relation to current or future P & SCM requirements in line with Research Questions 2 and 3.

The SCV validation and selection process for the case studies was aligned to WAG strategies, as identified in Chapter 2 in adherence to Hoshin Kanri definitions, models and findings from empirical studies (e.g. Witcher and Butterworth, 2001; Lethbridge *et al.*, 2007; Hacker *et al.*, 2001). For those SCVs that aligned to the strategies, these were considered for further investigation, but where no alignment existed, these were discounted. Conversely, WAG IBW have been pursuing inward investment opportunities that may create jobs, supported by WAG (2008a) but do not align to other WAG policies as supported by Daneke (1980) and Marsden (1998) and identified as issues by e.g. Womack and Jones (1996) and Hines and Taylor (2000) in relation to Hoshin Kanri, and Carroll and Stanfield (2001) for sustainable development.

The focus of this study has not been to assess the existing strategy development and policy deployment systems within the WAG, but to align the results of such activities (i.e. strategies and policies) with the case study SCVs. There are however a couple of issues worth noting, that have been highlighted within the study. WAG policies focus on measures such as 'number of jobs created' (e.g. WAG, 2008a) which do not appear

to address the quality of jobs, the need to deal with different sectors in different ways or sustainable development (e.g. Crone, 1999; Luthans, 1976; Carroll and Stanfield, 2001).

The 'what' is specified in numerous documents (see Chapter 2) but the 'how' (Hines *et al.*, 1998) varies as there is also a lack of cohesion between the departmental objectives of e.g. WAG DE & T teams and IBW in support of sectors. The reorganisation of WAG introduces some sector-based teams and strategies. This may help to align focus on a 'vital few' priorities for all of WAG to support (Deming, 1986; Womack and Jones, 1996; Witcher and Butterworth, 2001; Hacker *et al.*, 2001; Radnor *et al.*, 2006; Barber, 2007). This is supported by Lee and Billington (1992) and Holmberg (2000) who contend that performance measurement systems are fragmented, cause confusion and include numerous measures. In addition, Eccles (1991) and Adams *et al.* (1995) find that performance measures are often not derived from the company strategy. It is therefore important that the development of WAG sector strategies learn from such findings to align policy to strategy and minimise the number of performance measures throughout deployment, including the application of the SCVs framework.

Whilst there are critics of Hoshin Kanri (see Section 4.2.2.3), based on the literature gaps in relation to application in the public sector (Hacker *et al.*, 2001; Marsden, 1998; Radnor *et al.*, 2006), the current misalignment of targets and activities and the need to base the pan-organisational investigation of SCVs on WAG strategies and policies, the Hoshin Kanri approach has been adopted for the design of the SCVs framework.

10.4.2 MATERIAL INPUT OR LOCAL SUPPLIER LINKAGES AND EMBEDDEDNESS

This sub section compares the literature reviewed for material input or supplier linkages and embeddedness to the results of the study as aligned to the Research Questions.

The material linkages investigated in the study were between customer and supplier as defined in a variety of terms by Crone (1999), Dunning (1993), Crone and Watts (2000), Crone (2002), Hewitt-Dundas *et al.* (2005) and Phelps (1993a and 1993b). SCVs relate to those items where such linkages do not exist in Wales.

Bioscience and Financial companies reported the location of their most regularly used suppliers as summarised in Table 10.7.

Sector/ Company	Country	<10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 100	>100
Biosciences								
Anemone	Wales							
	RoUK							
	Europe							
	Other							
Buttercup	Not stated							
Clover	Wales							
	RoUK							
	Europe							
Daisy	Wales							
	RoUK							
	Europe							
	Other							
Financial Intermediation & Insurance								
Apple	Wales							
	RoUK							
Banana	Not Known							
Cherry	Wales							
	RoUK							
Damson	Wales							
	RoUK							
Elderberry	RoUK							

Table 10.7 – A Comparison Between The Location of Suppliers used by the Companies in the Bioscience and Financial Sectors (Source: The Author)

For Biosciences, the biggest source of supply is from the RoUK, followed by Wales, Europe then other. Tables 7.3 and 7.5 identify specific SCVs and their source of supply, reflecting that the RoUK is the most prominent. High-value SCVs total £16.672m p.a. with low-value SCVs in excess of £39k p.a. The Input-Output tables analysed in Appendix A show that for Biosciences, 33% was sourced in Wales, 35% from the RoUK and 32% from elsewhere, although, a variety of SIC codes are included

in this data that are not reflected in the SCVs case studies. However, over 5% of the Input-Output value for the RoUK is represented by this small sample of SCVs.

For the Financial companies, the RoUK is also the main source of supply, followed by Wales. Tables 8.5 and 8.6 show all but one input is sourced from the RoUK. High-value SCVs total over £1139.5m p.a. whilst data for the low-value SCVs was not reported. Input-Output data analysis in Appendix A for the Financial sector demonstrates that 50% was sourced in Wales, 40% from the RoUK and 10% from elsewhere although Gripaios and Munday (2000) report the poor state of linkages between inward investors and local companies in the broader Welsh Financial and Business Services sector. Again, a number of SIC codes are included; hence this data looks high for local linkages, for both sectors when compared to the literature. However, approximately 24% of the Input-Output value for the RoUK is represented by this small sample of SCVs which is high when compared to Biosciences.

Table 9.17 shows that all but one of the 14 high-value inputs for Unmanned Systems companies are currently sourced outside of Wales and the RoUK, conservatively valued at £5.622m p.a. These items would be preferred to be sourced locally or in Wales, if the companies re-located or used Parc Aberporth, based on a high or medium level of importance. Companies indicated that close proximity to suppliers was the most common benefit of local sourcing whilst Sparrow Hawk identified a lack of knowledge of the Welsh or RoUK market relating to their requirements. Table 9.18 shows seven high-value inputs which companies perceived they would still have to source from outside Wales, valued at over £4m p.a. Table 9.19 identifies low-value inputs worth over £1m which companies would prefer to source locally but are currently bought from outside Wales. All current requirements are sourced from outside Wales (see Table 9.13). Only Sparrow Hawk includes the RoUK. Two companies state it is difficult to see how purchasing profiles may change, whilst Red Kite anticipate a volume increase with the same countries and Buzzard anticipates UK supplier involvement providing ITAR is not affected.

Table 4.2 concludes that a low level of local linkages prevail in the UK, averaging less than 25%. In the RoI, linkages are strong for food related supplies but weak again for

non-food supplies (McAleese and McDonald, 1978). Girood and Mirza (2006) identify mixed linkage levels between the ASEAN countries. Considerable evidence supports the assertion that the sourcing patterns of multinational companies have become increasingly internationalised (see for example, Phelps, 1993a and 1997; Hudson, 1997) as supported in the cluster literature by Rees (2005). Twomey and Tomkins (1996) also demonstrate that smaller regions have greater deficiencies within their supply chains in relation to local availability which may align to Wales. Harrison and Brady (1992) find that FDI companies will only use local suppliers where quality and other supply chain priorities can be met as favourably as the best offered elsewhere, which was indicated by the Biosciences and Financial companies.

For 'immediate' SCVs, companies in both sectors identified a lack of availability as the main inhibitor to local sourcing for high-value goods and services. Other reasons cited include suppliers in Wales are too expensive, there is lack of technical competence and quality and service levels cannot be met by Welsh suppliers. These are supported in the literature by Hewitt-Dundas *et al.* (2005), Crone (2002) and Turok (1993). Other reasons included corporate policy, specialist requirements without regional capability and specialist knowledge which were not identified in the literature. Where there is an availability problem, Crone (1999, p 375) stresses that questions must be raised about the viability of creating local supply capability in areas where none exist but suggests that this approach may be more appropriate if building on existing strengths.

All Bioscience and Financial companies reported that if suitable suppliers were available in Wales, they would use them, providing that supply chain priorities, for example, were met (Harrison and Brady, 1992) whereas Unmanned Systems companies provided slightly different data, based on existing activities and potential operation at Parc Aberporth, as discussed above.

Crone (1999) recommends that a detailed survey of purchasing requirements of locally based customers and the capabilities of local suppliers would help RDAs to better target opportunities. This was carried out for the SCVs for both Bioscience and Financial sectors as shown in Table 7.16 for Freeze Drying and Table 7.17 for Contract Testing. Table 8.16 shows the total requirements for Advertising by Financial companies in

Wales and the SWOT records the 'supply potential'. Finally, Table 8.17 reports the total requirements for Biosciences and Financial companies for Data Centre Services which shows that most companies have in-house solutions and that limited capability and capacity exited in Wales prior to the introduction of the Newport site.

The discussion of results relating to the TOWS analyses is included here whilst the recommendations are reported in Chapter 11. For Biosciences, the WAG appears to be supporting a variety of priorities and therefore need to identify and pursue a 'vital few' as recommended by Deming (1986), Womack and Jones (1996) and Hines and Taylor (2000). They also need to align strategies and policies to develop and match skills to those priorities that help to attract inward investment (Crone, 1999) and collaboration with universities and Techniums (Rees, 2005) and to develop 'triple helix' type activities between NHS carve-outs, SMEs, universities and Techniums in line with Saad and Zawdie (2005), Saad (2004), Cooke (2001) and Luger (2000).

The lack of a fermentation facility in Wales (and the UK) could undermine Contract Research Organisation (CRO) and Contract Manufacturing Organisation (CMO) development in Wales so it is important that a cross-functional approach is taken during 'catchballing' (e.g. Cowley and Domb, 1997) involving all relevant WAG and sector experts to ensure that the few, appropriate policies are selected and deployed across departments supporting Nayatani (1984), Miura (1985), Womack and Jones (1996), Hines and Taylor (2000).

Threats from low cost countries could reduce opportunities for WAG to cultivate the manufacture of generics. Whilst FDI could be targeted, there are two related issues here for WAG. The Biosciences strategy must be clear regarding 'what' and 'how' this is to be supported (Hines *et al.*, 1998) because Crone (1999) for example, advises against the development of low cost activities whereas Rees (2005) and Alderman (2005) accept that local supply chains are complemented by non-local collaborations.

Labour shortages and a lack of GMP skills could reduce opportunities in the diagnostics sub-sector, identified by NIEC (1999), UNCTAD (2001) and Blomstrom and Kokko (2001) as 'supply potential' and supplier competency.

The 'credit crunch' may focus potential inward investors or M & A seeking companies to better target collaborations in Wales in line with factors suggested by Chen *et al.* (2004) (e.g. sales to local firms, R & D, local labour, subcontracting and financial resources supplied by local institutions). WAG IBW, for example, could emphasise such elements of Regional Selective Assistance (RSA) (WAG, 2002) when negotiating with potential inward investors who meet their entry criteria (e.g. Clancy *et al.*, 1998). Empirical evidence has suggested that Wales attracts investors based on access to grants and other financial assistance (Hill and Munday, 1994), although indicative costs and benefits of attracting FDI companies through such means have been reported (Christodoulou, 1996). The application of the WAG ROI model (WAG, 14 March 2008) should help to better understand the costs and perceived benefits of future inward investment opportunities.

Collaboration between inward investors and universities or the Boots Centre for Innovation, to ameliorate issues regarding R & D timescales and costs identified by Johnson *et al.* (2006) can be supported through cluster developments (e.g. Porter, 1998b, p 88) or building supplier linkages (e.g. PACEC, 1995). However, when universities were contacted at the tele-interview stage, none responded or appeared to want to participate.

The TOWS analysis for Freeze Drying shows that Wales could build upon recent growth in the CRO and CMO sub sector, optimising the restructuring underway in the industry (Johnson *et al*, 2006; Williams (WAG), 23 May 2008).

Wales has significant problems relating to limited demand and asset specificity factors for Freeze Drying. Principle markets are RoUK, Europe, North America, Australia and Japan (IBW, 1 May 07) which is demonstrated in Table 7.18. Crone (1999) identifies that the extent of linkages are primarily determined by the specific nature of a plant's demand for inputs and the 'supply potential' of the regional economy, hence where a region registers low demand its capabilities are also limited, which is supported by Scott-Kennel (2007). Carroll and Stanfield (2001) assert that development activities focussed on individual firms or markets often fail to achieve sustainable development as

they are not designed to support the free and uncoordinated contest of ideas that generates growth.

For Contract Testing, the TOWS identifies any inward investment would need to service broader markets as identified by IBW (1 May 07) and compete with e.g. the RoI who offer better tax rates, or other UK regions (Deloitte and Touche, 2006). NHS labs, higher education facilities or the small number of capable Welsh companies may be able to meet low Welsh demand, providing that supply chain priorities are met (e.g. Heriot, 1996). This could be through collaboration as 'SME' suppliers as suggested by Crone (1999) or cluster-type collaboration proposed by Porter (1998b).

When applying weaknesses and threats for Contract Testing, WAG should act to increase and formalise connectivity and communication between companies and higher education establishments to share capabilities, develop training and education and strengthen the sector. This is in line with the 'triple helix' approach (Saad and Zawdie (2005), Saad (2004), Cooke (2001) and Luger (2000) and echoes the recommendations for the Bioscience sector.

The TOWS analysis for the Financial sector identifies that WAG need to emphasise RSA benefits, as with Biosciences, and highlight low cost opportunities such as property (Bristow *et al.,* 2000). The quality of both staff and skills at contact centres (and comparator web site companies) need to be improved to fend off competition from low cost countries and meet higher levels of customer expectation. Wales continues to develop low-value service industries with low skills levels and functionally narrow job opportunities (Jones, 2000, p 19) which Crone (1999) advises against. In particular, SE Wales was developed to host contact centres (Bryan and Jones, 2000; Bristow *et al.*, 2000). Brundtland (WCED, 1987) recommends that to achieve sustainable development, regions need to develop skills, for example. Some clusters include the provision for training and development by trade associations (Porter, 1998b), as occurs in Wales by the Welsh Contact Centre Forum. WAG (2003) supports the development of higher value skills and jobs. Also environmental solutions must be employed in Data Centres (e.g. IBM, 2007) to minimise environmental issues and energy costs.

The recommendations for the Financial sector are much more defensive than those for Biosciences enforcing Lipietz (1992) and Morgan (1996) in relation to defensive or offensive structuring of an economy and Crone (1999) and Luthans (1976) in that different sectors require different management approaches.

The TOWS analysis for Advertising shows that suppliers exist in Wales and should be show cased. Where there are large and small companies, the smaller operators could provide extra capacity for the larger ones and work more closely in a creative cluster or as a coalition of SMEs, as supported by Porter (1990; 1998b) and Crone (1999). It is acknowledged that it would be difficult to encourage Financial companies to consider Welsh suppliers, owing to HQs, DMUs and centralised purchasing responsibilities residing outside of the region (Crone, 1999; Phelps, 1993a; Rozemeijer *et al.*, 2003). It is also recognised that existing advertising agencies will be retained by Financial companies as they have embedded relationships (Polyani, 1944; Granovetter, 1985 p 490). The economic downturn may reduce advertising budgets and as Elderberry prioritise cost from their supply chain, it may present an opportunity to look elsewhere, albeit the reputation of agencies and expertise in London and Manchester is important to them.

The overall issue identified in the TOWS for Data Centre Services is that the new Data Centre in Newport, introduced to fill a capability and capacity gap as supported by Crone (1999), Hewitt-Dundas *et al.* (2005), Crone (2002) and Turok (1993) needs to be promoted to fill its capacity, identifying a need for business development and advertising.

Embeddedness definitions by Polanyi (1944, p 57), Granovetter (1985, p 490), Halinen and Tornroos (1998, p 196), Jessop (2001, p 224), Hess (2004) and Amin and Thrift (1994, p 14) enforce Porter's (1998b) assertion that engaging locally is the social glue that holds (cluster) firms together.

Bioscience firms involved in the semi-structured interviews have all been in Wales for over 15 years whilst four of the five Financial companies report up to, or over 15 years, hence alignment to temporal, spatial or territorial embeddedness (Halinen and Tornroos,

1998; Hess, 2004; Giroud and Mirza, 2004). Key markets are outside Wales therefore market embeddedness cannot be claimed (Halinen and Tornroos, 1998). Technological embeddedness (Halinen and Tornroos, 1998) may be a feature for the Bioscience companies and social, relational, network and economic exchange may also be factors for both sectors, given that most inputs come from the RoUK, followed by Wales, Europe and elsewhere.

Input-Output data analysed in Chapter 2 appear higher than the UK norm (Polanyi, 1944; Granovetter, 1985; Halinen and Tornroos, 1998; Jessop, 2001; Hess, 2004; Amin and Thrift, 1994). In total, six of the Bioscience and nine of the Financial companies had Welsh HQs aligning to Porter (1998b; 1990) and 'home base' capabilities and Giroud and Mirza (2004) and UNCTAD (2001) in relation to autonomy of decision making. Strategy development, aligned to HQ functions is seen to assist in embeddedness in line with Chen *et al.* (2004) and Halinen and Tornroos (1998).

The number and quality of jobs to a region are important in line with NIEC (1986) and PACEC (1995). In general, those in Bioscience are understood to be of higher value compared to e.g. contact centre roles in the Financial sector. However, this was not addressed for these sectors.

For Unmanned Systems, companies reported potential activities and roles, if they re-located to Parc Aberporth which are summarised in Table 9.9. R & D (Chen *et al.*, 2004; Clancy *et al.*, 1998; Dunning, 1993; NIEC, 1999), P & SCM (PACEC, 1995), sales and marketing (NIEC, 1991; Driffield, Munday and Roberts, 2002) and manufacturing (Crone, 1999) are seen to support linkages and embeddedness. Two companies said they may use Parc Aberporth on a permanent basis whilst the other two reported semi-permanent or ad-hoc (Halinen and Tornroos, 1998). Chen *et al.* (2004) advise that subcontracting in a region relates to linkages and embeddedness. One of the Unmanned Systems companies indicated that they would let contracts with suppliers for up to five years but the remaining three said they would be ad-hoc, up to one year or short-term.

In relation to RSA or other assistance, Unmanned Systems companies would welcome grants (e.g. Hill and Munday, 1994), contact with the CAA, local suppliers and supply chain opportunities (e.g. backward linkages, see Markusen and Venables, 1997; Clancy *et al.*, 1998), forward linkages (e.g. Chen *et al.*, 2004) or network embeddedness (Hess, 2004), local cooperation and Government contracts.

Table 9.12 identifies collaborative opportunities sought by the Unmanned Systems companies aligning to the development of linkages and embeddedness (e.g. Girma, Gorg, and Pisu, 2004; Gunther, 2005; Halinen and Tornroos, 1998).

DTZ Pieda Consulting (1997), Crone (1999) and Taylor (2003) recommend the cessation of 'brokering' or 'matching' activities in regional sourcing but support supply chain development, which could include SCV investigations, as supported by Crone (1999).

The embeddedness literature was used to develop the framework in Chapter 6 thereby addressing Research Questions 2 and 3. Cognisance of the suggested benefits and disadvantages of embedding firms in a region was adopted throughout the process and its recommendations for use are proposed in Chapter 11.

Findings in Chapter 9 conclude that for whatever reason, Unmanned Systems companies are not locating at Parc Aberporth. Alderman (2005) proposes that capital projects and their supply chains are transitory by nature hence local embeddedness is not a usual outcome. Therefore, there is a need to embed knowledge on the project in many cases, but not necessarily in a region.

10.4.3 PURCHASING AND SUPPLY CHAIN MANAGEMENT – CLUSTERS

This sub section compares the results of the overall study and the features of Parc Aberporth with the literature reviewed for clusters relating to Research Question 1, along with specific elements for Biosciences.

The cluster vision aspired to for Parc Aberporth and Unmanned Systems support aligns to Porter's definitions (1990, p 4; 1998a, p 197; 1998b, p 78; 2003, p 562), UNCTAD (2001, Overview, p xix) and Reid *et al.* (2007) which promote geographic concentrations of firms and in some cases, associated institutions, in a particular industry. Similarly, Oakley (1995) and Oakley *et al.* (2001) define this as 'functional clustering' where firms gain benefit from close location. Clusters rarely align to SIC codes (Porter, 1998b) which is exemplified through the key products and services, sectors and existing and target markets of the Unmanned Systems companies (see Tables 9.7 and 9.16).

There are purported to be a number of benefits associated with regional clusters (including temporary coalitions) (Porter, 1998b; Alderman, 2005). The vision for Parc Aberporth (WAG, 2007a) is supported by Porter (1998b) relating to cooperation and competition, Porter (2003) for knowledge spillovers and innovation and McDonald *et al.* (2007) to strengthen local supplier linkages whilst aerospace, defence, analytical and communications equipment are typically high technology clusters (Porter, 2003), all of which are represented within Unmanned Systems. Rees (2005) identifies the importance of collaboration with local universities and research centres but highlights that most collaboration is with parties outside the region relating to strategic alliances and the need to fill technical and skills gaps. This has also been indicated by Kempainen and Vepsalainen (2003) and UNCTAD (2001) in relation to the restructuring of supply chains. Morgan (1996) warns that policy with technological transfer and learning at its core has two problems in relation to supply and demand within a region.

Defining features of clusters include shared products or activities of firms (Porter 1998b; 2003) as targeted for Parc Aberporth. However, Alderman (2005), Rees (2005) and Zucchella (2006) posit that clusters can be localised and involve collaborators or complementary suppliers from elsewhere. Local networks may not be as important as linkages with national and international networks, particularly relating to information and knowledge sharing (e.g. Simmie, 2003). Latterly, Porter (2000; 2003) suggests that a cluster can be at any geographical scale from a single city to a group of neighbouring countries. This could be the case for all sectors or supply chains in Wales as the case

studies identify that where suppliers are not available, goods and services are, or would potentially be sourced from outside the region (see Tables 7.3, 7.5, 8.4, 8.6, 9.17, 9.18 and 9.19). This also aligns to the material linkage analysis in Section 10.4.2.

Porter (1990; 1998b) asserts that 'home base' or HQ activities include strategy development, core product and process R & D, critical mass of sophisticated production and service provision. The Unmanned Systems companies reported that R & D and technical engineering would potentially be carried out at Parc Aberporth, along with other activities for some such as sales and marketing, P & SCM and manufacturing. This is also supported by NIEC (1991). Therefore some HQ type activities could reside at Parc Aberporth. These functions also relate to embeddedness which is addressed in Section 10.4.2.

Simmie and Sennett (1999) posit that accessible rural areas or low cost regions are often preferred locations for innovative, high technology firms. Certainly, the Unmanned Systems companies reported the remote location of Parc Aberporth as both a motivator and issue, based on accessibility.

Porter (1998b) recommends that governments must enable cluster development through the supply of high quality inputs e.g. education and physical infrastructure and cluster development initiatives should be built upon local sources of uniqueness or advantage. Clearly the infrastructure remains an issue for Parc Aberporth whilst skills development and retention is a challenge as Parc Aberporth is under utilised and under-developed regarding the science and engineering centre, for example.

AIM and WERU (2005), AIM (2005) and AIM (2006) find that UK regional clusters vary in their make-up and stages of development hence any policies should be tailored to the development stage of a cluster, as with Parc Aberporth. AIM (2005) also states that policy focus should be on activities and groups of products and services, not sectors hence Unmanned Systems at Parc Aberporth. Whilst the AIM and WERU report (2005) highlights concerns about regional clusters in the UK competing against each other, there are no other Unmanned Systems clusters being developed elsewhere in the

UK, therefore, the Parc Aberporth site should be supported by DBERR (now the Department for Business, Innovation and Skills (DBIS) and the UK Government.

Previous policy recommendations (relating to regional clusters for Wales) have included Taylor (2003) who states that the ability to manufacture differentiated products using some sophisticated technology, skilled and flexible labour and a degree of R & D is imperative to Welsh manufacturing, therefore policies need to protect, support and develop the segment of manufacturing in Wales which entails nurturing of clustering activities within the economy, which may relate to Unmanned Systems.

Martin and Sunley (1996) and the IWA (2005) caution against the Porter's regional cluster approach (1990) as increased regional specialisation leads to greater regional inequalities and risks.

Munday (2000) suggests that the large scale development of clusters along the Porter (1990) model is a distant possibility for Wales, likely to be impacted by the low underlying economic activity base in the region. The IWA (2005) also point out that Wales is over-represented in low-value adding sectors and under represented in high value-adding sectors. This may support the problems identified by WAG (2009) relating to the poor abilities of existing SMEs in meeting the needs of Tier one customers.

The development of Parc Aberporth and a regional cluster for Unmanned Systems remains slow and is more akin to 'temporary coalitions' (Alderman, 2005). When comparing this to the literature on the life cycle of clusters, it would appear that it remains at the 'birth' stage (Porter 1998a; AIM, 2005). Porter (1998a) suggests that the birth of a cluster can relate to historical circumstances and factors such as specialist skills, university research expertise, location, infrastructure, natural resources, local demand, presence of existing suppliers or related industries or clusters, one or two innovative companies or even chance events. It is understood that the existing test and evaluation (QinetiQ) and flying facilities (West Wales Airport) at Parc Aberporth initially attracted attention for investment by the WDA who developed a 'push' strategy for the site (e.g. Ahn and Kaminsky, 2005). Ffowcs-Williams (2004) asserts that whilst

cluster development must be driven by the industry itself, there is a partnership role for government agencies.

The life cycle positioning of the Unmanned Systems companies and their products and services are based on Hanks *et al.* (1993) and are summarised in Table 10.8.

Company Pseudonym	Position of Company of the Life Cycle	Position of Products/Services on the Life Cycle
Red Kite	Expansion	In between expansion and maturity. A combination of R & D and service & support.
Sparrow Hawk	Late start-up	Late stage start-up
Osprey	Expansion	R & D is pre-start-up. Early days of development/project
Buzzard	Expansion	Start-up or expansion

Table 10.8 – A Comparison Between The Life-Cycle Position of Unmanned Systems Companies and their Products and Services (Source: The Author)

Table 10.8 demonstrates that three of the companies are in expansion phase with one in late start-up. Of the three expanding companies, Red Kite is in expansion to maturity with its products and services, Osprey is pre-start-up and Buzzard is between start-up and expansion. The Parc Aberporth cluster is still at the birth (Porter, 1998a, AIM, 2005), or start-up stage so if companies like these re-locate, it may help to develop that further.

The critical success factors for the Parc Aberporth vision do not mentions skills, specifically, but include a well developed infrastructure and a leading edge science and engineering centre. Table 9.12 identifies areas for potential collaboration with SMEs and Aberystwyth University and Tables 9.20 and 9.21 identify the motivators (see Chen *et al.*, 2004) and issues associated with companies considering using or locating at Parc Aberporth. Motivators include collaboration with Aberystwyth University and the remoteness of the Parc Aberporth location although other services were valued by more companies e.g. the relationship with the CAA. However, issues include attracting skilled talent and the location, as the infrastructure to travel to Parc Aberporth is poor. Remaining concerns include the weather and the potential to lose flying time and

funding or exchange rates impacting potential use or location to Parc Aberporth. Anecdotal motivators may also have relevance.

Strengths in WAG (2009) include the capabilities at Parc Aberporth and the Welsh academic base which are indicated as motivators. Weaknesses include the poor infrastructure which is of concern to companies and identified for improvement by Hill (2000). Opportunities are identified in collaboration with other RDAs in niche areas of strength (recognising that they have capabilities lacking in Wales), hence supporting Alderman (2005) and Rees (2005) and on supply chain development of SMEs relating to collaborative R & D, as this may help to overcome the weakness of the poor SME base. Table 9.12 highlights that companies would like to collaborate with SMEs for specific activities.

The tri-party arrangement at the WWUAVC and the potential development of a science and engineering centre ally to the 'triple helix' approach to innovation supported by Saad and Zawdie (2005), Saad (2004), Cooke (2001) and Luger (2000).

Porter (1998a) states that the lack of development or evolutions of clusters relate to three factors which are the intensity of local competition, location and environment to support new start-ups and the efficacy of cluster development methods. In the Parc Aberporth case, there is no local competition, the location seems to be an issue, along with the efficacy of development methods. Maybe some of the research carried out in this study should have been completed by the WDA, prior to the establishment of the Parc Aberporth Technology Park. However, Porter (1998a; 1998b) acknowledges that clusters could take up to ten years to become established, if at all.

UNCTAD (2001) recognises the increasing role of clusters in relation to high technology sectors and notes that some are known by brand names such as 'Silicon Valley', 'Silicon Glen' and 'Wireless Valley' which attract high-value FDI. This approach allies to the Parc Aberporth vision (WAG, 2007a) relating to making Wales globally recognised for Unmanned Systems. Maybe a more 'catchy' label may help to increase attention, for example 'Unmanned Aberporth' or 'Unmanned in Wales' as the aspiration is to broaden the air space beyond Aberporth Bay? The annual PAUS event

is building the brand through advertising but is not 'snappy'. Having identified Welsh Advertising Agencies in Chapter 8, it may be worth engaging one of these to help develop the Parc Aberporth brand.

McDonald *et al.* (2007) caution against following the Porter type approach, identifying that it is insufficient to promote regional economic objectives such as innovation or specific sector development, thereby questioning elements of the 'priority sector' strategy for Wales.

Rees (2005) identifies that collaborations are needed both in and out side regions, particularly for Biosciences clusters in Vancouver who carry out R & D in the area and require manufacturing, for example, to be done elsewhere. Kempainen and Vepsalainen (2003) and UNCTAD (2001) support such findings which are reflected in the case study for Freeze Drying, where capabilities exist outside Wales and the RoUK.

This sub section shows that cluster development can be important and should form part of a sector strategy, where appropriate, based on its contingent requirements.

10.4.4 SUSTAINABLE DEVELOPMENT

This sub section compares the literature reviewed for sustainable development to the results of the study which helped to develop the framework in Chapter 6 addressing Research Questions 2 and 3.

WAG policies include a number of priorities relating to sustainable development (e.g. WAG, 2008b; WAG, 2007; WAG, 2004). During the validation of the Bioscience and Financial SCVs it was apparent that balancing economic, social and environmental needs is a challenge (WCED, 1987; Thomas, 2004; BBC News web site; Owens and Cowell, 2002; Munday and Roberts, 2006).

Carroll and Stanfield (2001) assert that development activities focussed on individual firms or markets often fail to achieve sustainable development as they are not designed to support the free and uncoordinated contest of ideas that generates growth. Both

Freeze Drying and Advertising were high value SCVs, predominantly based upon individual companies and whilst they provided useful case studies to aid development of the Hoshin Kanri framework, many factors were uncovered relating to Research Question 1, the reasons they exist and the potential challenges in balancing economic, environmental and social sustainable development.

A PESTEL analysis has been included in the framework as it takes a wide, environmental view, in support of identifying trends that may impact the long-term view of the economy, in line with WCED (1987).

10.5 CONCLUSIONS AND RELEVANCE TO THE THESIS

This chapter has compared the literature reviewed in Chapters 2, 3 and 4 to the findings from the case studies in Chapters 7, 8 and 9. The findings align to the Research Questions 1 - 3 as shown below:

'*What supply chain voids in capability exist in three of the priority sectors in Wales and why?*'

This question has been answered fully as the findings show that numerous SCVs are perceived to exist for various reasons, at the macro level, relating to:

- differences between sectors (e.g. Crone, 1999),
- supplier search criteria (e.g. such as strategy (Proctor, 1978), P & SCM priorities (e.g. Heriot, 1996), regulations or accreditations (e.g. Crone, 1999) and type of purchase (Robinson *et al.*, 1967),
- use of the appropriate search approach (e.g. sequential (Rothschild, 1974) for Financial requirements and FSS (Manning and Morgan, 1982) for Biosciences),
- types of search activities carried out by P & SCM DMUs (e.g Stigler, 1961; Salop,1973; Dellaert and Haubl, 2004),
- factors affecting the behaviour of searchers (e.g. Soelberg, 1967; Belich and Dubinsky, 1995; Palich and Bagby, 1995; Schmidt and Spreng, 1996; Ioannides and Loury, 2004; Yeoh, 2005),
- organisational size (e.g. Blau, 1970),

- organisational structure, as determined by e.g. technology (Woodward, 1965; Stonebraker, and Afifi, 2004) and corporate strategy, policies and decision making (Chandler, 1962; Galbraith, 1973; Quale, 2006; Lysons and Farrington, 2006, pp 168 – 172; Christopher and McDonald, 1995; Rosemeijer *et al.*, 2003),
- environmental and regional contingencies (e.g. Groff and Muth, 1972; Dicken 1992; UNCTAD, 2001),
- professionalism and expertise of P & SCM DMUs (e.g. Carr-Saunders, 1928, cited by Lysons and Farrington, 2006; Manning, 1976),
- determination of P & SCM requirements (e.g. technology, Woodward, 1965),
- markets and the nature of supply and demand (e.g. Baily *et al.*, 2005; Hines, 1993; UNCTAD, 2001; Crone, 1999; Woodward, 1965; NIEC, 1999; Alderman, 2005; Rees, 2005),
- technologies (e.g. Woodward, Marshall, 1979; Scott-Kennel, 2007).

Crone (1999) identifies different contingencies leading to weak linkages. Specific reasons for SCVs were identified by companies for example, lack of suitable suppliers in Wales, aligning to e.g. Hewitt-Dundas *et al.* (2005). However, if suitable suppliers were available and could meet supply chain priorities, companies would consider them.

In relation to the case study SCVs, Freeze Drying remains a SCV owing to low demand levels (Crone, 1999) and asset specificity relating to production technologies (Woodward, 1965). Demand for Contract Testing is also low and whilst collaborative opportunities may exist between SMEs (Crone, 1999), for example, to meet local requirements, this remains a SCV owing to the lack of capable suppliers who can meet customer priorities (Hines, 1993; Heriot, 1996). Advertising is not a SCV as capabilities exist in Wales, but for similar reasons to Contract Testing, are not used. Data Centre Services capability and capacity now exists in Wales but customer awareness or priorities may determine if they are used.

The slow development of Parc Aberporth as a cluster is impacting the potential for the development of supply chain support for Unmanned Systems owing to the lack of locally based companies with 'home base' capabilities (Porter, 1990; 1998b), issues relating to the location (Simmie and Sennett (1999), life-cycle position (Porter, 1998a,

AIM, 2005), the WDA 'push' strategy (Ahn and Kaminsky, 2005), the motivations of companies to move to Parc Aberporth (e.g. Chen *et al.*, 2004), the poor SME base (WAG, 2009), a lack of competition and the efficacy of development methods (Porter, 1998a) including maybe the branding of Parc Aberporth (UNCTAD, 2001).

Some authors contend that Porter-type cluster development does not work (e.g. McDonald *et al.*, 2007) and that clusters or supply chains can include local and global participants (e.g. Alderman, 2005, Rees, 2005; Kempainen and Vepsalainen, 2003; Zucchella, 2006).

'*Can a generic framework be developed to address supply chain voids in capability within the sectors?*'

Chapter 6 proposes a generic framework for use in a contingent manner, by the WAG (Alford and Hughes, 2008; Luthans, 1976), which has been 85% pilot tested within the case studies as demonstrated in Table 6.9.

'*How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term*?'

Embeddedness and sustainable development factors have been included within the framework proposed in Chapter 6 and pilot tested in Chapter 9.

Temporal, spatial or territorial embeddedness are indicated based on the length of time Biosciences and Financial companies have been in Wales (Halinen and Tornroos, 1998; Hess, 2004; Giroud and Mirza, 2004) and technological embeddedness may relate to Biosciences (Halinen and TornRoos, 1998). Material linkages as indicated by Input-Output analysis and levels of HQ or 'home base' activities were witnessed in both Biosciences and Financial sectors (Polyani, 1944; Granovetter, 1985; Jessop, 2001; Amin and Thrift, 1994; Porter, 1990 and1998b; Halinen and Tornroos, 1998; Chen *et al.*, 2004). The potential for material linkages and embeddedness, based on HQ type activities was indicated by the Unmanned Systems companies.

The investigation of SCVs based upon individual firms or markets often fail to achieve sustainable development, as demonstrated with Freeze Drying (Carroll and Stanfield, 2001).

In conclusion, the results emphasise a multi-disciplinary study, reinforcing e.g. Croom *et al.* (2000), Svensson (2003), Harland *et al.* (2006) and Storey *et al.* (2006) in relation to a SCM theory.

The case analysis has added to our knowledge on the nature of SCVs in Wales by identifying and understanding in detail, what is happening, why and how it can be addressed in a practical manner. Companies are different and have varied requirements based upon a number of factors and sectors are diverse so should be treated in a contingent manner. The SCVs investigated within the cases vary from multiple low value requirements of a technological nature (Contract Testing) to decidedly technical and asset specific (Freeze Drying), highly valued services where long term relationships with suppliers elsewhere are prized (Advertising) or where competitive costs via economies of scale can benefit customers across a number of sectors (Data Centre Services) and the embedding of knowledge rather than firms in the region is more important (Unmanned Systems). Such detail and methods of application are not reflected in earlier work.

This study and analysis has identified a number of recommendations for the WAG and are summarised in Chapter 11.

Chapter 11

Conclusions and Contributions

CHAPTER 11 – CONCLUSIONS AND RELEVANCE TO THE THESIS

11.1 INTRODUCTION AND STRUCTURE OF THE CHAPTER

This chapter brings together conclusions based on the research results, along with reflections of the way in which the research was carried out and the implications resulting from the research results.

The findings, based on the literature emphasise a multi-disciplinary study involving e.g. P & SCM, economics and economic geography and as different sectors and their sourcing activities have been investigated, the research has been of a complex and challenging nature.

11.2 ALIGNMENT OF FINDINGS TO THE RESEARCH QUESTIONS, AIMS AND OBJECTIVES OF THE STUDY

In response to Research Question 1, 'immediate' SCVs were perceived to exist for Biosciences and Financial companies and 'potential' SCVs were identified for Unmanned Systems. A number of reasons for these were identified, based on e.g. lack of suitable suppliers in Wales able to meet supply chain priorities (See Chapter 10). Case studies proved that whilst some capabilities for specific SCVs exist, they are not necessarily used, based on customer requirements. A framework was developed in Chapter 6 to address Research Question 2 and by considering and understanding the trade-off between embeddedness and sustainable development factors when investigating SCVs and opportunities for FDI, Research Question 3 was dealt with.

In relation to the theoretical objectives, numerous contingencies were identified in relation to specific SCV, companies and sectors which indicate or explain the existence of supply chain voids in Wales. The adoption of the Hoshin Kanri framework assists in the identification, understanding and application of those theoretical and empirical paradigms that facilitate the deployment of regional economic development strategies and encompasses processes that enable the identification, investigation and resolution of

supply chain voids, as detailed in Chapters 6, 7, 8 & 9. Finally, by considering and understanding the trade-off between embeddedness and sustainable development factors when investigating SCVs and opportunities for FDI helps to identify those theoretical paradigms that can be applied to underpin the Hoshin Kanri framework that aims to address supply chain voids through sustainable development.

The secondary objectives identified by the sponsors have been addressed as demonstrated within Table 11.1.

Secondary Objectives	
Identify the supply chain voids in Wales within the 10 priority sectors.	Macro economic data and in some cases, anecdotal SCVs identified for most sectors and used to select 3 for case studies.
Understand and collate evidence that identifies and validates these voids.	Completed for case studies.
Examine 3 or 4 highly targeted cases.	Completed for case studies.
Identify new business opportunities in Wales by fully researching the supply chain voids in capability.	Complete for case studies.
Assess the opportunities that exist to fill these voids both internal and external to the designated industries, sectors, or regions.	Complete for case studies. Other regions offering complementary capabilities recognised within the study.
Understand how other regions have attempted to address the supplier void issue.	Contacted all RDAs. Whilst the same issues were recognised, no framework exists.
Benchmark for the relevant performance required to fulfil these voids.	Performance related to supply chain priorities.
Understand the economic impact of the voids.	Value in £ quantified for SCVs, where data was provided.
Provide and test a framework that details the process of identifying and filling these voids	Framework developed and pilot tested - see Chapters 6, 7, 8 & 9.
Expansion of the customer base to optimise capability created through filling supply chain voids in Wales.	Results of the case studies passed to the relevant WAG personnel for action, as required.
Shorten and integrate supply chains within Wales, thereby reducing costs and the environmental impacts relating to transportation, such as carbon emissions.	See Chapter 7 for Bioscience products.

Table 11.1 – Alignment of the Secondary Objectives to the Study (Source: The Author)

11.3 METHODOLOGICAL ISSUES – LESSONS TO LEARN FROM THE STUDY

All research designs are subject to practical issues concerning the application of methods during the fieldwork and this section reflects upon the research process and identifies learning opportunities that could be used to improve or modify the study, if it was to be conducted again.

11.3.1 LIMITATIONS OF THE STUDY

Table 5.12 identifies those limitations anticipated early in the study. These have been reviewed at Table 11.2, based on the successful completion of the study, the framework developed n Chapter 6 and the findings discussed in Chapter 10.

In addition to Table 11.2, the Bioscience cases highlighted a number of challenges which could be overcome in further research into SCVs or by WAG if they adopt the framework identified in Chapter 7:

- The sample SCVs, companies to be contacted for the tele-interviews and the definitions for both Freeze Drying and Contract Testing were agreed with WAG DE & T and IBW sector experts (13 Jun 07 and 24 Oct 07). However, the knowledge and experience of the author appeared insufficient, as a generalist, to understand the nuances associated with these services and the associated manufacturing processes and technological issues. Therefore, any further SCV research carried out within Academia, WAG, or indeed any other RDAs, should be carried out by 'sector experts' who have the requisite knowledge and experience of the subject sector under investigation. Certainly this was the most challenging sector for the author who felt more comfortable with both Aerospace and Finance, although they had different challenges.
- The definitions of Good Manufacturing Practice (GMP) and ISO 9000 standard Freeze Drying were limited to a general understanding but proved useful during the tele-interviews.
- Face to face interviews carried out on site may have helped to identify and understand any nuances relating to these services and manufacturing processes.

- Walking through and/or 'mapping' the manufacturing process may have highlighted certain issues for the researcher. However, the focus was on the case study SCVs, based on the inability to purchase within Wales and not on the detailed technological and manufacturing process.
- Having an expert resource on hand during the tele-interviews may have helped, but was not feasible.

The important point to note from Table 11.2 is that the author has developed a framework that can be adapted for use in other regions, which is contingent upon the type of SCV or e.g. FDI opportunity identified. SCVs should only be investigated if they align to strategy.

Concern	Cause	Countermeasure	Outcome
Research is Wales Centric (Rosenzweig, 2008)	Funding from WAG Sponsors	Informants and involvement of people from different sectors, Industry Forums etc. Secondary Data compared to UK data etc, where appropriate. Empirical research compared to the Literature. Other RDAs consulted at the framework development stage for comparisons, where available.	Framework can be used outside of Wales to investigate e.g. SCVs/FDI. WAG centric tools could be replaced by those used by other regions e.g. Return on Investment (ROI) models, sustainable development assessments etc.
Research focus is South East (SE) Wales centric	Research is sponsored by WAG SE Wales office.	Research must include representative businesses from across Wales.	Pan Wales companies engaged for Biosciences and Financial sectors. International companies involved for Unmanned Systems
Use of secondary data is unreliable	Data may have been collected/manipulated in previous analysis that may impact this study	Use standard data from WAG and MSQA results from WERU & IWA in background phase.	Standard data used and analysed for this study.
WERU Input-Output Tables etc. are cross-sectional not longitudinal	1-off pieces of research in specific timescales	Tried to update the WERU Input-Output data/results with the latest version from WERU but cautioned against it by WERU as data collection, manipulation etc. was not using the same methods as those used previously. However, Input-Output Tables identify where local purchasing levels are low which help to make policy recommendations in Chapter 10 from the ToC in Chapter 2.	Relied on cross-sectional data as benchmark/indicator.
Businesses included on WAG & Industry Forum databases do not include all businesses in all sectors in Wales.	Only those that are e.g. members of Industry Forums/equivalent, or who have contacted/completed a questionnaire for WAG are included in databases.	Believed to be the most representative, relevant and accurate data available. Update using company web sites.	Best available data, updated for use in the semi-structured and telephone interviews, as required.

Semi-structured interviews only covered 10 companies for 'immediate' SCVs in Bio and Fin sectors	Non-Probability sampling used. Purposive samples from each sector. Criteria for sample led to purposive sample, time limits precluded more interviews.	Purposive heterogeneous samples and homogeneous samples used, with specific selection criteria. Follow on telephone interviews to all companies in sub/sector.	Follow-on interviews provided triangulation of data and results.
Access to companies could have resulted in bias/lack of objectivity	Identifying companies, based on clear criteria and then seeking advice/information/acces s via stakeholders i.e. Industry Forums, WAG Account Managers, KB4Bs etc.	Ensuring that the original criteria were sound and that samples were purposive.	Samples were representative of the sector.
Macro and other economic factors for example, exchange rates, forward linkages, displacement, dead weight and/or substitution were not addressed.	Time scales of the research were prohibitive to go into such detail.	Addressed factors that could be accommodated within the timescales. Scope defined in Chapter 4.	Results were of value to micro level cases with some read across to macro level economic factors via ROI economic assessments.
Only 4 sample companies included in Unmanned Systems for 'potential' SCVs.	Criteria for sample selection led to purposive sample and time limits precluded interviewing more companies	Once SCVs identified and examples selected to investigate further, develop suitable solution for framework based on investigation of 'immediate' SCVs.	Framework is operated based upon the contingencies of the SCVs.

Focus on 'Backward linkages' only which is a small element of the economic multiplier.	Interested in SCVs identified by Welsh customers. Scope defined in Chapter 4.	Alignment to a significant body of literature from economic geography.	Indicative 'sales' information reported. Results were of value to micro but could relate to macro economic recommendations.

Table 11.2 – Limitations and Outcomes (Source: The Author)

11.3.2 STRENGTHS OF THE STUDY

Table 5.10 summarises the anticipated strengths and weaknesses of the selected research methods. This section reviews these to see how they worked during the study.

The case study strategy applied mixed methods across multiple, small targeted cases to gather rich data (i.e. patterns and linkages of theoretical importance) from which understanding, descriptions and explanations have been obtained (Robson, 2002; Yin, 1993 & 1994). This assisted the development and pilot testing of the framework which derived the detailed results that have enabled a realistic understanding of what is happening in these sectors.

The sampling approaches all worked well and resulted in the selection of the right type of companies, for both semi-structured, face to face and telephone interviews. The secondary data helped to set a foundation for the study and aided the selection of the three sectors to target for the case studies. Access was particularly interesting as the author had to be chameleon-like, e.g. some companies were put off by 'sponsored by the WAG', whilst others were not keen to 'work with students'. Therefore, the best approach was to use 'mature doctoral candidate' which seemed to gain the best results.

The semi-structured interviews worked particularly well because they presented the author with the opportunity to probe or ask follow up questions to test understanding and responses. Whilst the telephone interviews obtained responses, the lack of face to face contact and opportunity to develop a relationship precluded the depth and understanding of data achieved when compared to the semi-structured interviews. However, the results aided triangulation of the data from the semi-structured interviews, which was the objective.

11.4 CONTRIBUTIONS TO ACADEMIC KNOWLEDGE

This section identifies a number of gaps and contributions claimed for the cognitive theories and foreground literature used in this study. These are detailed within Chapters 3, 4, 6 and 10 and are summarised in Table 11.3, where major contributions are highlighted in gold.

Research Question	Theory, Literature & Author(s)	Research Issue/Gap	Contribution
1. What supply chain voids in capability exist in three of the priority sectors in Wales and why?	Search theory. (Axell, 1974; Rothschild, 1974; Manning and Morgan, 1982).	Model(s) suitable for supplier search.	Models are contingent upon the customer requirement (e.g. sequential for many Financial service needs and FSS for more regulated Bioscience requirements).
	Search theory. (Stigler, 1961; Perry and Widgerson, 1986; Proctor, 1978)	No empirical studies applying or relating search theory to P & SCM within a business setting, or to regional economic development.	Search theory included in the proposed framework.
	Search theory and P & SCM priorities. (Axell, 1974; Rothschild, 1974; Proctor, 1978; Dellaert and Haubl; 2004, Heriot, 1996).	Application of search models in relation to achieving supply chain priorities.	Balancing the cost of search with the amount of search to meet P & SCM priorities.
	Contingency theory and the public sector (Alford and Hughes, 2008) and regional economic development assistance (Perry, 2007).	Few empirical studies applying or relating contingency theory to public sector activities or regional economic development assistance.	The framework is for use by the WAG to aid regional sustainable development.
	Contingency theory and P & SCM. (Rozemeijer *et al.*, 2003)	Sectors that use synergistic purchasing.	Synergistic purchasing is prevalent within Financial Intermediation and Insurance.
	Contingency theory and P & SCM priorities. (Heriot, 1996).	P & SCM contingency factors not applied in the service sector or UK.	Empirical study applied to a service sector in the UK.

	Contingency theory, P & SCM (e.g. Heriot, 1996) and material input, supplier or local linkages (e.g. Crone, 1999).	Contingency factors that determine SCVs.	Identified a number of specific contingencies, which may determine or affect sourcing decisions at the company, sector or regional economic development level.
	Contingency theory and material input, supplier or local linkages. (Groff and Muth, 1972; Crone, 1999; NIEC, 1991).	Capabilities should be developed based on their fit with the requirements of the firm, as determined by the environment they operate in and FDI/indigenous firms should be targeted based on regional requirements.	Results of empirical study suggest that SCVs should be investigated, based upon the fit with the regional and environmental requirements.
	P & SCM. (Burgess *et al.*, 2006; Croom *et al.*, 2000).	A lack of evidence of theoretical underpinning of SCM studies.	P & SCM findings underpinned by search and contingency theories.
	P & SCM. (Guinipero *et al.*, 2008).	No previous focus on potential P & SCM requirements.	'Potential' SCVs investigated for Unmanned Systems.
	P & SCM. (Guinipero *et al.*, 2008).	Only 2% of P & SCM studies include 'buyer behaviour'.	Identification of contingencies upon which DMUs may determine supplier search and selection decisions.
	Material input, supplier or local linkages. (Crone, 1999; Scott-Kennel, 2007).	Carrying out a detailed survey of purchasing requirements, the results of which can aid better targeting of e.g. FDI.	Detailed survey carried out at sector and SCV/micro level, particularly for Freeze Drying, Contract Testing, Advertising, Data Centre Services and Unmanned Systems requirements.

	Material input, supplier or local linkages. (Crone, 1999; Scott-Kennel, 2007; Hewitt-Dundas *et al.*, 2005).	Focus on the service sector and manufacturing companies that are indigenous to Wales and not multinationals.	SCVs investigated for Financial sector resulting in the case studies for Advertising and Data Centre Services. Also conducted research with manufacturing companies that are indigenous and not multinationals in the Biosciences and Unmanned Systems sectors.
	Material input, supplier or local linkages. (Scott-Kennel, 2007).	Lack of detailed, multiple case studies.	This study investigated multiple cases of backward linkages and indicative forward (sales) linkages.
	Material input, supplier or local linkages and clusters. (Twomey and Tomkins, 1996; Crone, 1999; UNCTAD, 2001; Crone, 2002; Crone and Watts, 2002; Rees, 2005; Alderman, 2005; Porter, 1998a, 1998b).	Viability of policies developed to fill gaps in regional capability. Difficult to develop policies for filling gaps.	This is contingent upon firm requirements and sectors. Where demand rate is low, high-value activities should not be considered and complementary capabilities from other regions are acceptable.
	Material input, supplier or local linkages. (Crone, 1999; AIM and WERU, 2005; Rees, 2005; Alderman, 2005).	Spatial scale at which to address local sourcing and/or cluster development.	Market and demand for Biosciences is not in Wales so companies are reliant upon capabilities from other regions/elsewhere.

	Material input, supplier or local linkages. (Crone, 1999; Turok, 1993).	High-value activities should be targeted for FDI over low-value activities.	This is contingent upon the requirement and sector. Where high demand levels exist in a region, the sector could be strengthened by high-value activities.
2. Can a generic framework be developed to address supply chain voids in capability within the sectors?	Search theory. (Various – see Table 7.6).	Application of search theory in the framework.	Suggested how search theory can be applied in the Hoshin Kanri framework in Chapter 7.
	Hoshin Kanri. (Hacker *et al.*, 2001; Marsden, 1998; Radnor *et al.*, 2006)	Lack of empirical studies using Hoshin Kanri in the public sector in the UK and the service sector.	Hoshin Kanri framework designed and pilot tested for use by the WAG, addressing both manufacturing and service sectors.
	P & SCM. (Guinipero *et al.*, 2008).	Need for 'intermediaries' to identify capability gaps in supply chains and instigate possible solutions.	WAG (or RDAs) to act as 'intermediaries'. See Chapter 7.
	P & SCM. (Guinipero *et al.*, 2008).	The majority of empirical SCM research focuses on the dyadic relationships between 2 firms.	Whilst the study targets the dyadic relationship to identify SCVs, it also investigates the sectors to address the SCVs and considers the wider environmental factors via PESTEL and SWOT analyses.
	Material input, supplier or local linkages. (Crone, 1999).	No framework exists to investigate SCVs or detailed material input linkage opportunities.	Framework developed in Chapter 7 and pilot tested in the case studies.

3. How can supply chain voids in capability be addressed in a sustainable manner to benefit regional economic development in the medium to long term?	Material input, supplier or local linkages. (OECD, 1993).	Policies that extend beyond 'job creation' and 'job numbers'.	Develop measures based upon the embeddedness and sustainable development criteria tool suggested in Chapter 7.
	Sustainable development and embeddedness. (WCED, 1987; Halinen and Tornroos, 1998; Hess, 2004; Giroud and Mirza, 2004; Polyani, 1944; Granovetter, 1985; Jessop, 2001; Amin and Thrift, 1994; Porter, 1998b; Chen *et al.*, 2004)	Difficult to achieve sustainable development.	Included in the framework to encourage sustainable development and regional embeddedness.

Table 11.3 – Contributions to Academic Knowledge (Source: The Author, based on Williams, 2004)

The major contributions relate to the development and pilot testing of a Hoshin Kanri framework for a public sector organisation in the UK, the application of search theory to P & SCM and regional economic development and the empirical investigation of P & SCM contingencies to a service sector in the UK. In addition, a detailed investigation into multiple SCVs, including 'potential', has been carried out. Finally, embeddedness and sustainable development literature has been used to develop measures that go beyond 'job numbers' for specific sectors, based upon contingency factors.

Contributions of minor value ally to the synthesis of literature from different academic disciplines, the detailed use of TOWS analysis and the application of consumer search to academic information search.

Crone (1999) is a significant predecessor of this study, albeit one-dimensional in comparison as it is limited to economic geography. This study has embraced a selection of multi-disciplinary literature and two cognitive theories against which the findings have been interpreted and contributions recorded. Crone (1999) and Crone and Watts (2002) reflect that it would be difficult to bring about changes in supply chain patterns through policy interventions. However, in this study, the approach has been to determine sector based strategies with a 'vital few' priorities that the region wants to pursue, thereby aligning all resources to achieving such goals. Therefore, the region must be clear, similar to Canada for Biosciences (Rees, 2005), rather than the often random approach that exists now, based on a general regional economic development strategy.

11.5 PRACTICAL RELEVANCE OF THE RESEARCH FINDINGS

The study results in a number of practical implications for academics, the WAG sponsors and other practitioners.

11.5.1 IMPLICATIONS OF THE RESEARCH TO ACADEMICS

This has been a multi-disciplinary study resulting in a proposal for a multi-disciplinary framework. Few studies of this type are found in the literature yet more inter-

disciplinary studies in the same, or different, institutions, could develop more holistic and meaningful recommendations.

11.5.2 IMPLICATIONS TO TEACHING

The study identifies the importance of both search and contingency theories in relation to P & SCM so should be embedded within teaching on this subject. Also, significant learning can be taken from the material input and supplier linkage literature in relation to local and global sourcing and SCM activities.

11.5.3 IMPLICATIONS FOR THE WELSH ASSEMBLY GOVERNMENT

The sponsors required a framework to aid the identification, investigation and potential resolution of SCVs in Wales, predicated on a need to increase local sourcing and reduce environmental implications of extended supply chains. Other studies such as Crone (1999) have sought similar objectives. During the study, the author met regularly with the sponsors, to keep them informed of progress and ensure that academic findings were complementary to the secondary objectives. However, the author took the lead in order to minimise any bias from the sponsor organisation therefore ensuring that the literature and not the sponsors took precedence. Clearly during the development and testing of the framework, members of operational teams within the WAG were consulted, as other RDAs were (One Northwest, 10 Sep 07; Yorkshire Forward, 11 Sep07; MAS West Midlands, 30 Jul 08), to generalise the framework. The conclusions of the study recommend that local supply chain development based upon filling capability gaps may be appropriate in some cases, but not all hence supporting the development of what remains of 'Source Wales' into a strategic management approach.

11.5.3.1 POLICY RECOMMENDATIONS FOR THE WELSH ASSEMBLY GOVERNMENT

There are considerable policy implications for the WAG as a result of this study which lead to the requirement to revise a number of those strategies identified in Chapter 2.

The '7S strategy model' (Peters and Waterman, 1982) is recommended to structure implementation plans which addresses both hard and soft (human) issues and includes: strategy (plan), structure (organisation), systems (activities, procedures), shared values (core values, work ethic, stakeholders), style (culture, leadership, symbols), staff (employees and capabilities) and skills (competences). As a practitioner on a number of successful organisational transformational change projects, albeit within the defence sector, the author has experience of this academic model working well, particularly on projects that are managed effectively.

Specific sector strategies are required, covering a 'vital few' pan-WAG objectives and performance measures for economic development that align implementation activities across the organisation i.e. DE & T should be meeting the same targets as IBW. (It is understood that sector strategies are now under development in the WAG, following its reorganisation in 2008/9). Individual sectors should be prioritised for support and funding based upon strengths in 'supply potential', demand rates and ownership of companies. Furthermore, pan-WAG personnel with sector based responsibilities, along with Industry Forum and other stakeholders (e.g. universities) should be involved in the development of sector strategies and the 'catchballing' process in agreeing targets and means. Furthermore, the WAG should aim to balance economic, environmental and social sustainable development, recognising this is a challenge and that trade-offs may be required. Therefore, sector based priorities should be set in recognition of this e.g. chemicals.

The WAG and DCELLS need to build capability and capacity into their planning for skills relating to sector-based priorities whilst different sectors require different managerial approaches for example, the recommendations for the Financial sector in the TOWS analysis were more defensive than those for Biosciences, based upon the credit crunch. In addition, measures over and above 'no of jobs' should be considered for SCVs or FDI to promote sustainable development. Measures of embeddedness include R & D, Sales & Marketing, P & SCM, quality of jobs, etc. (See embeddedness and sustainable development criteria tool in Chapter 6). WAG (2008) for example, will require amendment.

This study recognises that sectors cannot have wholly localised supply chains, based upon e.g. high-value, specialised technologies so complementary skills or capabilities must be outside the region e.g. Freeze Drying which may involve RDAs working together or the acceptance of extended, international supply chains. Where the majority of decision making is outside the region, there is little that WAG or other RDAs can achieve regarding SCVs e.g. Financial services, therefore, this may not be a priority sector for development, but protection.

Development activities focussed on individual firms or markets often fail to achieve sustainable development e.g. specialist GMP Freeze Drying, therefore the WAG should avoid investigation of these. Moreover, 'push' strategies, similar to that by WDA for Parc Aberporth must be underpinned by evidence prior to allocation of significant resources and SCVs should only be addressed as part of sector based strategies. It is worth noting that the true motivations of potential FDI companies may be masked so if they were assessed in line with the embeddedness and sustainable development criteria tool, the WAG may still not get the clarity required e.g. Unmanned Systems companies. From the Financial case study, Advertising is a high-value (£) customer requirement and should be considered under the e.g. Creative Industries strategy. Finally, the WAG, like any other RDA cannot 'poach' companies from elsewhere in the UK to fill SCVs, in accordance with DBERR (July 2007, Section 7.4, p 34).

For the proposed Biosciences sector strategy, the WAG needs to identify a 'vital few' priorities for Biosciences and then align strategies and policies to develop and match skills that help to develop the strengths in the sector. It also needs to review the perceived need for a fermentation facility, which may help to underpin CRO and CMO development in Wales/UK. Moreover, it needs to review the position of pharmaceuticals in relation to the sector strategy considering its demise in recent years and the competition from low-cost countries. In addition, the attraction of venture capitalists could help with the development of research based companies in Wales, although low cost competition and threats resulting from the credit crunch may prevent such investment at present. The WAG also needs to assist to develop a 'triple helix' approach for priority capabilities, involving key companies (including SMEs and NHS carve-outs), universities, higher education centres and government funded Techniums.

Labour shortages and a lack of GMP skills could reduce opportunities in the diagnostics sub-sector. Therefore, the WAG must improve education and skills in this area if it is a priority and address the lack of skills in other areas e.g. CRO, CMO and drug development, if these remain a priority. Furthermore, for specific, Welsh requirements, WAG need to emphasise RSA differentiators and strengths in e.g. skills, incentives, property, universities, the Boots Centre for Innovation, Techniums etc. to compete with other Bioscience regions in the UK and elsewhere.

For Freeze Drying, if the WAG was to fill this SCV, they would need to focus on inward investment or diversification of an existing company, whether Welsh, RoUK or internationally owned may be an option. Also, a limited internal market and asset specificity factors for this SCV means that any inward investment would need to service broader markets for 'general' GMP Freeze Drying. Products requiring asset specific Freeze Drying can only be addressed on a case by case basis and may be cost prohibitive for WAG to support.

In relation to Contract Testing, the limited Welsh requirements may be met through a collaboration of SMEs and other possible suppliers (e.g. NHS).

For the proposed sector strategy for Financial Services, the WAG needs to focus on the retention of companies, jobs and skills throughout the credit crunch and recession, concentrating on Welsh indigenous companies, where possible to retain the few HQ functions here. Moreover, indigenous companies may be worthy of more attention than inward investors as the majority of Financial companies have their HQs and decision making outside Wales. There is also a requirement to nurture key companies in Wales to prevent the loss or transfer of jobs to low cost economies. Wales may need to dis-associate from the London Financial services centre and focus on indigenous and other Welsh based companies for job retention or potential growth (see e.g. Munday, 2000).

In relation to skills, the WAG needs to assist companies to develop stronger links with universities to develop highly skilled graduates for the software and IT sector that supports e.g. comparator web site companies. It must also emphasise the strengths in

the Financial sector to differentiate Wales and to develop and improve the quality of contact centre and price comparator web site staff and their skills, to fend off competition from low cost countries. In addition, help is required for companies to develop product and service offerings to meet higher levels of customer expectations, particularly for indigenous companies.

For Data Centre Services, the WAG needs to focus sales and marketing activities to attract customers for the new Data Centre in Newport whilst recognising that potential customers would not just be within the Financial sector. In addition, technological solutions to SCVs must address sustainable development requirements e.g. 'green data centres'. All industries in Wales and the UK, all companies, public sector organisations and inward investors should be targeted to advertise the Newport Data Centre. Moreover, the WAG could utilise Welsh advertising agencies to carry out the campaign. Those differentiators that help Wales stand out to potential customers should be emphasised within an advertising campaign including connection to fibrespeed, global tele-communications systems, Data Centre capabilities and capacity. Increased capability and capacity in Wales should increase the services on offer and could reduce prices for customers.

In relation to Advertising, the WAG needs to encourage the big Welsh HQ'd Financial companies to consider e.g. Granada, for their advertising needs. Also, Relationship Managers should encourage their companies to buy creative and design services in Wales as they are understood to be cheaper than e.g. London and Manchester. In addition, organise a Creative Industries/Advertising show case for Financial services companies to promote what is on offer across the Welsh sector i.e. large and small companies where some of the small companies could collaborate to provide extra capacity for the larger ones. There may even be an opportunity to get a piggy back from 'Dr Who' and its Welsh creativity. It is recognised that the majority of Financial HQs and DMUs are outside Wales even though in current economic times, Wales may offer competitive alternatives to London and Manchester.

Porter-type cluster development is supported by the current Parc Aberporth vision. However, it may be that Parc Aberporth will be limited to 'capital project' or

'campaign' based operations, reliant upon supply chain support and collaboration from outside the area, meaning that knowledge is developed and embedded in projects, not the region. (Access and infrastructure need to improve to enable companies to travel to Parc Aberporth). Furthermore, motivators for those companies involved in the study include the proposed science and research centre at Parc Aberporth which may encourage increased use/re-location. This will help to embed knowledge in Wales, therefore WAG should continue to pursue this objective. The Parc Aberporth brand needs to be developed to heighten awareness, using a 'catchy' label e.g. 'Unmanned in Aberporth' or 'Unmanned in Wales', akin to 'Silicon Glen'. Again, Welsh advertising capabilities could be engaged for this.

The framework recommends the use of Industry Forum (or equivalent) facilitation to address 'potential' SCVs. Therefore, WAG will need to consider if funding is to remain/be made available for such services in support of sectors. If the proposed framework is to be adopted, WAG need to determine if it is to be operated in-house or by external assistance and for which elements of the process. The investigation of SCVs is to be carried out by a cross-departmental and functional, sector based team including specialist expertise in relation to e.g. technologies and production processes, where appropriate i.e. Biosciences. Moreover, individuals should be empowered, accountable and responsible for the contingent application of the framework. WAG would benefit its customers if it worked in a multi-disciplinary manner aligned to a sector strategy. New WAG tools such as the 'diagnostic' process, ROI and SDI&AT have been built into the framework and should be used to address SCVs/FDI etc. In addition, the WAG should test and develop the embeddedness and sustainable development criteria tool further to see how best to utilise it in targeting/assessing SCVs and FDI. The proposed framework for use in the investigation of SCVs (or FDI) can be used to address current and future requirements, considering environmental factors through the use of strategic analysis tools. Hence there are training and development requirements for personnel in sector teams who may operate the framework.

The WAG must identify the sectors with both high and low levels of demand and supply activity as this will help to determine the contingencies required to develop the sector strategies, as recommended in Table 11.2. This supports Crone (1999, p 375)

which identifies where there is an availability problem, questions must be raised about the viability of creating local supply capability in areas where none exist but suggests that this approach may be more appropriate if building on existing strengths. By way of an action plan, Table11.4 indicates how the WAG may achieve this.

Applicability	**Proposals, based on Table 2.4**
Strategy	SCVs must be selected for investigation, based upon a fit with the requirements of the region as determined by the environment it operates within. For example, where high levels of demand and supply are witnessed, addressing a SCV may strengthen the sector/region.
Strategy, Aerospace	GVA per head is ranked 1st, indicating high-value adding jobs. However, purchasing value (PV) in Wales is 7th, RoUK 5th and RotW 2nd, which is high. Therefore, purchasing and 'supply potential' are low. Unmanned Systems can fall into the Aerospace category. Aerospace should be targeting embeddedness and sustainable development factors such as e.g. R & D, IPR and high value jobs, HQ if possible, accepting that supply chains are to be extended. The measure of 'job numbers' is not appropriate to this sector.
Strategy, Agri-food	GVA per head is 6th, PV in Wales 5th, RoUK 5th and RotW 6th. The sector should be protected supporting indigenous companies and only addressing SCVs or FDI to add strengths, particularly if an HQ is to be sited in Wales. Threats from low cost companies may prevent FDI for manufacturing or end-of life products so other embeddedness and sustainable development factors are important. Job numbers is a more appropriate measure for this sector.
Strategy, Automotive	GVA is 3rd, PV in Wales is 6th along with the RoUK, PV in the RotW is high at 4th. Protect the Welsh jobs and activities to stem the flow of moves to low-cost countries. SCVs and FDI should only be accepted, similar to Aerospace for high-value adding activities i.e. R & D, IPR, novel and innovative ideas where Wales/UK can take the lead. Embeddedness and sustainable development factors should dominate measures, not job numbers.
Strategy, Biosciences	See specific recommendations above. Measures should be embeddedness and sustainable development based, not number of jobs. Scientific and innovative ideas and high-value activities should be targeted.
Strategy, Chemicals and Pharmaceuticals	GVA per head is 2nd, so high value jobs, PV in Wales is 8th, RoUK 7th and RotW 5th so 'supply potential' and demand is not in Wales. In addition, environmental strategies preclude the development of some chemical activities. WAG need to determine what is acceptable and what is not, to clarify this. Protect the status quo and only target SCVs and FDI to strengthen the sector. Job numbers are relevant but embeddedness and sustainable development factors are prevalent, to fill gaps.

Strategy, Contruction	GVA per head is 4th, PV in Wales is 2nd with PV in RoUK 3rd, so high. PV from the RotW is 7th. Promote an indigenous focus on good quality jobs and innovative construction processes to strengthen the sector. SCVs and FDI should only target high-value adding or innovative activities that can strengthen the sector.
Strategy, Creative Industries	Very little data was available so more research needs to be carried out into this sector. Advertising is big value business so should be prioritised for creativity in Wales.
Strategy, Electronics	GVA per head is 5th, PV in Wales and the RoUK is 4th with RotW 1st. SCs are extended as capabilities exist elsewhere. Electronics are used in various sectors including Unmanned Systems so are an enabling technology at the systems level. Market and demand is not in Wales. The sector should be protected, similar to Automotive. Embeddedness and sustainable development factors should determine how SCVs and FDI is addressed, not job numbers.
Strategy, Financial and Professional Services	See specific recommendations above, where applicable for Financial. Protect status quo and only target SCVs and FDI where the sector is strengthened.
Strategy, Hospitality, Leisure and Tourism	PV in Wales and the RoUK is 1st but low value jobs. Develop indigenous firms and capabilities to strengthen the sector and only encourage FDI for specific activities which may offer USPs e.g. golfing and spa developments, environmental holiday parks etc.

Table 11.4 – Proposals for the Welsh Assembly Government, based on the Sector Data in Table 2.4 (Source: The Author)

In addition, wide ranging implications across the WAG and other stakeholders must be considered for specific priorities, e.g. those for Biosciences summarised in Chapter 7 implicate the following:

- The aging population needs to consider the Welsh NHS, social services, local authority and third sector services in relation to budgets, skills, education, labour and facilities in public, private and third sector,
- Preventative medicine needs to consider e.g. diagnosis methods, services, locations and costs,
- Earlier diagnostics and treatment needs to consider what ailments are to be targeted, when, where, who, how and how much will such services cost,
- The changing business model has implications on the structure of the sector in Wales, possible opportunities for CROs and CMOs, skills, education and labour, opportunities for personalised or niche treatments and drugs and the requirement to understand costs at a total cost of acquisition and ownership level.

Therefore, a holistic approach to strategy development and policy deployment is required.

For Parc Aberporth and Unmanned Systems, the lack of an effective communications and marketing tool may be impacting upon business development and the ease with which potential users can find out all relevant information. Therefore, based on the learning from the benchmarking activities with F1 and aircraft testing companies, along with the competitors to Parc Aberporth, the author created a template for a proposed, integrated web site which could be created to advertise the comprehensive and USP services offered by all three parties involved at Parc Aberporth. This is shown at Figure 11.1.

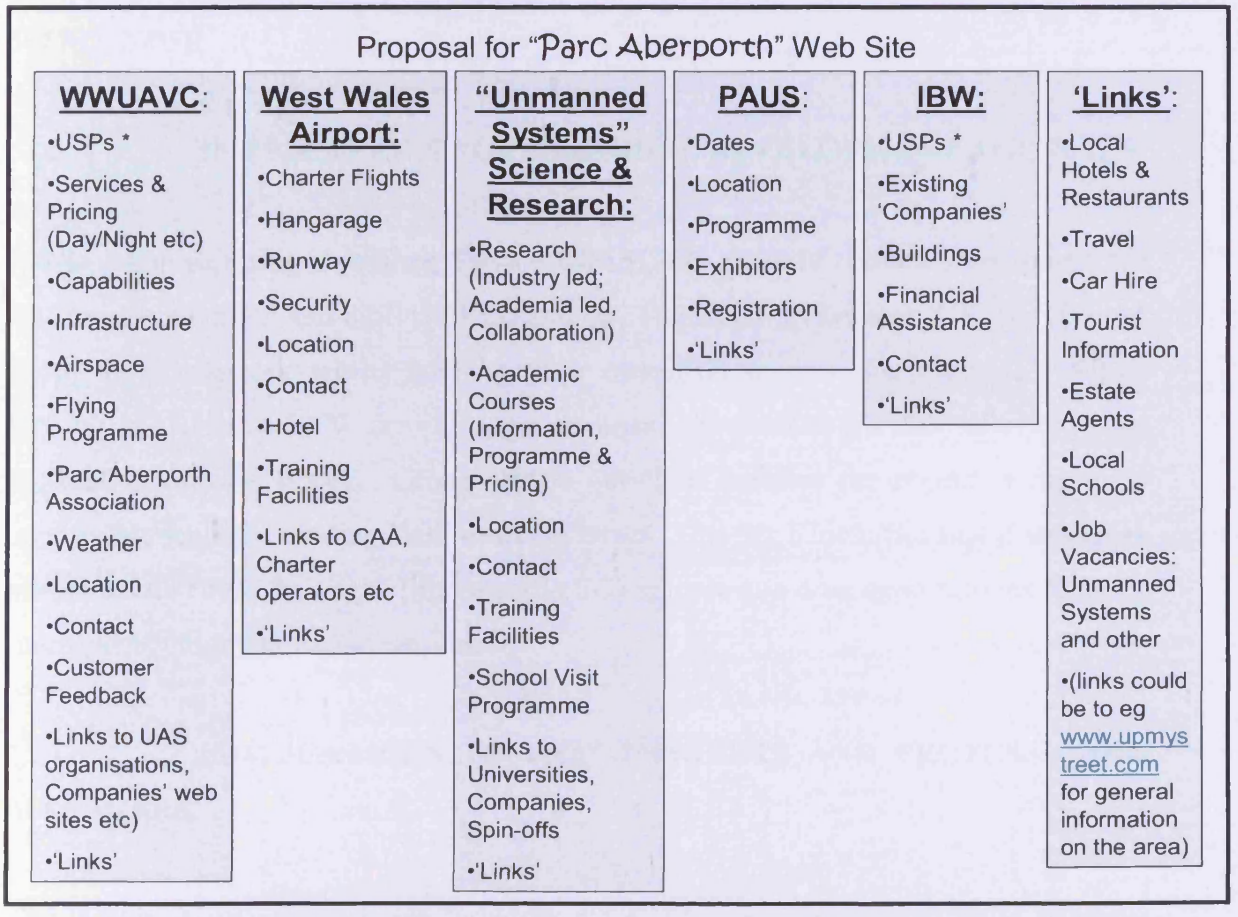


Figure 11.1 – Proposed Content for an Integrated Web Site for Parc Aberporth (Source: The Author)

Figure 11.1 brings together the best elements of the F1 circuits, aircraft testing facilities and those included in the web sites by competitors to Parc Aberporth. No integrated web site for Parc Aberporth or the WWUAVC exists as the research concludes. Without companies utilising the Parc Aberporth facilities and services, there is no demand for goods and services from the Welsh supply chain which explains why, to an extent, 'potential' SCVs may exist.

11.5.4 IMPLICATIONS FOR UK GOVERNMENT POLICY MAKERS

Whilst some policies can address local issues in specific regions, it can be seen that cluster and supply chain development, in particular those involving high technologies or complex production processes can only be addressed on a multi-regional basis, thereby optimising, rather than sub-optimising government support (e.g. Crone, 1999; AIM and WERU, 2005).

11.5.5 IMPLICATIONS FOR REGIONAL DEVELOPMENT AGENCIES

RDAs, Manufacturing Advisory Service (MAS), the recently created Department for Business, Innovation and Skills (DBIS) and UK Trade and Investment (UK T& I) could adopt the framework whilst utilising their own ROI models, for example. When looking to address SCV or FDI opportunities, the framework has relevance for application outside Wales. Crone (1999) questions whether the region is the most appropriate scale for treating local sourcing issues. Chapter 6 identifies that if strategies across RDAs could be aligned for specific SCVs, there could be opportunities to work more closely together to address these.

11.5.6 IMPLICATIONS TO PRACTITIONERS AND PROFESSIONAL MANAGERS

The Hoshin Kanri approach can be adopted for use in relation to P & SCM in many organisations by aligning company strategy to P & SCM strategy and operations. Trade Associations and Industry Forums could utilise similar approaches in relation to sector and supply chain challenges.

11.6 DIRECTIONS FOR FUTURE RESEARCH

Based on the findings, it is recommended that further research could include a number of options. Firstly, the data should be updated for Table 2.4 to aid development of sector strategies as this could help WAG develop the sector strategies. In addition, a study into the developing Creative sector could be carried out to understand their contingent factors. Also, the framework could be tested with the WAG or another RDA, MAS or Industry Forum for example, in the UK, to further demonstrate how the limitations identified in Table 11.2.can be overcome. Moreover, the framework could be tested in other sectors e.g. construction, social care or hospitality and tourism where contingencies may differ from those engaged in this study. Alternatively, the framework could be tested in another country, where cultural, economic or tax differences may have an influence.

A quantification of the investigation of SCVs, possibly in an economic and environmental manner, based on the use of the ROI, SDI&AT and the embeddedness and sustainable development criteria tool may help to evaluate options for addressing SCVs and FDI. In addition, the further development and testing of the embeddedness and sustainable development criteria tool would be welcome in order to test its efficacy. Further research could also follow the Parc Aberporth and Unmanned Systems developments to enable a longitudinal study. Finally, in a non-business environment, the SCVs framework could be applied to sport e.g. rugby union to understand the need to fill capability gaps with players from outside a particular region.

11.7 SUMMARY OF THE STUDY

This study explored P & SCM through a regional economic development lens within Wales in relation to the body of knowledge from multiple disciplines including economics, economic geography and P & SCM. The literature review and multiple case studies have resulted in a framework for potential use by the sponsors.

By way of a postscript, this study commenced before the 'credit crunch', since when, governments have introduced measures to protect jobs, at any skill level, along with

some initiatives to promote 'local' sourcing of goods and services, which was a WAG ambition prior to the economic downturn. Therefore, this thesis and its recommendations reflect those market conditions experienced before and during the early stages of the economic downturn in relation to Wales.

At October 2009, it is understood that the first sector to be addressed using the findings of this study is Financial Services.

Appendices

Appendix A – Preliminary Research into Priority Sectors and Supply Chain Voids in Wales

Introduction

This Appendix provides the detailed investigation and analysis of the priority sectors identified in Chapter 1, Figures 1.3 and 1.4. The WAG specified that the research into SCVs should be within 3 or 4 sectors, but did not define which ones. Chapter 2 provides the background to the study and summarises the results of the author's preliminary research into the priority sectors, required in order to select 3 for research in the case studies.

Preliminary Research into the Priority Sectors - Approach

The preliminary research began by identifying stakeholders in each of the priority sectors, along with the gathering of secondary data for each sector from reliable sources. In total, 34 individuals from within the WAG and Industry Forums were identified and contacted during the preliminary stage. (A comprehensive record of meetings held throughout the preliminary and full study is referenced in Chapter 6). Between June 2006 and October 2006, 30 meetings were held with informants during the creation, population and analysis of the ToC, along with the investigation of purchasing linkage data from WERU (2004).

The purpose of these meetings was to:

- identify key informants,
- identify key sources of information relating to the sectors
- validate and update the secondary data and information collected
- identify anecdotal SCVs in capability within Wales
- compare supply chain structures for each sector with examples from literature, where representations were available, or generate supply chain structures for the sectors in Wales, where a requirement arose.

A copy of the template used as the agenda for these meetings is at Annex A to this Appendix.

Preliminary Research into the Priority Sectors – Supply Chain Structures/Processes

Supply chain structures for Aerospace (Niosi and Zhegu, 2005) Automotive (Hahn *et al.*, 2000; Johnson and Johnson, 2005) and Electronics (Wang, 2005; Lau and Yam, 2005; de Kok *et al.*, 2005) sectors were easily identified within the literature and these were confirmed with industry informants. Other sector based supply chain structures were identified and used as a basis of discussions with industry informants. Whilst representative examples of the pre and post discovery phases for the Bioscience sector were found (Savage *et al.*, 2005; Leibovitz, 2004), these have been expanded upon to aid the author's understanding of this complex process. Therefore supply chain process diagrams were generated based on detailed discussions with the industry informants, where feasible. No supply chain process has been generated for the Creative sector as there has been no opportunity to do so.

Figures A1.1 to A1.3 relate to Insurance Services and were developed based on academic stakeholder advice (O'Grady, 4 Jul 06). No diagrams were developed for financial intermediation services. Where company names are used, these are only examples of the types of companies involved, as no companies were engaged during the preliminary phase.

Figure A1.1 demonstrates where *Zurich Insurance* for example, identifies companies such as *Lloyds TSB* who have established distribution channels that can be used for their products and services. In this example, *Zurich* would negotiate with *Lloyds TSB* to sell their products and services via that distribution channel. Figure A1.2 shows an example of where the *AA Insurance* company negotiates with insurance providers and creates a 'panel' of providers who they will 'search' for insurance quotes, when their customers ask for them. Figure A1.3 relates to insurance claims where replacement goods/services are required by the policy holder and for the purpose of this example, it could be *Lloyds TSB* or the *AA Home Insurance* service, for example. The value and complexity of the supply chain in this instance requires a Loss Adjuster so these are included in the supply

chain. Some items are subject to 'cash settlement' for example, a piece of jewellery. Other goods or services will have to be replaced or repaired e.g. carpets, roof tiles etc. Contracts are negotiated with suppliers of building services, carpets and plumbers, for example.

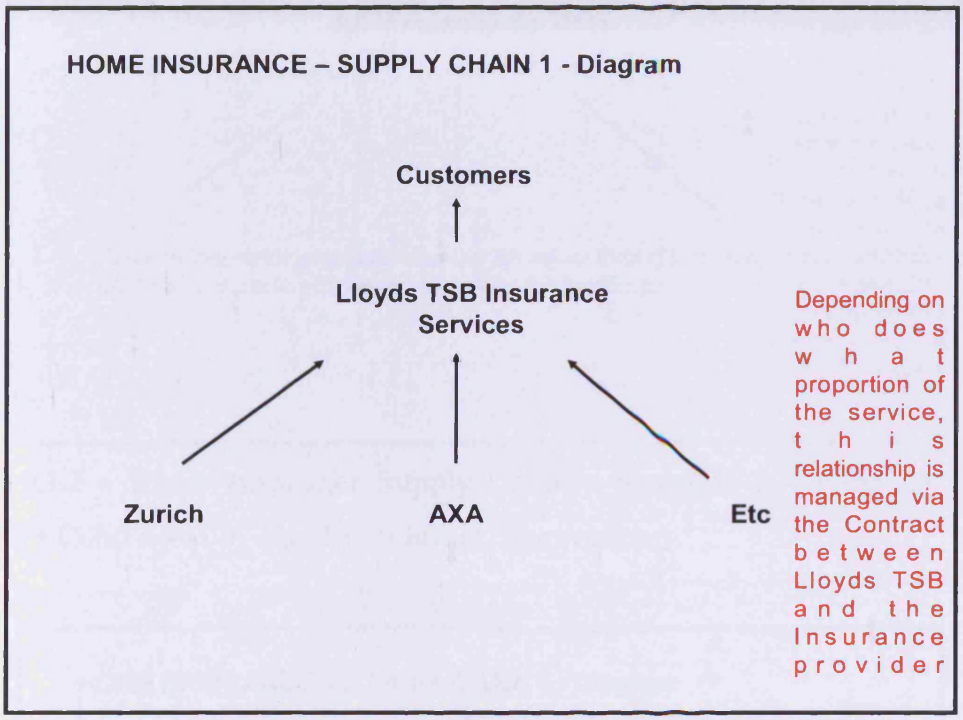


Figure A1.1 – Home Insurance Supply Chain – Example 1 – Service Providers Utilise Established Distribution Channels e.g. *LloydsTSB Insurance Services* (Source: The Author)

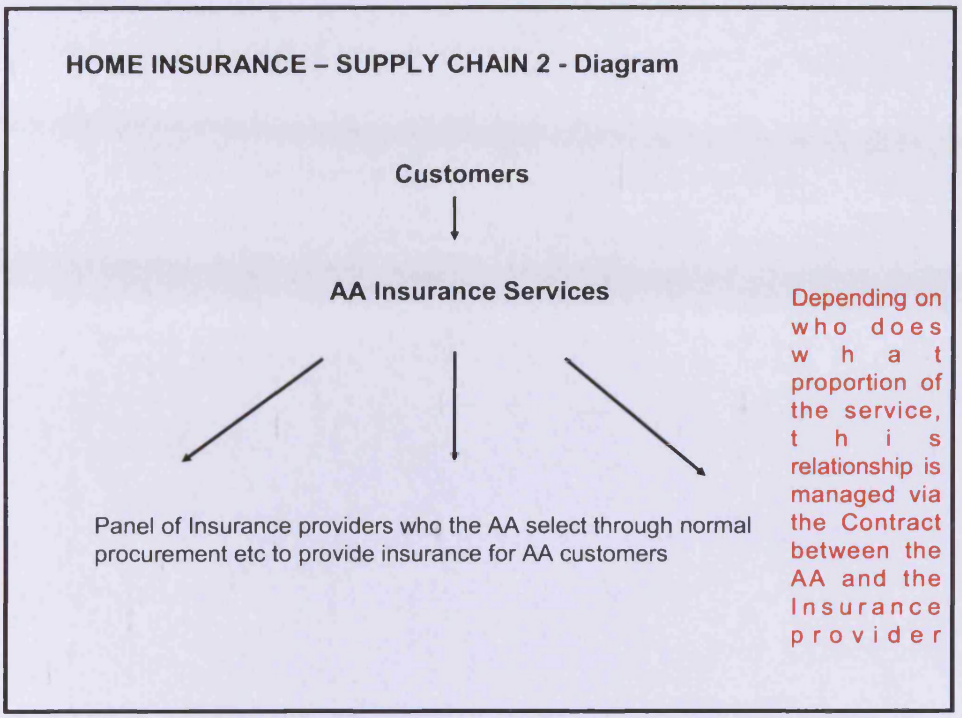


Figure A1.2 – Home Insurance Supply Chain – Example 2 – Panel of Service Providers Contracted by the *AA* (Source: The Author)

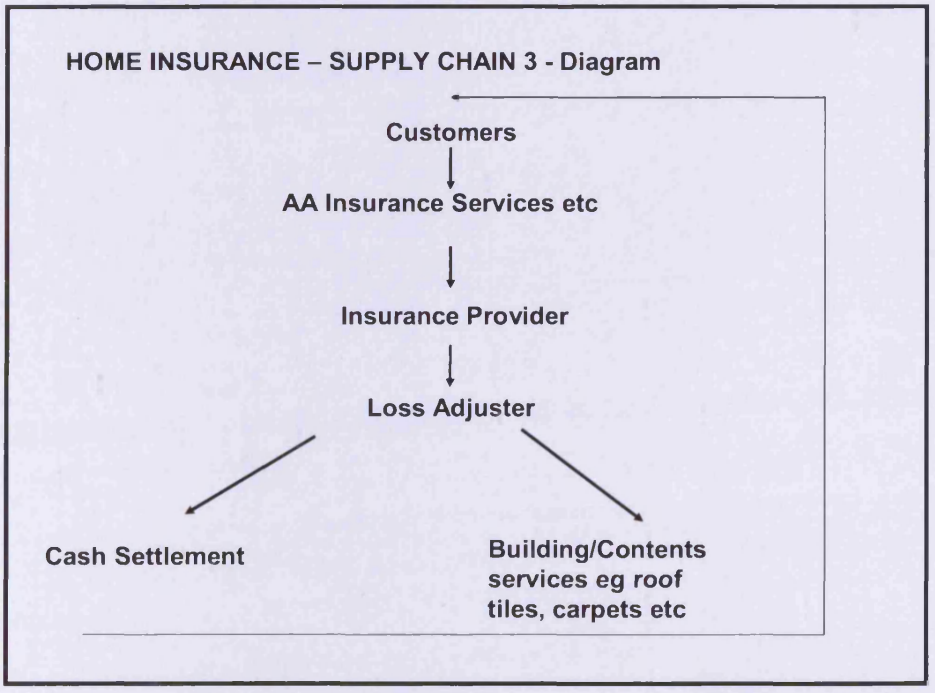


Figure A1.3 – Home Insurance Supply Chain – Example 3 – Claims Management (Source: The Author)

Figures A1.4 and A1.5 relate to the pre-discovery supply chain process for Biosciences.

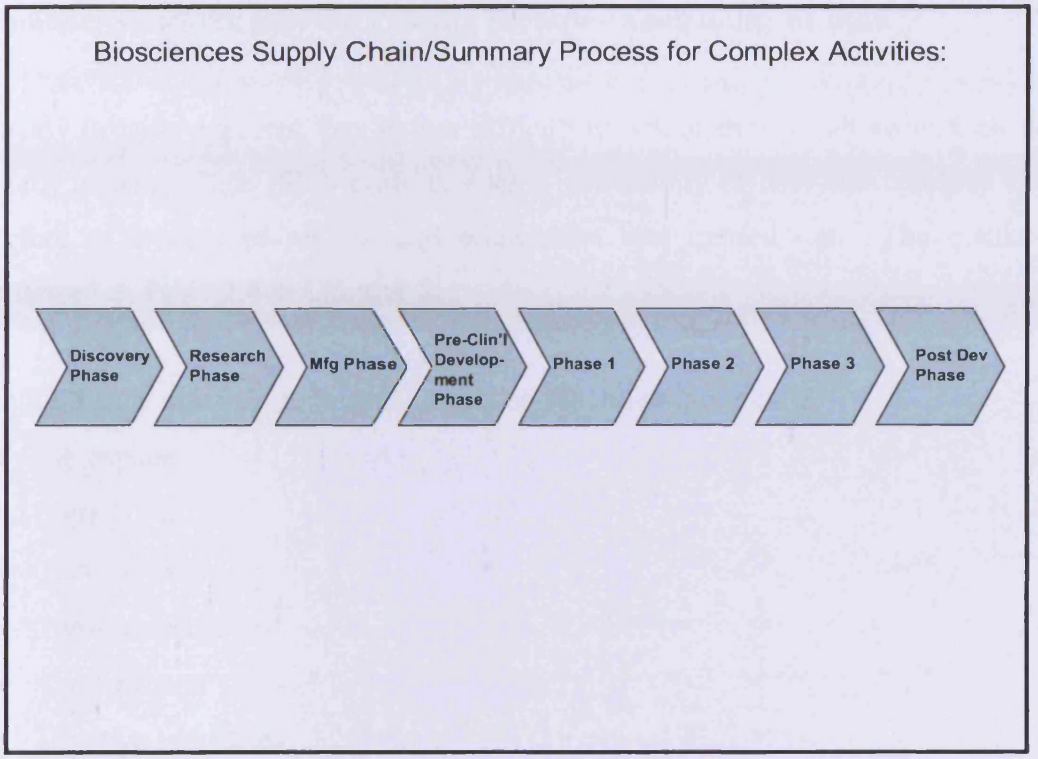


Figure A1.4 – Summary of the Pre-Discovery Supply Chain Process for Biosciences (Source: The Author)

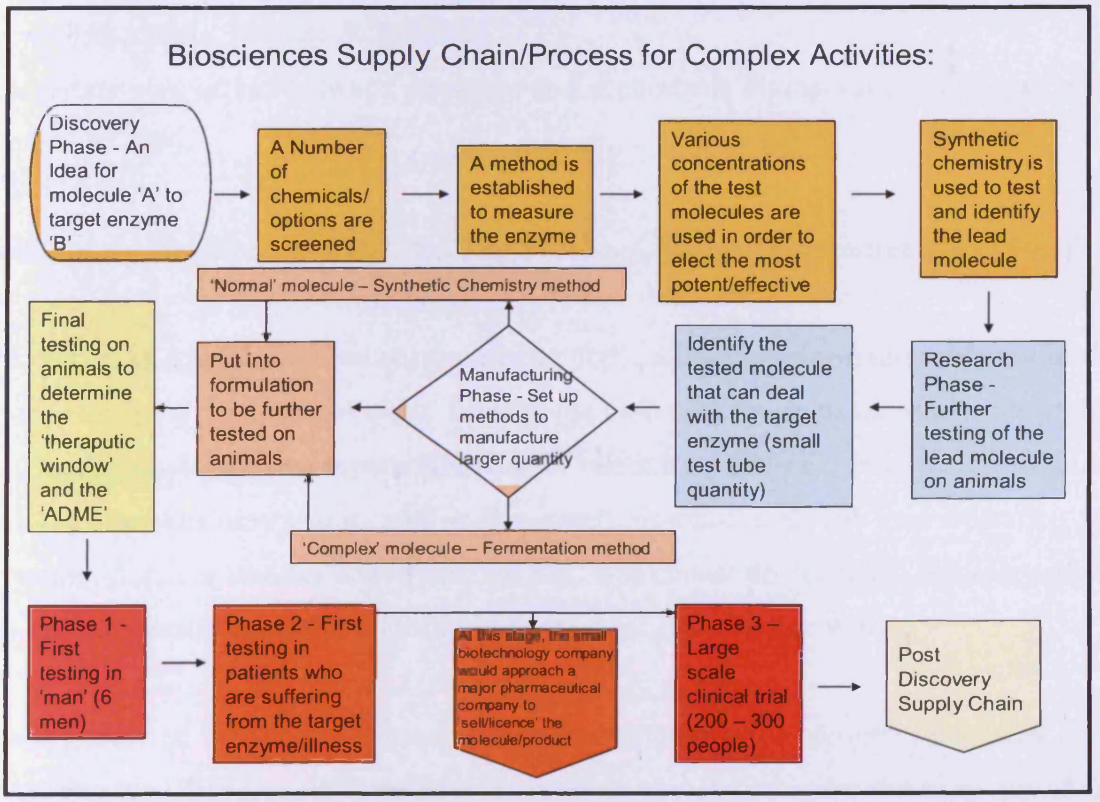


Figure A1.5 – Detailed Process of the Discovery Supply Chain/Activities for Biosciences (Source: The Author)

Preliminary Research into the Priority Sectors – Availability of Data

It quickly became apparent that it was difficult to obtain data on all sectors owing to Standard Industry Code (SIC) code problems, availability of data and resource issues. Therefore, a process of review and elimination was carried out. The results are summarised in Table 2.4 in Chapter 2.

The preliminary research continued, based on the following sectors:

- Aerospace
- Agri-Food
- Automotive
- Biosciences
- Construction
- Creative Industries
- Electronics (including Opto-Electronics)
- Financial Services
- Hospitality, Leisure & Tourism

This listing was agreed between sponsors and supervisors during various discussions in September 2006.

Preliminary Research into the Priority Sectors – Table of Characteristics (ToC)

The ToC was structured to contain statistics and qualitative information relating to the priority business sectors in Wales. Prior to the commencement of the study, the author was familiar with the Aerospace industry in relation to Defence, but was not familiar with the other business sectors and/or characteristics associated with their operation and economic status in Wales. Therefore, the ToC was created to provide a summary of the key statistics and characteristics relating to the priority sectors in Wales.

It was populated with data gathered from a limited number of recognised sources. The WAG Strategy Department were able to provide key statistics for the majority of the priority sectors, based on Office of National Statistics (ONS) data. Between the WERU

and the IWA, qualitative data such as competences, risks and trade assessments were obtained for many of the priority business sectors, based on the results of previous research (WERU, 2002, IWA, 2005). The data collected and structured into the ToC is summarised in Table A1.1.

Sector	Key Stats (WAG)	MSQA Assessment (WERU/GBS)	Other	Misc
Aerospace	Y	Y - WERU - Satellite		
Agri-Food	Y	N	Asked WAG Agri-Food Regional Development Mgr to assess Competences etc iaw WERU questionnaire. Relevant points input on ToC.	
Automotive	Y	Y - WERU		
High Technology - Electronics	Y	Y - WERU - Final Assembly & Intermediate		
High Technology - Optronics	N	Y - WERU		
High Technology - ICT Content	N	Y - WERU		
High Technology - ICT Hardware	N	Y - WERU		
High Technology - Biotechnology	N	Y - WERU		
Pharmaceuticals/Bio-chemicals	Y	Y - WERU		
Pharmaceuticals/Bio-science	Y - except current GVA and forecast GVA	Y - see Pharmaceuticals/Biochemicals		
Financial & Professional Services	Y	Y - WERU - Insurance & Pension Funds, Accountancy and Other Business Services		
Creative Industries	Y - except current GVA and forecast GVA	N		Need a view on MSQA criteria from Creatives Team at WAG
Construction	Y & some from IWA Report	Y - IWA		
Hospitality, Leisure & Tourism	Y	Y - WERU - Satellite - Tourism, Special Events		
Social Care	Y - except current GVA and forecast GVA	N		Public Sector in Wales spend approx £5Bn p.a., includes Social Care, therefore a team in WAG addressing under Value Wales.
Possibly - Energy	N	N		Agreed with Sponsors and Supervisors scope too big to include this.
Possibly Environmental-related	N	N		Agreed with Sponsors and Supervisors scope too big to include this.

Table A1.1 – Summary of Initial Data Collected for the Table of Characteristics for the Priority Business Sectors in Wales (Source: The Author)

The key statistics obtained from the WAG include the number of FTEs, number of business units, GVA and forecasts for employment and GVA between 2005 –2015. The statistics were gathered by WAG for the sectors using SIC codes 1992 & 2003 and the forecast data was sourced from the Regional Economic Prospects, 2005, Cambridge Econometrics. However, in subsequent discussions with Dr Calvin Jones of WERU (20 Jun 06), this data was discredited as it is believed by WERU to be unreliable. Therefore, these forecasts have not been used for this research project.

The qualitative information relating to competences, risks and trade opportunities were obtained from relatively recent research carried out by WERU (2002) and the IWA (2005) using the technique known as MSQA. These reports state that targeting potential growth sectors has been extremely difficult and a number of economic orientated methods have been used for regional development strategies. These include location quotients, Input-Output Tables and Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. MSQA has been suggested as another method that can supplement more quantitative methods, owing to the reliance of such methods on scarce regional, economic data at the disaggregated/sector level.

This situation is certainly borne out through the author's experience of identifying, collecting and analysing data for this study. As SIC codes were used by WAG, WERU and IWA on the data gathered to analyse the priority sectors in Wales, a number of weaknesses have been identified:

- The identification and selection of SIC codes that may or may not accurately reflect the sector under analysis e.g. Aerospace. This is identified by WAG as SIC code 92:353 (Manufacture of aircraft & spacecraft) which falls under the Industry/Product Group of 'Other Transport Equipment'. Whereas Aerospace may fall into this category under a sub-code, it does not seem to reflect the sector accurately and the Aerospace Wales Forum Operations Director has disputed the figures for numbers of employees, for example (Paul Lindsay, 3 Sep 06). The WERU classifies Aerospace as a 'satellite' sector and have not quoted any SIC codes owing to the difficulty experienced in trying to assign any to this sector.

- Some SIC codes could fall into more than 1 sector e.g. 9232 (Operation of Arts Facilities/Leisure) and 9234 (Other Entertainment Activities/Dance halls/Leisure) are both recorded twice – once for the Creative sector and again for the Hospitality, Leisure & Tourism sector.
- The Hospitality, Leisure & Tourism sector is the subject of ongoing, detailed research by the WERU, commissioned by the WAG under 'Visit Wales' (was the Welsh Tourist Board). Again, it is classified as a 'satellite' sector based on the inability to easily classify the activities of the sector within SIC codes.
- The Biosciences sector is one of the priority sectors being addressed by the WAG within the High Technology support team. However, some statistics have been generated or gathered by the WAG on both Biosciences and the broader manufacturing grouping of Chemicals and Pharmaceuticals.
- The Financial Services sector is a poorly defined grouping in the WAG statistics and this has caused confusion with industry informants and various departments within WAG. The SIC codes used by the WAG Strategy Department define it as Financial Intermediation, Insurance, Other Professional Business Services, Research and Development and Engineering Services. However, other WAG informants only acknowledge Financial Intermediation and Insurance. Figure A1.6 defines the Financial Services sector in Wales in accordance with 'Financial Services Wales: People, Profitability, Productivity' CD ROM (IBW, 2005). Some of the professional business services, for example architecture and design also feature under a Creative Industries and Design heading in 'Corporate Wales' (WAG, 2006). These differences demonstrate that defining the content of sectors is an issue for the WAG and academic researchers.

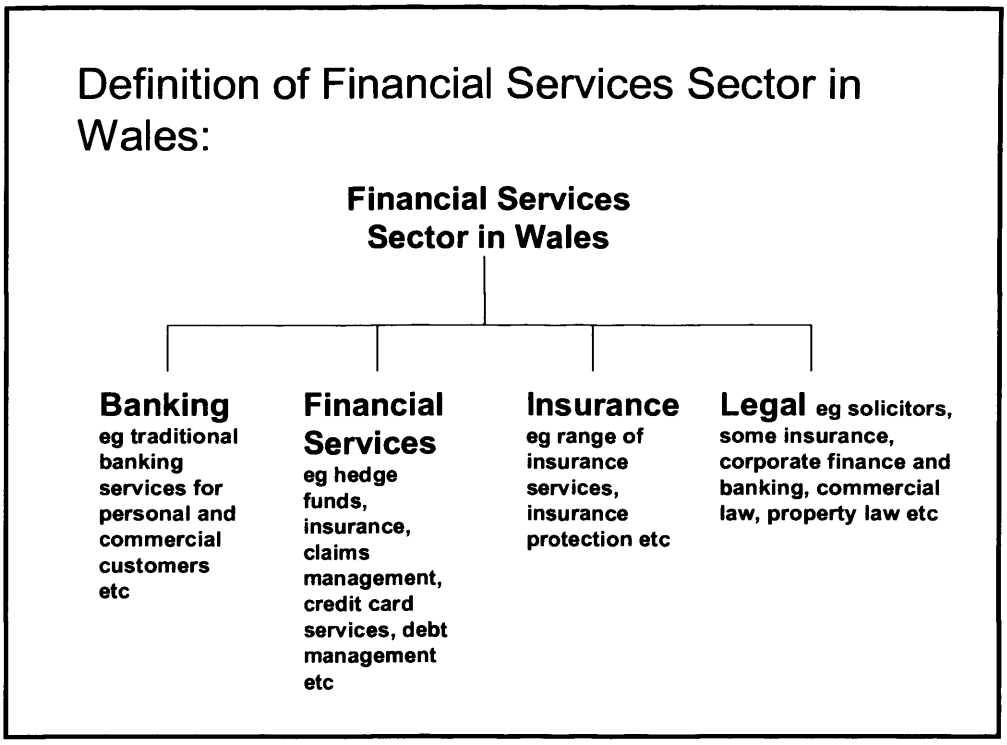


Figure A1.6 – Definition of the Financial Services Sector in Wales (Source: The Author, based on IBW, 2005)

- WERU (2002) also includes such professions as accountants within their grouping of Financial and Professional services. Therefore, whilst the statistics and MSQA include a range of professions, interviews with informants from Financial and Insurance services only have been carried out as there are established job roles within WAG, IBW and an Industry Forum in support of these (for example, The Welsh Contact Centre Forum).
- As the scope of industries moves with technological developments for example, it is often difficult to identify appropriate SIC codes which accurately depict the sector i.e. Electronics.
- As both the Creative and Biosciences sectors are developing, there is limited data available from WAG, WERU and IWA, compared to other, more established sectors. However, a strategy for the Creative Industries in Wales has been produced by WAG (December, 2005) and a report commissioned by the WDA in 2005 was produced on the Biosciences sector by Deloitte and these have provided some information (Deloitte and Touche, 2006).

The MSQA methodology aims to provide information about sectors, together with analysis of the characteristics of the region under investigation (WERU, 2002, pi). It records information for selected sectors on a range of factors, classified into various characteristics including:

- Regional or sector core competences
- Economic linkage possibilities
- Trade possibilities
- Regional economic and industry risk.

These characteristics are sub-divided into different aspects or evaluation criteria for example, when looking at core competences, aspects such as business efficiency, value-adding activities, technology and human resource development.

For the purposes of this study SCVs, the MSQA results generated by WERU (2002) and the IWA (2005) were extracted and added to the ToC, organised by sector, in order to provide complementary qualitative information to the statistical information obtained from the WAG Strategy Department.

Where both statistics and MSQA are available for the sectors, analysis has been carried out by targeting the number of employees, trends in employment, GVA and trends in GVA, GVA per employee, the number of strengths, weaknesses, risks and trade opportunities.

Figure A1.7 shows the comparison of numbers of FTEs, where available, in the priority sectors in Wales and identifies the top 3 as Hospitality, Leisure and Tourism; Financial and Professional Services and Social Care. However, as Social Care is encompassed within the major review of public expenditure in Wales called 'Value Wales' by the WAG and therefore should not form part of this research, the next highest number of recorded FTEs are in Construction. It should be noted however, that one of the key features of the Construction sector is that a high number of its employees are self employed and that there is a grey economy element, therefore the figures could be doubled to reflect the correct number of FTEs in Wales within this sector (Vaughan, 28 Sep 06).

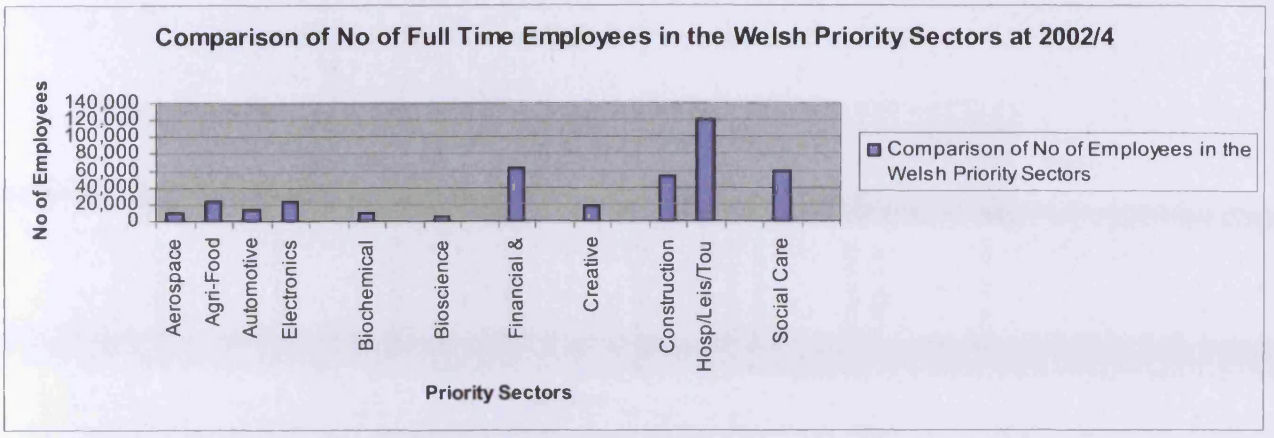


Figure A1.7 – Comparison of Welsh Priority Sectors by Number of Full Time Employees (Source: The Author, based on WAG data)

It is understood from informal discussions with WAG representatives, that the priority sectors were originally determined by their GVA value and therefore that has been borne in mind as a key criteria to help identify 3 of the priority sectors for the case studies.

GVA measures the contribution to the economy of each individual producer, industry or sector within the UK, including Wales. GVA is used in the estimation of Gross Domestic Product (GDP) which is the key indicator of the state of the whole economy. In the UK (and Wales), 3 theoretical approaches are used to estimate GDP and these are production, income and expenditure. When using production or income, the contribution to the economy of each industry or sector is measured using the GVA data from the National Statistics web site.

Figure A1.8 shows the comparison of GVA between the priority sectors, where data is available. The top 3 sectors by GVA are Construction, Financial and Professional Services and Hospitality, Leisure and Tourism.

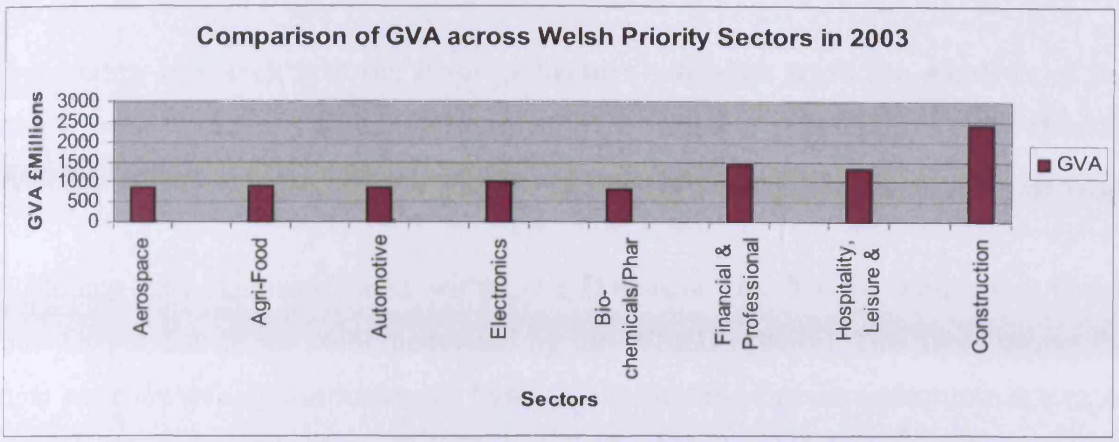


Figure A1.8 – Comparison of Welsh Priority Sectors by Gross Value Added (GVA) (Source: WAG)

By dividing the GVA for each sector by the total number of FTEs for each sector, a calculation of GVA per head/employee was produced. This is shown in Figure A1.9 below.

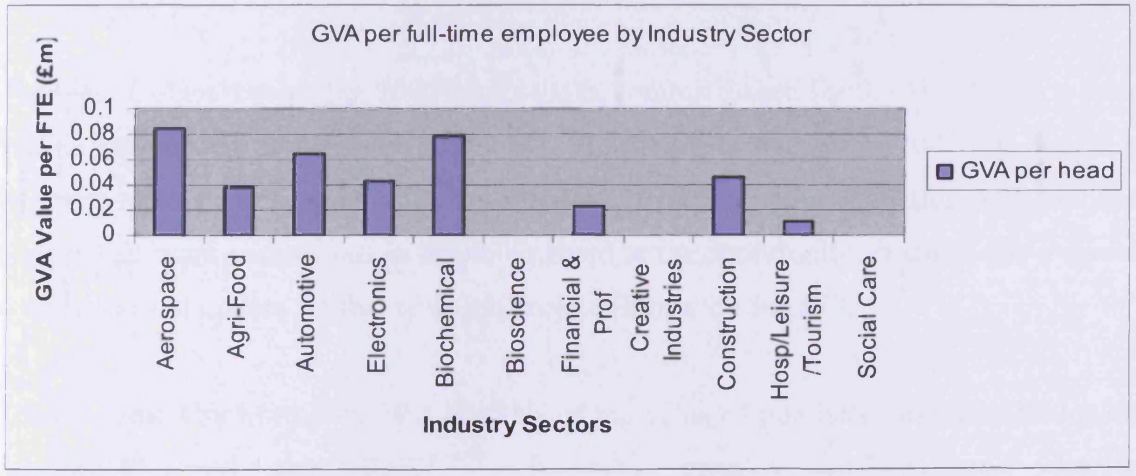


Figure A1.9 – Comparison of Welsh Priority Sectors by Gross Value Added per head/employee (Source: The Author, based on WAG data)

Based on the analysis of GVA per head, the top 3 sectors are Aerospace, Biochemical (Chemical & Pharmaceutical, not Biosciences) and Automotive. Those sectors favoured previously by the number of FTEs and GVA per sector are now relegated to the lowest values for GVA per employee i.e. Hospitality, Leisure and Tourism, Financial & Business Services and Construction. (With reference to Construction, if the total number of employees in Wales was recorded (i.e. self employed and the grey element, obviously the GVA per employee would reduce significantly).

Preliminary Research into the Priority Sectors – Results from the Analysis of the Welsh Input-Output Tables – Domestic Use Matrix (Appendix 2) Purchasing Activity

Purchasing data is encapsulated within the Domestic Use Matrix within the Welsh Input-Output Tables for 2000, generated by the WERU (2004). This table shows the input structure of each industry, in terms of its intermediate consumption in £m of products sourced within the regional economy and from outside (i.e. RoUK and the RotW) over a 12 month period. It also shows product consumption of final demand (i.e. sales). However, for this research, the author has elected not to concentrate on sales and trade activity but on purchasing activity only as this relates to SCVs. The structure of the table is based upon the classification of 74 Input-Output Industry/Product Groups by SIC 92 Classes as shown in Appendix 1 to the Welsh Input-Output Tables for 2000 (WERU, 2004).

The Input-Output Tables for 2000 project was commissioned by the WDA and a later version was due for publication in 2006/7, in relation to data from 2003. It does not however, replicate and update the exact format, structure, data collection and analysis process that were carried out in 2000, so there is no opportunity to carry out a direct comparison and update for this research project (Jones, 20 Jun 06).

The Domestic Use Matrix enables analysis of the value of purchases made in Wales, in the RoUK and the RotW. It also enables analysis to identify alignment/interdependencies between Industry/Product Groups in Wales, based on their purchasing patterns and financial value in £m.

The first piece of analysis to be carried out was to align the SIC codes used by the WAG and adopted for use in the ToC with the SIC codes adopted by WERU for the Domestic Use Matrix. The results of this alignment exercise are shown in Table A1.2. Whilst alignment is not exact in all cases, it is believed to be representative and therefore useful to this research project.

Industry/Product Code	Industry/Product Groups	SIC 1992	WAG SIC Used	WAG Sector Definition
5	Meat Processing	15.1, 15.4	15	Agri-Food
6	Dairy Products	15.5	15	
7	Fruit, Vegetables, Fish Processing	15.2, 15.3, 15.6	15	
8	Bread & Biscuits	15.81, 15.83	15	
9	Other Food Products	15.7, 15.85 to 15.89	15	
10	Confectionary	15.83, 15.84	15	
11	Drinks & Tobacco	15.91 to 15.98, 16	15	
16	Printing & Publishing	22	22.11 to 22.15	Creative
18	Chemicals & Chemical Products	24.1 to 24.3, 24.6, 24.7	24, 24.41, 24.42	Chemicals and Pharmaceuticals (not necessarily Biosciences)
9	Pharmaceuticals	24.4	24, 24.41, 24.42	
20	Soaps and Cleaning Products	24.5	24, 24.41, 24.42	
31	Office Machinery and Computers	30	30	Electronics & Optronics
32	Electrical Motors and Transformers	31.1, 31.2	31	
33	Wires and Cables	31.3	31	
34	Lighting and other Electrical Equipment	31.4 to 31.6	31	
35	Electronic Components	32.1, 32.2	32	
36	Television and Video Recorders	32.3	32	
37	Instrument Engineering	33	33	
38	Motor Vehicle	34	34	Automotive
39	Other Transport Equipment	35	35.3	Aerospace (Manufacture of Aircraft & Spacecraft)
45	Construction	45	45.11, 45.21, 45.22, 45.31 to 45.34, 45.41 to 45.45	Construction
49	Hotels, Bars & Restaurants	55	55.1 to 55.5	Hospitality, Leisure & Tourism
51	Other Land Transport	60.2	60.22, 60.23	
53	Travel Agencies and Other Transport Services	63	63.3	
56	Financial Intermediation	65	65	Financial & Professional/Business Services
57	Insurance	66	66	
64	Computer & Related Services	72	72.20	Creative
65	Research & Development	73	73, 73.10	Financial & Professional/Business Services
66	Other Professional Business Services	74.13 to 74.15, 74.4	74.1 to 74.4	
68	Engineering Services	74.2, 74.3	74.20	
72	Recreation, Culture & Welfare	85.3, 91, 92	92.11 to 92.13, 92.20, 92.31, 92.32, 92.34, 92.40, 92.72, 92.52, 92.53, 92.61, 92.62, 92.7	Hospitality, Leisure & Tourism/Creative

Table A1.2 – Alignment of SIC codes used by the WAG and the Welsh Economic Research Unit (WERU) for Data Collection/Analysis Purposes (Source: The Author)

The next stage of analysis addressed the contents of the Domestic Use Matrix relating to purchases made in Wales, the RoUK and the RotW and identifies the percentages for each.

The initial analysis concentrated on purchases made in Wales by the Welsh priority sectors. Figure A1.9 shows the results of this analysis with the top 3 highest values being made by the Construction, Recreation and Financial Intermediation Industry/Product Groups.

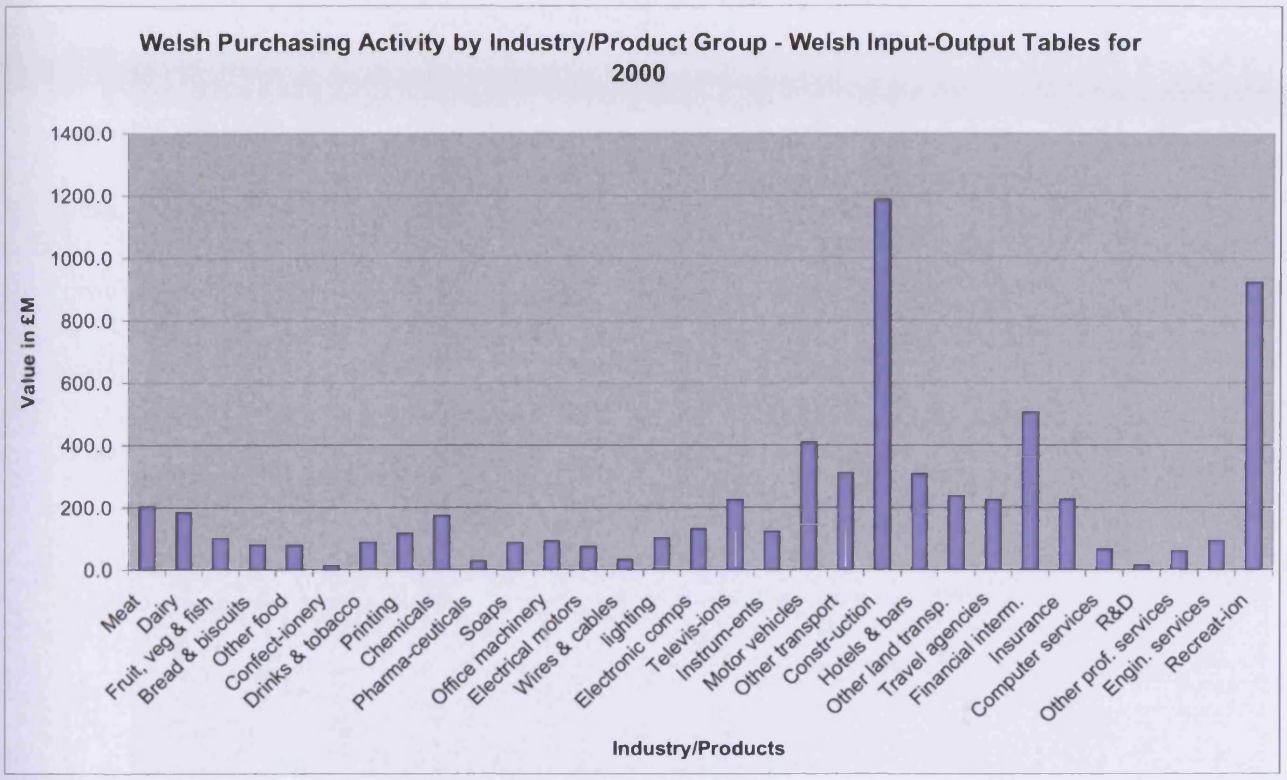


Figure A1.9 – Comparison of Purchasing Activity in Wales by Industry/Product Group (Source: The Author, based on Welsh Input-Output Tables for 2000)

However, by grouping individual SIC codes into the Welsh priority sectors as defined by WAG for example 'Total Agri-Food', the author believed that this may put a different complexion on the results. Therefore, additional analysis was carried out to group SIC codes as colour coded and shown in Table A1.3 in order to align to the priority sectors in Wales.

Figure A1.10 shows the revised results based on the grouping of SIC codes. It can now be seen that by grouping industries and products into the 'priority sector' totals, the top 3 are Hotels, Bars and restaurants, Recreation etc. (Hospitality grouping), Construction and the Financial, Professional Business Services groupings closely followed by the Electronics and Agri-Food groupings. Therefore, by assessing these in a cumulative

manner, the top three results at Figure A1.9 are strengthened in Figure A1.10, although the 'Hospitality' grouping total now replaces Construction in 1st position.

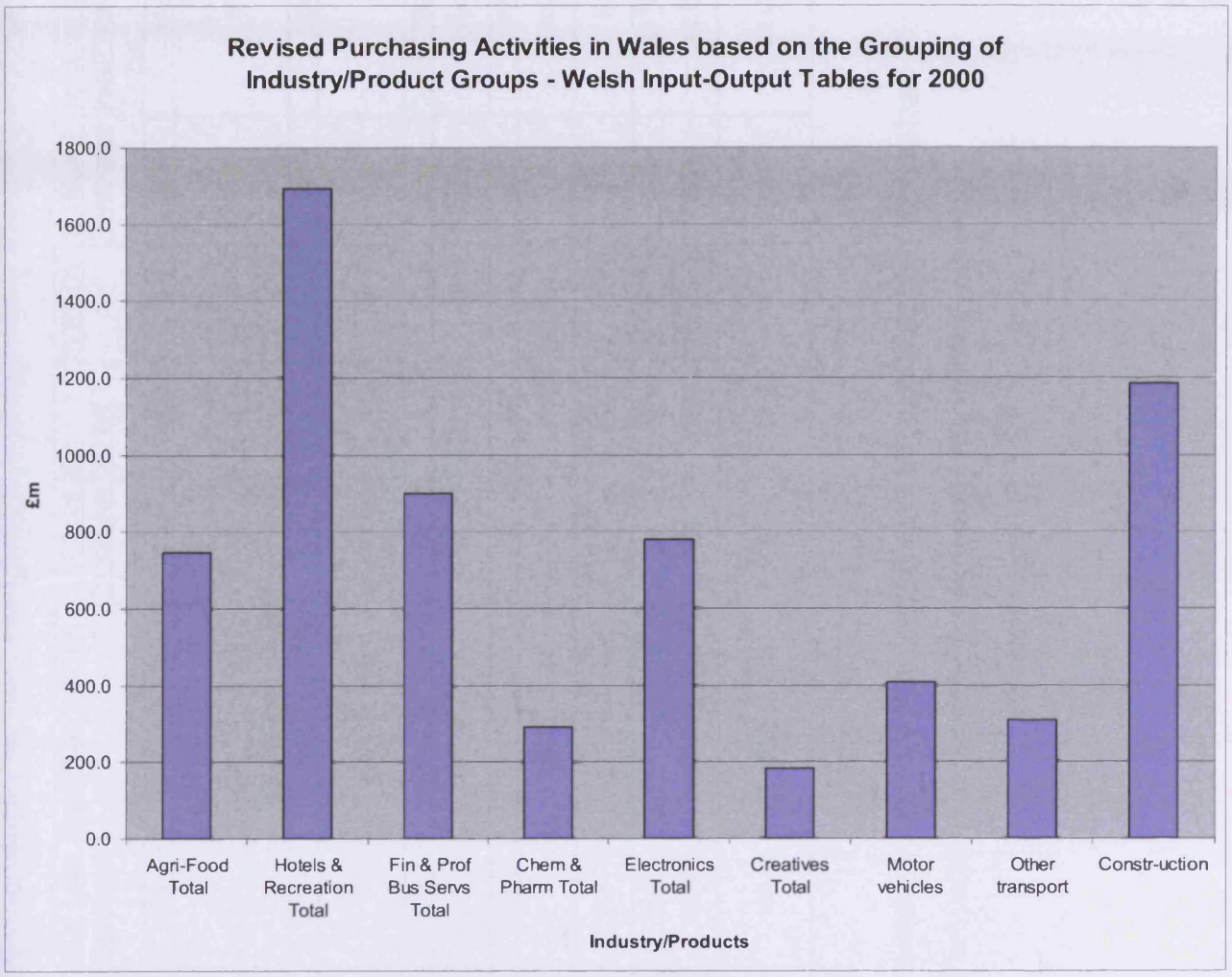


Figure A1.10 – Comparison of Welsh Purchasing Activity by Revised Industry/Product Groups using Total Groupings (Source: The Author, based on the Welsh Input-Output Tables for 2000)

Based on these groupings, Table A1.4 has been used to summarise the purchases for each sector, in Wales, the RoUK and the RotW. Total purchases within Wales by the priority sectors are also shown, along with the total purchases for all sectors in Wales. It can be seen that based on total purchases in Wales, the priority sectors account for 37.6% of total purchases made in Wales, 36.5% of total purchases made in the RoUK and 39.9% of all purchases from the RotW. The priority sectors consist of 31 Industry/Product groups from the total of 74 listed on the Domestic Use Matrix.

Industry/Product/'Group'	£m Wales	% Wales	% of Total Purchases	£m ROUK	% ROUK	% of Total Purchases	£m ROTW	% ROTW	% of Total Purchases	Total £m per Indy/Product/ 'Group'
Agri-Food Group	747	50	4.3	522	35	4.3	227.3	15	3.2	1496.3
Chemicals, Pharmaceuticals & Soaps Group (No data for 'Biosciences')	290.1	33	1.7	307.9	35	2.5	275.2	32	3.8	873.2
Construction	1186.5	58	6.9	683.5	33	5.6	176.1	9	2.4	2046.1
Creative Group (Printing, Publishing & Computer Related)	181.9	36	1	212.2	42	1.7	111.9	22	1.5	506
Electronics Group	778.9	34	4.5	589.5	26	4.9	913.2	40	12.9	2281.6
Financial, Professional & Business Services #	898.6	50	5.2	728.8	40	6	174.2	10	2.4	1801.6
Hospitality Group	1692.6	59	9.9	819.2	29	6.8	328.5	12	4.6	2840.3
Motor Vehicles (Automotive)	408.3	38	2.3	368.4	34	3	298.5	28	4.2	1075.2
Other Transport (Aerospace)	309.3	35	1.8	213.1	24	1.7	351.4	41	4.9	873.8
Priority Sector' Totals	**6493.2**		**37.6**	**4444.6**		**36.5**	**2856.3**		**39.9**	**13794.1**
Balance of Total in other Sectors	**10549.6**		**62.4**	**7582.6**		**63.5**	**4203.4**		**60.1**	**22335.6**
Total Purchases - all SIC/Industry Product/Groupings	**17042.8**	**47**	**100**	**12027.2**	**33**	**100**	**7059.7**	**20**	**100**	**36129.7**

Table A1.3 – Comparison of Welsh Purchasing Activity by Revised Industry/Product Groups using Total Groupings – Split by Wales, Rest of the UK and Rest of the World (Source: The Author, based on the Welsh Input-Output Tables for 2000)

Purchases made in the RoUK were then analysed. The top 3 sectors are the 'Hospitality group total', 'Financial & Professional Business Services group total' and Construction. Therefore the largest purchasers in Wales are also the largest purchasers from the RoUK.

For purchases made from countries throughout the RotW, the top 3 priority sectors here are the Electronics grouping, Other Transport Equipment (which relates to Aerospace, based on the SIC code used by WAG) and the Hospitality grouping. Electronics is not a surprise as the OEMs and strategic parts in most electronics goods are designed and manufactured outside of the UK for example, Intel semi-conductors (Young, 3 October 2006).

For the total purchases made by Welsh companies, within Industry/Product Groups from Wales, the RoUK and the RotW, it can be seen that the top 3 sectors are the Hospitality grouping, the Electronics grouping and Construction.

Table A1.3 shows that 88% of all purchases made by the Hospitality Grouping are made within Wales (59%) or the RoUK (29%), with only 12 % being purchased from the RotW. In conversation with a stakeholder from a theme park in Pembrokeshire (Evans, 4 Oct 06), this would sound sensible as she advised that they only buy volume items such as novelty pens and pencils from the Far East/RotW.

In comparison to the Hospitality Grouping, the Electronics grouping purchases the majority of its requirements outside of Wales (66%) with only 34% being purchased within Wales. 60% in total is bought within Wales and the RoUK, based on the 2000 figures. However, it is understood from the MD of the Welsh Electronics Forum that the amount bought outside of Wales and the UK is increasing as at 2006 (Young, 3 Oct 06).

The Construction sector purchases the majority of its requirements from within Wales and the RoUK (i.e. 91%) with only 9% being purchased from RotW.

It can be seen that over all of the Industry/Product Groups, products and services bought in Wales account for less than half (47%) of all purchases made. Purchases from the

RoUK represent 33% of all purchases made with the RotW accounting for 20% or one fifth of all purchases made by Wales.

In addition to the analysis of purchasing patterns in Wales, the RoUK and the RotW, analysis has been carried out to identify alignment between sectors in Wales, based on their purchasing patterns. No grouping of SIC codes has been applied, therefore, each Industry/Product Group is counted separately.

Firstly, analysis was carried out on the purchases made within Wales by those individual Industry/Product Groups from within the priority sectors. The results of this are summarised at Table A1.4. The majority of sectors align with the individual Financial & Professional Business Services Industry/Product group codes (41 instances), the Hospitality grouping Industry/Product codes (23 instances), Creative grouping (15 instances) and the Electronics groupings (8 instances). Therefore, these are significant in Wales.

Purchasing Industry/Product Group	1	2	3
Meat Processing	Other Land Transport	Other Food Products	Financial Intermediation
Dairy Products	Financial Intermediation	Construction	Insurance
		Other Land Transport	
Fruit, Veg, Fish Processing	Other Land Transport	Other Professional Business Services	Financial Intermediation
Bread & Biscuits	Fruit, Veg, Fish Processing	Other Food Products	Other Land Transport
Other Food	Other Land Transport	Other Professional Business Services	Financial Intermediation
Confectionary	Other Professional Business Services	Other Land Transport	Dairy Products
			Financial Intermediation
Drinks & Tobacco	Other Land Transport	Other Professional Business Services	Fruit, Veg, Fish Processing
Printing & Publishing	Recreation, Culture & Welfare	Other Land Transport	Other Professional Business Services
Chemicals	Other Land Transport	Financial Intermediation	Printing & Publishing
Pharmaceuticals	Financial Intermediation	Other Professional Business Services	Recreation, Culture & Welfare
		Engineering Services	
Soaps	Other Professional Business Services	Other Land Transport	Financial Intermediation
Office Machinery	Electronic Components	Financial Intermediation	Printing & Publishing
Electronic Motors & Transformers	Financial Intermediation	Other Land Transport	Electronic Components
		Engineering Services	
Wires & Cables	Other Land Transport	Financial Intermediation	Electronic Components
			Engineering Services
Lighting & Other Electrical Equipment	Financial Intermediation	Engineering Services	Other Land Transport
Electronic Components	Lighting & Other Electrical Equipment	Printing & Publishing	Financial Intermediation
Television & Video Recorders	Financial Intermediation	Lighting & Other Electrical Equipment	Electronic Components
Instruments	Electronic Components	Electronic Motors & Transformers	Financial Intermediation
Motor Vehicles	Construction	Other Land Transport	Printing & Publishing
Other Transport Equipment	Engineering Services	Financial Intermediation	Computer Related Services
Construction	Engineering Services	Other Land Transport	Other Professional Business Services
Hotels, Bars & Restaurants	Bread & Biscuits	Meat Processing	Fruit, Veg, Fish Processing
Other Land Transport	Travel Agencies & Other Transport Services	Computer Related Services	Other Professional Business Services
Travel Agencies and Other Transport Services	Computer Related Services	Construction	Other Land Transport
Financial Intermediation	Printing & Publishing	Computer Related Services	Travel Agencies & Other Transport Services
Insurance	Printing & Publishing	Other Professional Business Services	Construction
Computer Related Services	Engineering Services	Other Professional Business Services	Recreation, Culture & Welfare
R & D	Computer Related Services	Travel Agencies & Other Transport Services	
	Engineering Services	Insurance	
		Other Professional Business Services	
Other Professional Business Services	Engineering Services	Recreation, Culture & Welfare	Printing & Publishing
Engineering Services	Computer Related Services	Printing & Publishing	Other Professional Business Services
Recreation, Culture & Welfare	Other Professional Business Services	Computer Related Services	Engineering Services

Table A1.4 – Summary of Alignment Between Priority Sectors Based on Purchasing Patterns in Wales (Source: The Author, based on the Welsh Input-Output Tables for 2000)

Based on the analysis of alignment between sectors, supplementary analysis was carried out to quantify the value of purchases made by the Welsh priority sectors, from the most represented Industry/Product Groups within the Financial and Professional Business Services grouping. These appear to be of considerable importance as enablers to the other priority sectors. The results of this are shown at Figure A1.11.

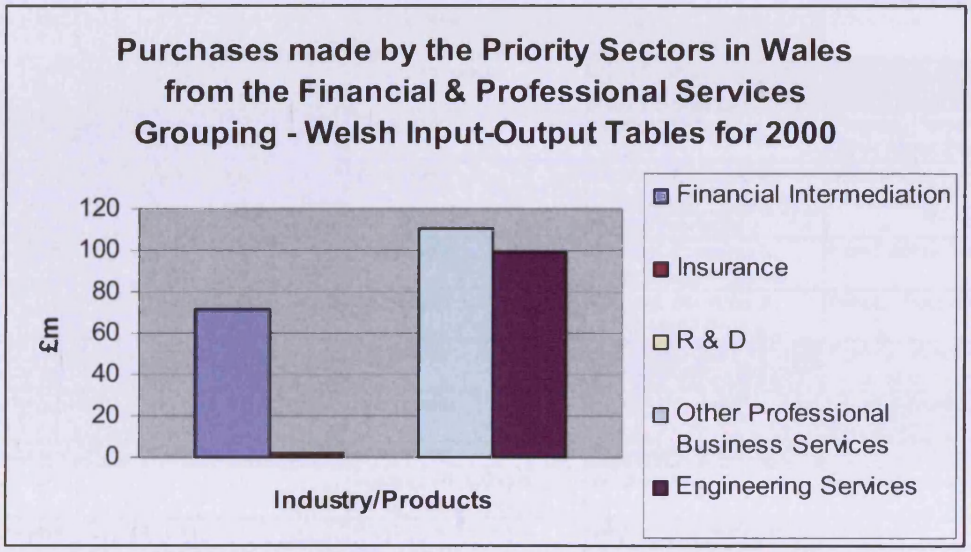


Figure A1.11 – The Breakdown of the Purchases made by the Priority Sectors in Wales from the Financial and Professional Business Services Grouping (Source: The Author, based on the Welsh Input-Output Tables for 2000)

It can be seen from Figure A1.11 that the largest purchasing expenditure is with Other Professional Business Services (for example, Consultants), followed by Engineering Services and Financial Intermediation.

Secondly, analysis was carried out for the priority sector Industry/Product Groups across all Industry/Product Groups to identify if larger purchases and stronger associations between sectors existed outside those designated as priority sectors in Wales. The results of this analysis is summarised in Table A1.5.

Purchasing Industry/Product Group	1	2	3
Meat Processing	Agriculture & Fishing	Wholesale	Other Land Transport
Dairy Products	Agriculture & Fishing	Wholesale	Plastic Products
Fruit, Veg, Fish Processing	Agriculture & Fishing	Wholesale	Electricity
Bread & Biscuits	Fruit, Veg & Fish Processing	Plastic Products	Wholesale
Other Food	Agriculture & Fishing	Other Land Transport	Other Professional Business Services
Confectionary	Agriculture & Fishing	Other Professional Business Services	Wholesale
Drinks & Tobacco	Forging, Pressing & Other Metal Products	Other Land Transport	Other Professional Business Services
Printing & Publishing	Recreation, Culture & Welfare	Property Development & Letting	Wholesale
Chemicals	Electricity	Wholesale	Other Land Transport
Pharmaceuticals	Financial Intermediation	Other Professional Business Services	Wholesale
Soaps	Plastic Products	Other Professional Business Services	Other Land Transport
Office Machinery	Wholesale	Plastic Products	Forging, Pressing & Other Metal Products
Electronic Motors & Transformers	Wholesale	Forging, Pressing & Other Metal Products Plastic Products	Mechanical Engineering
Wires & Cables	Wholesale	Forging, Pressing & Other Metal Products	Non-Ferrous Metals
Lighting & Other Electrical Equipment	Wholesale	Forging, Pressing & Other Metal Products	Plastic Products
Electronic Components	Wholesale	Lighting & Other Electrical Equipment	Forging, Pressing & Other Metal Products
Television & Video Recorders	Wholesale	Financial Intermediation	Lighting & Other Electrical Equipment
Instruments	Wholesale	Electrical Components	Plastic Products
Motor Vehicles	Forging, Pressing & Other Metal Products	Wholesale	Plastic Products
Other Transport Equipment	Forging, Pressing & Other Metal Products	Engineering Services	Wholesale
Construction	Other non-metallic mineral products	Renting of Moveables	Property Development & Letting
Hotels, Bars & Restaurants	Bread & Biscuits	Meat Processing	Agriculture & Fishing
Other Land Transport	Oil Processing	Travel Agencies & Other Transport Services	Sub-Contract Business Services
Travel Agencies and Other Transport Services	Railways	Computer Related Services	Sub-Contract Business Services
Financial Intermediation	Postal Services	Telecomms Services	Printing & Publishing
Insurance	Real Estate & Brokerage	Telecomms Services	Postal Services
Computer Related Services	Sub-Contract Business Services	Engineering Services	Legal Services
R & D	Sub-Contract Business Services	Education	Property Development & Letting
Other Professional Business Services	Sub-Contract Business Services	Telecomms Services	Engineering Services
Engineering Services	Sub-Contract Business Services	Accountancy Services	Computer Related Services
Recreation, Culture & Welfare	Sub-Contract Business Services	Other Professional Business Services	Engineering Services

Table A1.5 – Summary of Alignment Between Priority Sectors and All Other Industry/Product Groups, Based on Purchasing Patterns in Wales (Source: The Author, based on the Welsh Input-Output Tables for 2000)

It can be seen from Table A1.5 that when analysing purchasing against the full range of Industry/Product Groups there is less alignment between the priority sectors in relation to purchasing patterns in Wales. However, the individual Industry/Product Groups for Financial & Professional Business Services Grouping have 12 instances of alignment, the Hospitality grouping has 7 instances with both Electronics groupings and Creative sector having 3 each. With reference to the Electronics groupings, it can be seen that many purchases are made from wholesalers in Wales, indicating that these goods and services may also be from the RotW and outside of the UK.

Preliminary Research into the Priority Sectors – Summary of the Analysis and Results from the Table of Characteristics and the Purchasing Data from the Domestic Use Matrix

This information is detailed within Chapter 2. Previous research by IWA (2005, p 9) into regional development and the identification of priority sectors concluded that it may be worth selecting the top 3 priority sectors for further research based on the following criteria:

- *To support where necessary, current areas of strength.*
- *To develop new/latent sectors.*
- *To ameliorate problems in sectors likely to decline further.*

This was used to determine which 3 sectors would be used to investigate SCVs in the case studies:

- Biosciences – a developing sector
- Financial and Professional Business Services, with a focus on Financial Intermediation and Insurance Services in Wales – an established sector still growing in Wales (i.e. Financial in the thesis)
- Aerospace – a mature sector

The preliminary phase of the research was written up during Nov-Dec 2006, along with the corresponding literature review and an Executive Summary was produced for the stakeholders, in accordance with WAG requirements.

Annex A to Appendix A

Preliminary Research Phase - Stakeholder/Informant Meetings Template

1. **Stakeholder/Informant Name & Contact details:**
WAG Informants ie Tony Griffiths, Creative, Tourism etc

2. **Date/Time/Location of Meeting:**

3. **Agenda/Basis of Discussion:**
TW - Overview of SCV – sectors, initial data gathering – 2 pronged attack

Where do you fit within the org?

Does anyone else have a similar responsibility/links with ind forums/associations that I need to talk to/obtain info?

Do you deal with existing companies and potential start-up companies and do you have a contacts list?

I have a questionnaire to go out to companies etc – could you please review it for me and give feedback?

For any contact with the questionnaire, should I come via you? Do you have a database of companies? Is it up to date?

Do you have any events planned that I could present at in order to introduce the research?

What are the main characteristics of the sector (validate the 2002 report page(s) by WERU?) Competences, Risks, Trade or get them to identify these by referring to the 2002 report, where data not available.

What does a supply chain look like?

What could SCVs include?

Populate/validate the matrix of sectors/enabling technologies.

AOB/DONM

4. **Agreed Actions:**

5. **Queries/concerns/advice:**

Appendix B – Historical Context of Regional Economic Development in Wales

This appendix summarises how the Welsh economy has evolved over the past 300 years. James (2003) investigates the competitiveness of the Welsh economy and highlights the developments within the Welsh economy between 1700 and the 1990s, following five phases of development:

- Phase 1 – Wales as the engine of the British Empire.
- Phase 2 – Welsh coal fuelled steam power
- Phase 3 – Manufacturing, engineering and the initial attempts at regional development. It was not until this time that regional economic development policies were introduced within Wales and the UK, transforming regions from traditional, raw materials based industries to manufacturing based industries such as electrical engineering, petro-chemicals and automotive.
- Phase 4 – Mass production and inward investment. Diversification was prominent to aid the restructuring of the post-war Welsh economy which included the twilight years of the coal and steel industries, expansion in the petro-chemicals and oil industry and the introduction of financial services.
- Phase 5 – Restructuring for the 21st century. The Welsh economy has become more dependent on the service and public sectors.

Based on James (2003), Table B1.1 has been developed tracking more recent developments from the post World War II Phase 4 to the 1990s Phase 5. The author has added post year 2000 information from more contemporary literature (e.g. WAG, 2005; WDA, 2004) which identifies 'priority sectors' for targeted and sustainable regional economic development activities. It is from these sectors that three would be selected for the case study research into SCVs in Wales.

Phase 4: Mass Production and the Advent of Inward Investment				
Year	**Location**	**Industry/Sector**	**Regional Development Policy**	**References**
1948 - 1979	Wales	Restructuring of the Welsh economy	Inward Investment became a large part of Welsh economic development, moving Wales from its dependency on its natural resources of raw materials and diversifying into manufacturing.	Humphreys (1972)
1948	Merthyr Tydfil	Electrical including Thorn Lighting & Hoover	Inward investors	
1948 - 1960s			Carrot and stick policy used to attract manufacturing FDI to depressed post-war regions.	
Post war	South Wales	Automotive components manufacturers including Calsonic, Llanelli		Humphreys (1972)
1950 - 1957	Wales	Coal & steel		May (1994)
1957 - 1958	Wales	Rationalisation of metal industries		
1960	Milford Haven	Esso oil refinery		
1960s	Milford Haven	Texaco oil refinery		
1960s	Llandarcy	BP oil refinery		
1966	Baglan Bay	Petro-chemical complex		Humphreys (1972)
1970s	Wales	Rationalisation of steel industry		
1970s	Cardiff	Automotive eg Rover		
1970s	Llanelli	Automotive eg Fisher Ludlow body plant		
1970s - 1980s	Wales	Continued decline of the coal industry		
1970s	South East Wales	Financial services		
1972	Milford Haven	Amoco oil refinery		
Phase 5: Restructuring for the 21st Century				
1980s	Mainly Swansea and Cardiff	Service sectors (including financial services and public sector)	Policy shift away from diversification. Aim for sustainable economic development, building on a mix of indigenous and FDI firms.	
1990s	Wales	Automotive, chemical, electric and electronic engineering sectors account for 50% of FDI employment		Hill and Munday (1995)
2005	Wales	Priority sectors identified in the regional economic strategy for Wales (Automotive, Aerospace, Agri-food, High Technology, Pharmaceuticals/bio-chemicals, Financial Services, Creative (eg Film/Music Industry), Construction, Hospitality, leisure and tourism, Social care. Possible additions: Energy & Environmental-related sectors.)	Priority sectors identified in the regional economic strategy for Wales	WAG (2005)

Table B1.1 - A Detailed Summary of Wales' Regional Economic Development – Post World War II - 2005 (Source: The Author, based on James, 2003; WAG, 2005; WDA, 2004)

Bryan and Jones (2000) highlight some key influences on the evolution of the Welsh economy and the contemporary challenges faced at the turn of the millennium. This includes developments such as the progression of the service sector in Wales, including the South East Wales Call Centre Initiative and its importance to the development of the financial services sector, instrumental European Objective 1 funding and the continued significance of FDI, for example.

FDI in Wales is understood to have reaped benefits, particularly in South Wales, by limiting the fall of employment associated with the demise of traditional industries such as coal mining and in employment terms, steel production. Without the success in attracting FDI, Wales may have suffered more through the recessions of the 1980s and 1990s (Welsh Office, 1998). However, another issue for FDI is that of the concern of a growing dependence by Wales on foreign capital, as an increasing proportion of manufacturing in Wales has become foreign owned over time (Munday, 2000).

Lovering (1998) investigates the role of FDI in Wales and questions the policy of using multinationals as a catalyst for the development of regional clusters, believed to generate the static benefits of reduced costs and the dynamic benefits of a collective commitment to innovation. Lovering (1998, p 7) states that this 'is now ubiquitously seen as the key to both corporate and regional competitiveness'. He also contends that there is little evidence on the levels of embeddedness of foreign investors in Wales.

Different foreign investors have different location criteria. Empirical evidence has led to a belief that Wales attracts investors based on low unit labour costs, good road infrastructure and access to grants and other financial assistance whilst maintaining access to key consumer markets (Hill and Munday, 1994). During the 1970s and 1980s there seemed to be few alternatives to inward investment as a means of regional economic development. However, indicative costs and benefits of attracting FDI companies using incentives such as grants and infrastructure have been reported (Christodoulou, 1996).

In 2000, there was a continuing movement towards the development of low-value service industries which were seen to pose serious problems for Wales in relation to low

wages, low skills levels and functionally narrow job opportunities. Encouraging high-value added services to Wales was seen as a difficult task owing to these factors being an attraction to FDI companies (Jones, 2000). In addition, despite the development of FDI and branch plant manufacture, Wales still lacks company head quarters (HQs), and as a consequence, research and development (R & D) activity.

Porter (1990) argues that successful FDI in the future, as far as the host nation is concerned, will depend on attracting 'home bases' where technology is housed, the sophisticated value adding production takes place and where strategic management decisions are made.

In both demand and supply terms, FDI can play a crucial role in regional economic development, providing that the appropriate institutional environment and support exist. Hines (1993) identifies that one of the major issues facing both inward investors and indigenous companies is the quality of local sources of supply contending that if Welsh suppliers are to take advantage of the establishment of foreign plants in Wales, then the goods and services supplied must match the best offered elsewhere in terms of quality, cost and delivery. In addition, research has recommended that local suppliers must have the technological capacity to adapt to accelerating technological advances and shortening product life cycles (Morgan, 1996). FDI can therefore act as a catalyst for indigenous firms to increase their demand for technology.

Rhisiart (2004) reports that the restructuring of the Welsh economy over the past 25 years has been a reminder of the fallout created by economic globalisation with the collapse of the heavy industrial base posing major policy changes for the region. Economically, the dominant paradigm that guided the post industrial strategy for the regeneration of affected areas was the attraction of capital from overseas (FDI). Whilst employment was created in the short-term, the sustainability of the approach has been severely undermined by the loss of investments and the migration of jobs to lower cost economies. The cost of labour in developing countries is understood to be substantially lower than those within Wales, along with other countries that have witnessed the loss of manufacturing jobs to for example, South East Asia. In addition, the European Union (EU) accession countries of Central and Eastern Europe have also competed with Wales for FDI. This poses a challenge for developed countries to exploit opportunities

to market and supply goods and services to low cost economies. Therefore, the role and competence of Wales when compared to the global economy is critical and the adoption of new technologies and dematerialisation offer such opportunities.

Brahm (1995) questions the idea of targeting high technology sectors in support of economic development, claiming that the authorities targeting such initiatives has led to them becoming excessively competitive. In particular, he states that over-targeting aid to such sectors results in an industry with average rates of return below the competitive rate, and accelerated innovation and investment in new products, plant and equipment beyond rates that can sustain average industry profits. In relation to other research in Wales, Morgan (1996) believes that Brahm misses the point as not all innovation is blue sky, leading edge research or high technology. Much is concerned with adaptation, improvement and rapid imitation (Ashcroft *et al.*, 1995). Morgan (1995) points out 'we would do well to remember Rosenberg's excellent critique of intellectual prejudices .... the result is that 'grubby and pedestrian forms of knowledge' are neglected in the study of innovation and economic development, even though they play a discerningly large role'.

Appendix C - UK Regional Development Agencies (RDAs) and their Priorities for Regional Economic Development

This appendix identifies and summarises the priorities for regional economic development by the UK RDAs, including the WAG.

A priority for the UK and the EU is to deliver a knowledge-driven economy, within which clusters play an important part (IWA, 2005). WERU (2002, pp 91 – 92; Bryan *et al.*, 2005) summarised the list of clusters and sectors targeted by RDAs within the UK as shown in Table C1.1. Those sectors identified for Wales (WDA, 2004; WAG, 2005, p 58) have been added for 2005, along with an additional column covering developments from 2006 to 2009, as identified by the author. Those sectors or clusters highlighted in blue depict those that are replicated between regions at 2005 and those highlighted in red show commonality between 2006 and 2009.

Regional Development Agency	Priority Sectors up to 2005	Priority Sectors 2006- 2009
Scottish Enterprise (www.scottishenterprise.com)	Biotechnology, Food, Oil & Gas, Opto-electronics, Semiconductors, Software (including multimedia), Tourism	6 priority industries: Energy, Life Sciences, Tourism, Financial Services, Food & Drink, Digital markets & enabling technologies. (Scottish Enterprise, 2007, p 8 and http://www.scottish-enterprise.com/publications/delivering_competitive_advantage.pdf accessed 14 Nov 08).
Invest Northern Ireland (www.investni.com)	Contact Centres, Hi-Tech Manufacturing, Life & Health Sciences, Software, Telecoms/ Electronics	Financial Services, Business Services, ICT, Telecoms/Electronics, Software, Manufacturing, Life Sciences (http://www.investni.com/index/locate/our_key_business_sectors.htm accessed 4 Sep 07 and 14 Nov 08).
East of England (www.eeda.org.uk)	Key sectors in: ICT, Life Sciences, Media and Cultural Industries, Financial and Business Services, Agriculture & Food Processing, Tourism, Leisure and Heritage, Automotive, High Tech	Not a sector based strategy. Key priorities and themes for example regional infrastructure, innovation and skills. However, the new Regional Economic Strategy (RES) includes the support of

	Manufacturing & Advanced Engineering, Transport Gateways	the expansion of important, high-value sectors such as Pharmaceuticals, Aerospace and Film Production. (http://www.eastofengland.uk.com/res/ accessed 14 Nov 08).
South West of England (www.southwestrda.org.uk)	Aerospace, Biotechnology, Creative Industries, Environmental Technologies, Food & Drink, ICT, Marine, Tourism	Advanced Engineering, ICT, Marine, Food & Drink, Tourism, Creative Industries, Environmental Technologies, Bio-medical (SWRDA, 2006, http://www.southwestrda.org.uk/downloads/document.asp?lang=&documentid=1036& accessed 17 Nov 08).
North East (www.onenortheast.co.uk)	Clusters in: Automotive & Precision Engineering, Bio-science, Chemicals, Clothing & Textiles, Culture, Digital/Multimedia, Electronics, Environmental Industries and Energy, Food & Drink, Nanotechnology, Offshore/Marine Engineering, Tourism	Chemicals & Pharmaceuticals, Automotive, Commercial Creative, Defence & Marine, Energy, Food & Drink, Health & Social Care, Knowledge Intensive Business Services, Tourism & Hospitality (One North East, 2006, http://www.onenortheast.co.uk/page/res.cfm accessed 17 Nov 08).
South East England (www.seeda.co.uk)	Sector Groups in: Defence & Aerospace, Media & Creative Industries, Transport & Logistics	Not a sector based strategy but focuses on 6 key drivers in 3 key areas: Employment, enterprise, innovation and creativity, skills, competition and business regulation, investment in infrastructure – targeting the inner South East, outer South East and coastal South East. Also emphasises the 2012 Olympics in London (SEEDA, 2006, http://www.seeda.co.uk/RES_for_the_South_East_2006-2016/docs/RES_2006-2016.pdf accessed 17 Nov 08).
Advantage West Midlands (www.advantagewm.co.uk)	Added Value Engineering, Automotive, Electronics & Telecommunications, Food & Drink, Healthcare and Pharmaceuticals, Logistics & E-fulfilment, Rubber &	Priority business clusters: Aerospace, Automotive, Building Technologies, Business & Professional Services, Environmental Technologies, Food & Drink,

	Plastics, Services & E-business, Software	High-Value Added Consumer Products, ICT, Manufacturing, Medical Technologies, Rail, Screen Image & Sound, Tourism & Leisure (Advantage West Midlands, 2007, p 47 http://www.advantagewm.co.uk/Images/WMES_tcm9-9538.pdf accessed 7 Nov 08)
Yorkshire Forward (www.yorkshire-forward.com)	Advanced Engineering, Bioscience, Chemicals, Digital Industries, Food & Drink	Clusters: Digital Industries, Food & Drink, Advanced Engineering & Metals, Chemicals, Bioscience, Environmental Technologies, Healthcare Technologies, Financial & Business Services, Construction, Logistics (Yorkshire Forward, 2006, http://www.yorkshire-forward.com/asset_store/document/res_summary_06_15024.pdf accessed 17 Nov 08).
North West (www.nwda.co.uk)	Automotive Components, Financial Services, Food and Drink, ICT, Life Sciences (Pharmaceutical, Biochemical Centres), Software	Bio-medical (including biotechnology, pharmaceuticals & medical devices), Energy & Environmental Technologies, Advanced Engineering & Materials (including chemicals, aerospace, automotive, advanced flexible materials), Food & Drink, Digital & Creative Industries, Business & Professional Services (North West Development Agency (NWDA), 2006, http://www.nwda.co.uk/publications/strategy/regional-economic-strategy-200.aspx accessed 17 Nov 08).
East Midlands (www.emda.org.uk)	Existing/emerging cluster areas with competitive advantage and growth potential: Clothing & Textiles, Creative Industries, Food & Drink (Processing & Technology), Healthcare Industries, High Performance Engineering	Priority sectors: Transport Equipment, Construction, Food & Drink, Healthcare (EMDA, 2006, http://www.emda.org.uk/res/docs/RESflourishingFINALA4.pdf accessed 5 Sep 07 and 17 Nov 08).

London (www.lda.gov.uk)	Business led advisory 'sector commissions' in : Creative Industries, Manufacturing	Priority sectors are not targeted. The Economic Development Strategy (EDS) supports businesses that can promote productivity, employment, social inclusion or environmental goals (LDA, 2005, http://www.london.gov.uk/mayor/strategies/economic_development/sustaining_success.jsp accessed 5 Sep 07 and 17 Nov 08).
Welsh Development Agency (Welsh Assembly Government Department post 2005) (http://new.wales.gov.uk)	Aerospace, Agri-Food, Automotive, Construction, Creative Industries, Financial Services, High Technology (including Biosciences, Electronics, Opto-electronics, ICT, Materials, Nano and Micro Technology, Combined/ Converged Technologies) Hospitality, Leisure and Tourism, Pharmaceuticals/Biochemicals, Social Care (Plus potentially Environmental Related and Energy) (WAG, 2005, p58).	Foundation/Core Sectors: Energy, Environmental Management, Telecommunications/ICT Tier 1 Sectors: Bioscience, Health, Financial Services/Products and Professional Services, Creative Industries Tier 2 Sectors: Automotive, Aerospace, Construction, Food, Defence, Retail, Leisure & Tourism (WAG MAG, Summer 2007)

Table C1.1 - UK Regional Development Agencies Priority Sectors (Sources: WERU, 2002, pp91 – 92; Bryan *et al.*, 2005, except where specified)

Table C1.1 and Bryan *et al.* (2005) shows a remarkable consensus on policies to promote local development although EEDA, SEEDA and the LDA appear to be moving away from sector strategies during 2006 to 2009.

Based on strategies from central Government, RDAs have been preoccupied with promoting key industries or clusters which are deemed to have the potential to deliver economic benefits by via local linkages and the value added they create. Unfortunately, policy in the UK regions has rarely been supported by a consistent economic rationale to aid in the selection of such key sectors or groups of industries, or by methods that show how these industries will actually contribute to regional competitiveness. Often, selection has been based on crude methods, simple followership or anecdotal judgement (Bryan *et al.*, 2005). (The author of this thesis understands that the use of GVA

measures aided the selection of priority sectors in Wales). This is a problem and as Feser and Bergman (2000, p 2) state, 1 result is that although many areas in the United States of America (USA) and Europe have key sector and cluster based policies, the logic underlying their selection can be badly specified or worse, not recognised as relevant.

The selection of key sectors, however defined, is unlikely to be straightforward and several studies have questioned the underlying desirability of promoting individual groups of industries. For example, methods such as Input-Output Tables, location quotients, comparative advantage and network analysis have been used to prioritise sectors. However, several authors identified the need for alternative methods, hence MSQA (see IWA, 2005; WERU, 2002; Roberts and Stimson, 1998).

The chronology/summary of the importance of identifying key sectors in regional strategies at Table C1.2 is based on Bryan et al. (2005). A common theme in modern UK RDA strategies is the identification of sets of key growth sectors, or clusters of interrelated activities which are assumed to be critical drivers of regional competitiveness.

A major problem facing regional development strategists globally is the paucity of economic data at the required regional or local level. Most nations collect statistics in some form or another at different levels, but limited data are collected at the regional level in relation to production, trade, expenditure, technology development, capital flows and investment by industry sector. In fact, much of the economic data relating to regions and cities are provided by disaggregating national and state data, causing errors and anomalies arising from this process (Roberts and Stimson, 1998).

Government Publication	**Academic/ Government Influences**	**Key Points**	**Impacts**
DTI, 1998 – White Paper on Competitiveness	Porter, 1990; Thurow, 1992	New growth industries of the future would depend on 'brain power' (DTI, 1998, p 2).	Identification of key industries for the following decades including micro-electronics, biotechnology, new materials, civilian

			aviation, telecommunications, robotics and machine tools, computer hardware and software.
House of Commons (HoC) Library, 2000	DTI various policy documents	DTI documents 'provided the springboard for a large number of government micro-economic activities and policies' (HoC Library, 2000, p 6).	Generated a large number of apparently separate but closely related policies to support key sectors which appear to have growth properties (at least at the UK level), an to identify incipient clusters of 'knowledge-based' activities around distinct spatial nodes (DTI, 2001)
House of Commons Library, 2000	DTI various policy documents	UK Government's strategy focussed on 'knowledge industries', the success of which will 'substantially raise the overall competitiveness of the economy' (HoC Library, 2000, p 3).	
DTI and Department for Education and Employment (DfEE) (2001) White Paper		Encourages RDAs to continue to develop active and embryonic clusters in their regions, building on existing capabilities (DTI & DfEE (2001).	
	Harding *et al.* (1999); Morgan (1999)	Contemporary review of the changed policy context resulting from the creation of English RDAs and the tensions and challenges in developing new economic strategies following devolution and the greater powers for English RDAs.	

Table C1.2 - Chronology/Summary of the Importance and Implications of Adopting Key Sector Development Strategies (Source: Bryan *et al.*, 2005)

Based on Table C1.2 there appears to be a widely accepted view of the importance for knowledge creation in key sectors and clusters. Analysis of the DTI White Papers by Bryan *et al.* (2005) states that there is evidence to suggest that the source of this conviction is often anecdotal and heavily recycled with a reliance on exemplar regions or localities usually outside of the UK. In addition, there is evidence of a top-down rather than a bottom-up approach possibly reflecting the central government control of resources (Harding *et al.*, 1999), hence RDA strategies contain similar themes and similar sectors. The prioritisation of sectors is rarely subject to rigorous analysis, partly because of the absence of data and tools (WERU, 2002, IWA, 2005, Roberts and Stimson, 1998).

Feser and Bergman (2000) examines the development of national industry clusters in the USA and identify that approaches frequently 'involve little more than the identification of current regional specialisations as targets for traditional development initiatives' (p 2). This appears to be the case in the UK.

WAG (2002) highlights the magnitude of economic challenges facing Wales at the turn of the century. A key target was to raise Welsh GDP per capita level closer to those for the rest of the UK average over the long term. It was envisaged by WERU (2002) that in order to close this gap, it was necessary to focus on those sectors in Wales that were deemed to be high-value adding and likely to grow in the medium term.

The targeting of potential 'winning' sectors has historically been difficult for lagging regions such as Wales. WERU (2002) assert that the use of MSQA is an alternative or supplementary tool to help explain more quantitative analyses, particularly for small regions or sectors.

Appendix D – Reviewed, Selected and Discounted Literature for the Study

This appendix summarises the literature reviewed and justified as selected or discounted for this study during a reflective and retroductive approach. The Research Questions were originally derived from the P & SCM literature but were finalised from the final selection shown in Chapter, 3, Figure 3.1.

Table D1.1 shows the background literature and the reasons for original inclusion and retention within this study whilst Table D1.2 summarises the background literature that was initially included and subsequently discounted. Similarly, Table D1.3 shows the foreground literature that was selected and retained whilst Table D1.4 shows the foreground literature that was originally selected but subsequently discounted.

Cognitive Theory/Background Literature	Main Author	Reason for initial selection for SCVs research	Reason for retention within the SCVs research
Contingency Theory	Various – see Chapter 3	Contingency factors affect decisions and structures in organisations.	Retained as relevant – literature gaps. Sourcing decisions by companies are contingent upon a number of factors as are possible solutions to address SCVs.
Search Theory	Various including Stigler (1962 & 1968)	Search activities carried out by sourcing/purchasing companies to identify suitable suppliers.	Retained as relevant – literature gaps. The 'search' activity used by companies to source products and services or the 'search' carried out by e.g. the WAG when looking to address a SCV.

Table D1.1 – Background or Cognitive Theory Literature - Reasons for Original Selection and Retention within the Study (Source: The Author)

Cognitive Theory/Background Literature	Main Author	Reason for initial selection for SCVs research	Reason for discounting from SCVs research
Complexity Theory	Various	Linked to strategic management and organisations. Initially thought that it would be relevant to company sourcing strategies.	Not relevant because orientated around the organisation.
Knowledge Based Theory	Various	Knowledge based theory is especially relevant to e.g. bioscience companies etc. This theory extends the RBV.	Discounted RBV and this in favour of more relevant theories.
Management Theories	Koontz (1960 & 1980)	11 theories relating to management. Some may be applicable to this study.	Includes for e.g. Contingency theory, which is addressed separately. Generally, these theories are not suitable for this study.
Organisational Behavioural Studies/Theory	Various	Study of organisations. Thought this may be relevant to either the decision making activities in firms, or to the WAG and its potential use of any framework resulting from the SCVs research.	Eliminated early as not relevant – too in-depth for this study.
Resource Based Theory/View (RBV)	Penrose (1959), Barney (1991)	Used in SCM research previously. Resources required by a firm to achieve competitive advantage. Links to companies and their capabilities.	Not looking at competitive advantage. Whilst companies' resources are important in determining their capabilities/gaps, this is not believed to be as strong as other theories for this study.
Resource Dependence Theory	Pfeffer and Salancik (1978).	Links with external organisations and companies.	Did not seek to 'test' dependence between organisations in the research, therefore discounted.

Systems Thinking Theory	Bertalanffy (1951 & 1972)	Often used in supply chain research. Relates to organisations and relationships between organisations.	Open systems, cybernetics, operations research, information & communications, game theory and simulation all included within systems thinking. Not core to this study.
Transaction Cost Economics (TCE)	Coase (1937), Williamson (1985)	Focus on the make/buy decision and the total cost of acquisition (TCA)/ownership led to the investigation of this theory.	Eliminated when TCA discounted.

Table D1.2 - Background or Cognitive Theory Literature - Reasons for Original Selection and Subsequent Discounting from the Study (Source: The Author)

Foreground Literature	**Main Author**	**Reason for initial selection for SCVs research**	**Reason for retaining within the SCVs research**
Clusters	Porter (e.g. 1998). See Chapter 4.	Linked to networks in relation to e.g. Biosciences and Parc Aberporth.	Retained as relevant to the developing strategy for Parc Aberporth. Literature gaps.
Hoshin Kanri & Policy Deployment	Various e.g. Akao (Ed, 1991), see Chapter 4.	Development of a framework for potential use by the WAG identified this as a key theme, relating to both policy development and deployment.	Retained as relevant – literature gaps. More flexible than classical, rational and other models with a feedback loop, based on PDCA. The framework developed as a part of this study is based on policy deployment of key WAG strategies.
Material Input, Economic and Local Supplier Linkages	Various e.g. Crone (1999) and Scott-Kennel (2007). See Chapter 4.	Identified a large body of literature which is relevant to the study.	Retained as relevant – literature gaps. Whilst the term 'supply chain voids' is missing from the literature, there is a significant body of literature within economics and economic geography relating to the theme of 'linkages'.

Purchasing and Supply Chain Management (P & SCM)	Various e.g. Quale (2006). See Chapter 4.	Relevant to the initial semi-structured interviews used to understand what companies are buying from outside Wales and why. Definitions of supply chains, their structures and the scope of the study.	Retained as relevant – literature gaps. This sets the scope of the research from a Purchasing or Sourcing Managers' perspective and relates mostly to the semi-structured interviews carried out initially. It also helps to position the focus of the study and to define those elements of the supply chain relevant to the study.
Regional Economic Development and the WAG strategies and policies	Various – see Chapters 2 and 4	Core to the research.	Foundation literature. This focuses in on the Welsh economy, its history and emergence of the priority sector policy.
(Regional) Embeddedness	Various e.g. Granovetter (1985). See Chapter 4.	Identified as relevant during the empirical phases and emerging results. Links to the development of an embeddedness and sustainable development criteria tool for regional economic development.	Literature gaps. Links to sustainable development. How companies become embedded within regional economies has led to the interest in this theme, particularly its relationship, if any, to the potential to achieve sustainable development.
Supply Chain Gaps/Voids	See 'linkages'	Core of the research.	Literature found to be in economic/economic geography as various 'linkages', which is retained.
Sustainable Development	World Commission on Environment and Development (WCED) (1987).	Links to embeddedness. Sustainable development of policy decisions relating to regional economic development and resolution of SCVs.	Retained as relevant – literature gaps. This is important to develop the economy from a social, economic and environment perspective, in relation to sustainable development.

Table D1.3 - Foreground Literature - Reasons for Original Selection and Retention within the Study (Source: The Author)

Foreground Literature	Main Author	Reason for initial selection for SCVs research	Reason for discounting from SCVs research
Strategic planning, classical and rational planning, 'logical incrementalism', emergent, processual and systemic strategy models, policy deployment.	Mintzberg (1994), Sloan (1965), Quinn (1978), Whittington (2001)	Strategy development and policy deployment models for use in the development of the SCVs framework.	Various top down, bottom up and emergent models. Less flexible than Hoshin Kanri which offers adaptability and a dynamic feedback loop focussing on strategy and policy deployment.
'Best Practice' SCM	Various e.g. Quale (2006)	Believed to be relevant based on the initial SCV research focus.	Once the empirical phase commenced and the 'linkage' literature was identified, did not believe this theme was as relevant as previously.
'Best Practice' Sourcing	Various e.g. Quale (2006)	Believed to be relevant based on the initial SCV research focus.	
Capability – Core & Non-Core	Various	Believed to be key to the research.	
Collaboration	Various e.g. Hines (1994)	Understood to be key in some sectors e.g. Bioscience, Aerospace.	Relates to Clusters and reference to this in the PESTEL & SWOT for Biosciences and Parc Aberporth.
Cooperation	Various e.g. technical cooperation (Raffa *et al.*, 1996, in Cox (Ed), 1996, pp 33 – 62)	Understood to be key in some sectors e.g. Bioscience, Aerospace.	
Future Trends in SCM	Various	Understood to be relevant based on the initial literature review for the study.	Eliminated once the 'linkage' literature discovered.
Network Sourcing	Hines (1994)	Although this is of relevance to the study, a focus on clusters was deemed more appropriate, for Parc Aberporth in particular.	Eliminated as focus is on cluster i.e. structure, features, benefits, policy guidance etc.
New Product Development	Various e.g. Francis (2002)	Originally linked this to capability.	Eliminated with capability literature.

Table D1.4 – Foreground Literature - Reasons for Original Selection and Subsequent Discounting from the Study (Source: The Author)

Other themes were briefly considered and eliminated and these are summarised in Table D1.5.

Type of Literature	Literature Theme(s)	Reason(s) for Elimination
Background	Agency Theory, Choice Theory, Weber's Theory (of the location of the firm), Technological Gap Theory, Product Life Cycle Theory, Matching Theory and Consumer Theory (link to Search Theory).	These were thought to have some initial relevance but were not deemed to be as aligned to the study as 'search' and 'contingency'
Background/Foreground	Supply Chain Management (SCM) Theory	Whilst arguments exist over whether SCM is a concept or a theory (See Cousins *et al.*, 2006), as the SCV research evolved and the linkage literature came to the fore, this was deemed no longer relevant as the majority of literature is within the economics and economic geography arena.
Foreground	Local vs global sourcing	The study focuses on material linkages etc. and the reasons why companies do not buy locally, rather than the wider issues associated with the advantages and disadvantages of buying locally or globally.
Foreground	'Virtual' clusters	This was identified as a possible topic relating to the development of Parc Aberporth. However, although limited literature was found, the evolving strategy for Parc Aberporth eliminated the requirement for such literature.
Foreground	Life Cycles of sectors, firms and products/services	These were seen to be of some relevance as they could determine the types of good and services being sourced. However, this theme was peripheral to others and was minimised.

Foreground	Competitiveness of Nations	This was eliminated because although it is recognised that 'linkages' are only 1 element of regional economic development, the study focuses on the lack of 'linkages' between Welsh firms for specific goods and services, not competitiveness. Also, other authors have addressed this topic in detail (Taylor, 2003)

Table D1.5 – Other Literature - Reasons for Original Selection and Subsequent Elimination from the Study (Source: The Author)

Appendix E – Key Features of Clusters (Source: The Author, based on the selected literature)

Author(s)	Key Features of Clusters
Porter (1998b)	Clusters include e.g. **suppliers of specific inputs such as components, machinery and services and providers of specialised infrastructure**.
Porter (1998b)	Clusters often **stretch downstream** to **channels and customers** and **laterally** to **manufacturers** of **complementary products and companies in those industries related by skills, technologies or common inputs**.
Porter (1998b)	Many clusters **include government or other institutions** e.g. universities, standards-setting agencies, think tanks, vocational training providers and trade associations providing specialised training, education, information and technical support.
Porter (1998b)	Clusters **rarely align to SIC codes**.
Porter (1998b)	Clusters promote both **competition and cooperation**.
Porter (1998b)	'Home base' or **HQ** activities include **strategy development, core product and process R & D, critical mass of sophisticated production and service provision.**
Porter (1998b, p 88)	'**Colocating R & D, component fabrication, assembly, marketing, customer support, and even related businesses** can **facilitate internal efficiencies in sourcing and in sharing technology and information**'.
Porter (1998b)	**Engaging locally** is the **social glue** that **binds cluster firms together**. (This links to embeddedness).
Simmie and Sennett (1999)	'**Accessible rural areas**' or places with lower costs than urban cores are often the **preferred locations for innovative and high technology firms**.
Porter (2000 and 2003)	A cluster can be at **any geographical scale from a single city to a group of neighbouring countries**.
UNCTAD (2001)	Industrial clusters are **playing an increasing role in economic activity**, particularly in relation to **technology intensive activities**. Here, clusters are seen to **comprise demanding buyers, specialised suppliers, sophisticated human resources, finance and well developed support institutions**. Clusters of innovative activity such as in **Silicon Valley in California, Silicon Fen in Cambridge, UK, Wireless Valley in Stockholm or Zhong Guancum, a suburb of Beijing, are understood to have a distinctive advantages in attracting such (high-value) FDI**.

Porter (2003)	**Externalities** that **link** industries or **clusters** include **common technologies, skills, knowledge and purchased inputs.**
Porter (2003)	**A given industry can be part of more than 1 cluster, based on different types of externalities.**
Porter (2003)	**Knowledge spillovers** affecting **innovation and performance** should be **strongest within a cluster of related industries.**
Porter (2003)	**High technology** clusters include for example, **aerospace, defence, analytical instruments, biopharmaceuticals, communications equipment, information technology and medical devices.**
Porter and Ketels (2003)	Only a **small number of clusters are truly innovative.** Others tend to **focus on products or services targeted at specific market segments or are manufacturing centres.** Finally, clusters can be **regional assembly or service centres.**
Alderman (2005)	**Regional clusters are also part of wider value chains. Access to and acquisition of knowledge is strategically crucial for projects.** Although **knowledge acquisition often benefits from face to face communications, proximity is not brought about through a process of spatial embedding, but through embedding of knowledge in projects** where resources are mobilised on a temporary basis at the project site. **Temporary coalitions are generally geographically dispersed because the transitory nature of projects and supply chains do not induce firms to collocate.** However, firms are increasingly performing **R & D activities and supporting services are also found within clusters.**
Alderman (2005)	**Cluster firms most often source components outside clusters and perform R & D inside the clusters** which underscores the importance of a **multi-level approach to regional clusters as firms exploit both local and extra-regional resources and knowledge to strengthen competitiveness.** It also indicates that it may be more empirically relevant to regard regional clusters as **knowledge-intensive areas where localised learning takes place. Some activities may remain in clusters whilst others are increasingly sourced nationally or internationally.**

Rees (2005)	In contrast to much of the literature that prioritises local links over non-local, empirical research in the biotech cluster in Vancouver found that **collaborative links are mostly outside the region and frequently outside the country. Less than a quarter of collaborations are local, mainly for flows of knowledge rather than materials. Local collaborations are mainly with universities or other public research organisations** and reflect their importance as key **anchors for the industry within the region**, providing **skilled labour and region-specific competences**.
Rees (2005)	**Non-local collaborations** are mainly forged with corporate partners and take 2 forms: • **Strategic alliances with large pharmaceutical companies** for evaluation and full-scale production and reflects a **lack of local competence in the commercialization stage of the innovation process and the specialization of the regional cluster on drug discovery.** No large pharmaceutical manufacturing plants are in the region. The region/cluster appears to have **positioned itself at the R & D/drug discovery** end of the process, with **non-local collaborations providing local firms with essential complementary assets that are unavailable locally**. • **Skills/technical competence gaps lead firms to link with companies and in some cases, universities outside the region**. For high technology clusters, particularly those that have relatively limited high technology experience, **collaboration with firms located in other clusters** can be essential in providing **expertise, ideas and finances that do not exist locally**. Oinas and Malecki (2002) state that in the case of **specialised regions with a more narrow range of economic activities, external relations compensate for the lack of regional diversity**.

Appendix F – Generic Semi-Structured Interview Questions – 'Immediate' SCVs

Interview to be completed with the Owner/Operator, Purchasing Manager or equivalent.
All responses will be treated as confidential.
Complete the appropriate boxes and provide additional information where prompted/requested.
Answers should relate to the company/business/site only.

A Business Card can be attached to cover the following details:

Name of Interviewee:

Contact details : Company Name:
Job Title:
Office Address:

Post Code:

Tel No (W)
Tel No (M)
E-Mail Address

Company Orientation - General Questions

1. How long has the company been operating in Wales (under the same trading name/different trading names (take a note if different)?

Up to 5 Years		Up to 10 years		Up to 15 years		Over 15 years	

2. How many Full Time employees or equivalents does the company employ (criteria based on the definition for SMEs)?

Less than 10	
10 - 50	
50 - 250	
Over 250	

3. What was your Annual Turnover in £ for the last financial year (based on definitions for SMEs)?

Less than or = to £1,350,000 (EU 2M).	
Less than or = to £6,750,000 (EU 10M)	
Less than or = to £33,750,000 (EU 50M)	
Less than or = to £50m (EU 74M)	
Over £50m (EU 74M +)	

4. What Standards/Accreditations does your company have/comply with?

Purchasing and Supply Chain Management Orientation

5. What is the company's Purchasing **budget/spend** per annum in £?

Less than £250k	
£250k – £1m	
£1m - £5m	
£5m - £10m	
Over £10m	

6a. Do the Purchasing personnel have professional qualifications?

Yes	
No	

6b. If so, which qualifications and where were they studied for?

7. Is your purchasing activity centralised or de-centralised?

On-site decision (De-centralised/own decision)	
Off-site/Centralised/Headquarters decision (Please advise location/country)	

8. Who makes the decision to buy goods/services in your company?

Owner/Operator	
Purchasing Manager or Equivalent	
Multi-Disciplinary Team Decision (eg Purchasing/Engineering/Technical/Finance etc)	
Other (specify)	

9. Do suppliers have to comply with Standards/Accreditations in order to supply goods/services to your company?

10. Do you have a policy for the risk assessment of suppliers providing goods/services bought from overseas?

Yes	
No	
Not Applicable	

11. What are the key priorities from your supply chain?

Cost	
Quality	
Delivery (on time and in full)	
Flexibility	
Local	
Other	

12. How many suppliers do you have on your 'supplier database'? _____

Of those that you buy from regularly, how many are in:

Country	Less than 10	10 - 20	21 - 30	31 – 40	41 - 50	51 - 100	Over 100
Wales							
UK							
Europe							
Other							

13. By value per annum (£), what are the top 10 products/services that you buy from outside of Wales and where do you buy them from? Please complete Form 1 below.

Form 1 - By value per annum (£), what are the top 10 products/services that you buy from outside of Wales.

Product/Service Description	Company/ies bought from	Country/Location	Reason(s) why bought from outside Wales (See below)	Total Value in £ p.a.	Comments

Reasons why bought from outside Wales eg Prefer Group Supplier, Company Directive/Policy, Technical Competence, Delivery Times, Quality Issues, Too Expensive, Supplier Capacity, Local Availability, Unreliable Suppliers, Following investigation – no supplier found in Wales, Other Reasons (example).

14. If a supplier/service provider was available in Wales, would you consider buying these goods/services from them?

Yes	
No	

15. Are you concerned about sourcing items locally in order to reduce logistics costs?

Yes	
No	

16. Are you concerned about sourcing items locally in order to reduce environmental impacts?

Yes	
No	

17. Are there any other products or services that you buy from outside of Wales, that are not high value and you would prefer to buy locally?

Yes	
No	

If yes, what are they? Please complete Form 2 below.

Form 2 - Other products or services that you buy from outside of Wales, that are not high value and you would prefer to buy locally.

Product/Service Description	Company/ies bought from	Country/Location	Reason(s) why bought from outside Wales (See below)	Total Value in £ p.a.	Comments

Reasons why bought from outside Wales eg Prefer Group Supplier, Company Directive/Policy, Technical Competence, Delivery Times, Quality Issues, Too Expensive, Supplier Capacity, Local Availability, Unreliable Suppliers, Following investigation – no supplier found in Wales, Other Reasons (example).

18. Do you provide goods/services to other sectors?

Yes	
No	

If yes, which ones?

19. As the research project progresses, would you and your company like to be involved in the case study phase? (This was modified during the semi-structured interviews as the emphasis changed from companies to voids).

Yes	
No	

20. Are there any comments you would like to make about the research project?

21. **Supplementary question post interview**: Do you have disaster recovery contracts. If so, where are the suppliers and how much do you spend per annum?

Thank you for your time.

Appendix G – Generic Interview Script for Structured Telephone Interviews

The Welsh Assembly Government is investigating the market demand by the ** sector for **. The following questions are intended to aid the scoping of the market demand and supply for Wales.

Questions to be addressed by the Owner/Operator, Purchasing/Procurement/Sourcing Manager or equivalent.
All responses will be treated as confidential.
Answers should relate to the company/business/site only.

Name of respondent:

Contact details : Company Name:
Job Title:
Office Address:

Post Code:

Tel No (W)
Tel No (M)
E-Mail Address

1. Do you have responsibility for making the purchasing/sourcing decisions for your site (group/site responsibility)?

2. Do you have a contract for e.g. advertising/media services? If so, what s the cost per annum?

3. Is the supplier of this service in Wales?

4. If the supplier is not in Wales, where is it?

5. Who is the supplier?

6. What main services does the contract cover?

7. If a comparable service was available within Wales, would you consider using it?

8. If no, why not?

9. What markets do you sell to:
   Wales %
   UK %
   EU %
   Rest of the world %

10. Would you like more information on the advertising agencies in Wales? (Pass contact details to IBW if yes).

11. Do you have capability to do this product/service/process? Follow-up if yes.

Thank you for your time.

Contract testing definitions:

Definitions of different types of contract testing (microbiology) -

Basically, there are two levels of contract testing iaw Chris Williams (29 Oct 07):

Screening - yes/no or quantification assays

Indentification - as a result of the positive screening assay, the next stage is to identify the chemicals/organisms, etc. This allows the ability to formulate a strategy/response to what is found ie traceability/tracking of potential source of contamination, etc – ie what do we need to do - what are the next steps.

Sterility tests – used to test for bacterial and fungal contamination. (anon).

Sterility – the state of being aseptic or free from micro organisms. www.biology-online.org/dictionary/Sterility accessed 11 Oct 07.

Sterility – defined in academic terms as the total absence of viable life forms. (In N A Halls, Achieving Sterility in Medical and Pharmaceutical Products. *Drugs and the Pharmaceutical Sciences,* Volume 64, Chapter 1, Page 1). http://books.google.com/books?hl=en&lr=&id=VEg5twQ8xc4C&oi=fnd&pg=PP9&dq=definition:+sterility+tests+in+pharmaceuticals&ots=zra6Th-kjP&sig=o7kdFvKeKguIvOnVjRRbcIwVlLA#PPP1,M1. Accessed 31 Oct 07.

Endotoxin – testing to identify harmful protein contained within certain bacteria and released only when the bacteria dies or is broken down. (Certain gram-negative bacteria produce endotoxins). www.english-test.net/pcat/vocabulary/words/087/pcat-definitions.php#endotoxin accessed 11 Oct 07

Bioburden – Tests for the number of contaminating microbes on a certain amount of material prior to that material being sterilised. www.biology-online.org/dictionary/Bioburden accessed 11 Oct 07

Freeze Drying definitions:

Freeze drying is also known as **lyophilization** and it is a hydration process typically used to preserve perishable material or make the material more convenient for transport. Freeze drying works by freezing the material and then reducing the surrounding pressure and adding enough heat to allow the frozen water in the material to sublime directly from the solid phase to gas. http://en.wikipedia.org/wiki/Freeze_drying accessed 10 Oct 07

Freeze drying was initially used to preserve food in historic times. In the last 50 years it has become more widespread in the pharmaceutical industry in order to stabilise products. Dry formulations are particularly well suited to formulating sensitive biological materials and are required for use with modern drug delivery technologies. Destructive enzymes and chemical species are rendered immobile and harmless, by being fixed in the solid state following drying. Freeze drying in particular is less damaging to labile bioproducts than other drying methods as it is performed at lower temperatures, also processing n the absence of oxygen prevents oxidative reactions.

Drying results in increased shelf-life and a tremendous reduction in weight and volume.

Definitions of different types of contract manufacturing – freeze drying –

The process chosen to formulate a particular drug depends on the intended delivery method as well as the stability of the substance.

Classical Freeze Drying – refers to freeze drying under vacuum. **It is used to produce the majority of today's dried pharmaceuticals**. By removing water from the frozen rather than the liquid state, morphology, solubility and chemical integrity of the product are for the most part maintained after freeze drying. In the vacuum, the drying rate is accelerated and the drying temperature can be set at a lower value compared to other drying methods.

Accreditations in relation to Freeze Drying:

GMP requires the substance being freeze dried to maintain sterility. If substance/drug is to be used in humans, a single freeze dryer may also have to be used (asset specificity)

Non-GMP – ISO 9000 does not require sterility to be maintained.

Freeze Drying can be carried out with the substance in vials (saw at GE, 24 Oct 07) or in trays. It is a biological technique.

Advertising requirements/definitions:

On-Line advertising (or marketing) is hosted on the internet/web and comes in the mediums of search engines such as 'Google', display advertisements and e-mails.
(Adapted from http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/1/hi/business/6293380.stm accessed 30 Aug 07))

Off-Line advertising (or marketing) is carried out within the traditional media such as radio, TV, directories, the press and magazines.
(Adapted from http//www.pcmag.com/encyclopedia_term/0,2542,t+offline+advertising&i=48317,00.asp accessed 30 Aug 07).

Media printing iaw one company is involved with the production of leaflets, flyers etc advertising products or services for a company, for eg those that are included with insurance renewal documents. However, other definitions include:

- a medium that disseminates printed matter (http://dict.die.net/print%20media/ accessed 30 Aug 07).
- Print media include such forms as newspapers, periodicals, magazines, books, newsletters, advertising, memos, business forms, etc (http://www.apt.gc.ca/dProdExpandE.asp?Action="&Id=504 accessed 30 Aug 07). This cuts across some off line advertising mediums.

DC/DR/BC definitions:

Disaster Recovery (DR) is defined as 'The ability to recover from the loss of a complete site, whether due to natural disaster or malicious intent. Disaster recovery strategies include replication and backup/restore'.
(www.microsoft.com/windowsserversystem/storage/storgloss.mspx accessed 30 Aug 07).

A Data Centre (DC) is a facility used for housing a large amount of electronic equipment, typically computers and communications equipment. As the name implies, a data centre is usually maintained by an organization for the purpose of handling the data necessary for its operations. A bank for example may have a data centre, where all its customers' account information is maintained and

transactions involving this data are carried out. (en.wikipedia.org/wiki/Data_centre accessed 30 Aug 07).

Business Continuity (BC) is defined as 'the ability to recover designated critical systems within specified time frames and sequences agreed upon via the use of an off-site recovery capability or other facilities. www.infosys.com/services/glossary.asp accessed 30 Aug 07).

Examples of DR or BC provided by a DC include:

- IT – covers a disaster affecting a company's IT such as system failure or theft. The service could include direct delivery and technical support of replacement IT within a specified timescale. This can be used up to for eg 30 days whilst the original IT is repaired or it can replace the original IT.

- Office – covers a disaster affecting a company's place of work such as fire, flood, local incident or gas leak. The service would include the relocation of staff to the contracted business continuity centre to utilise the fully equipped, professional office environment and access the IT resources covered by the contract. Such a service can cover up to 30 days, for example, whilst the issues at the usual office are resolved.

Typical contracted DR services include:

- A specified no of desks, telephones, PCs, chairs
- For eg 2 days recovery rehearsal testing with technical support
- A specified no of faxes, photocopiers, printers
- A specified size of internet connection (for eg 512k)
- A specified no of servers
- Web based support portal
- Procedures and Guides
- Critical document storage facilities

Additional DR could include:

- Wide area comms
- Increased telecoms bandwidth
- E-mail back-up service

Supplementary services could include:

- Hosting of a company's data/transactions caters for eg with any application that can be hosted in a data centre; web or inward facing. This service is offered to companies who want to outsource the hosting and running of their IP networks, web facing systems and applications, in a secure, reliable and proven environment.
- Managed services for eg whereby a company decides to outsource its IT activities to a capable DR/DC/BC supplier.
- Networking as part of a managed service.

Appendix H – Semi-Structured Interviews for 'Potential' SCVs

The Welsh Assembly Government (WAG) is investigating the potential supply chain requirements of those organisations who may be considering the possible utilisation or location of 'UAS' type activities to Parc Aberporth. The following questions are intended to assess the potential supply chain needs of such organisations with a view to developing linkages with local/Welsh suppliers, if or where possible to do so. The aim of the questions is to theoretically identify and assess potential activities that WAG could assist with, in order to help organisations during their operating time at Parc Aberporth.

Questions to be addressed by the Owner/Technical Developer/Trials Manager or equivalent.
All responses will be treated as confidential.
Complete the appropriate boxes and provide additional information where prompted/requested.
Answers should relate to those business activities to be carried out at the Parc Aberporth site unless stated differently.

Name of respondent:

Contact details : Company Name:
Job Title:
Office Address:

Post Code:

Tel No (W)
Tel No (M)
E-Mail Address

1. Table 1 has some general questions relating to your company and its potential interest in locating at Parc Aberporth. Please answer to the best of your knowledge, at this stage.

Question 1 - Table 1 – Assessment of the potential to embed the company within Parc Aberporth/Wales

Embeddedness factors	Options	Responses
Company - General Questions	-	
When might you anticipate using/locating at Parc Aberporth	2008, 2009, 2010, 2011, 2012 (Please specify eg 2008 – 2010)	-
How will you use Parc Aberporth	Permanent location, semi-permanent location, campaign/ad-hoc (please specify)	
In which business sector(s) does your company operate	Eg Defence, Aerospace, Civil, Other - specify	-
What is the company's position on the 'Life Cycle' (Growth indicator)	Start-up, Expansion, Maturity, Diversification, Decline.	
Which type(s) of assistance, if any, might be sought from WAG	Grants, Local sourcing and supply chain opportunities, other	-
What size is your company	Small (< 50), Medium (50 - 250), Large (> 250).	-
Where is your head office located	Specify	-

Parc Aberporth - Potential Products & Services		
What type of products or services might you 'produce' at Parc Aberporth	Specify	-
For the potential Parc Aberporth operation, where might the 'Product/Service' be positioned on the 'Life Cycle' (Growth indicator)	Start-up, Expansion, Maturity, Diversification, Decline.	
Parc Aberporth - Potential Jobs		
What is the possible number and type of full time jobs to be created at Parc Aberporth	By type ie R & D, Technical/Engineering, Purchasing & Supply Chain Management, Administrative, Sales & Marketing, Other	
What is the potential quality of any jobs (based on average salary in Wales - £27,447 per annum)	Specify average salary per annum, per grouping (ie R & D, Technical etc) as above	
What are the average qualifications for such jobs	Per grouping as above, specify as None, Vocational, GCSEs, Graduate, Postgraduate, Other - specify)	
Parc Aberporth - Potential Purchasing & Supply Chain Activities		
Might autonomous Purchasing and Supply Chain decisions be made at Parc Aberporth	Yes/No	
Might the Parc Aberporth operation have its own sourcing policy and procedures or would it follow guidelines from head office	Own or Head Office	
What might the estimated annual Purchasing Budget (£) for Parc Aberporth activities be	Estimate in £ per annum	
Might you require good/services to be sourced locally/within Wales	Yes/No	
Might you be interested in opportunities to collaborate with local SMEs in Wales	Yes/No. Specify examples of collaboration, if 'Yes'.	
Might you be interested in opportunities to collaborate with a Science & Research Centre at Parc Aberporth	Yes/No. Specify examples of collaboration, if 'Yes'.	
From which countries, if any, do you currently source your products/services from	Estimate % per country, based on value of annual purchasing budget	
How do you estimate your purchasing profile to change over the next 5 - 10 years	Eg Increased purchases from UK, decreased purchases from North America because	
What key priorities may you require from your supply chain	Specify in order of priority - top first - from: Cost, Quality, Delivery on time/in full, Flexibility, Local, Other	
Would you consider environmental implications when sourcing products and services	Yes/No and Why	

What accreditations/certifications might you stipulate for your suppliers	Eg ISO 9000 etc	
On average, how long might you let contracts with suppliers for	Up to 1 year, 2 - 5 years, over 5 years	
Parc Aberporth - Other Potential Activities		
Might R & D activities be carried out at Parc Aberporth	Yes/No	
Would any other activities be carried out from Parc Aberporth (eg Sales & Marketing, Manufacture, Logistics, Other)	Sales & Marketing, Manufacture, Logistics, Other	
Parc Aberporth - Potential Sales Activities		
Which sectors might you (intend to) sell your products/services to?	Specify % per sector	
How do you estimate your sales profile to change over the next 5 - 10 years	Eg Defence to decrease by 10% over the next 5 years. Civil - 'emergency services' to increase by 50% over the next 5 - 10 years. Reasons and best estimate required.	

2. Which key high-value inputs might you require to be sourced from local/Welsh suppliers? Please complete Table 2 below.

Question 2 - Table 2 – Identification of key 'high-value' inputs that may be required to be sourced locally/in Wales

Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source locally/in Wales (H/M/L)	Reasons why is it important to source locally?

3. Which key high-value inputs might you source from elsewhere? Please complete Table 3 below.

Question 3 - Table 3 – Identification of key 'high-value' inputs that may be sourced from outside Wales

Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source elsewhere (H/M/L)	Reasons why is it important to source from elsewhere?

4. Which low value inputs might you require to be sourced locally or from within Wales? Please complete Table 4.

Question 4 - Table 4 – Identification of low-value inputs that may be sourced locally/within Wales

Products/services	Current source of Supply (Country)	Current Value per annum (£)	Level of importance to source locally/in Wales (H/M/L)	Reasons why is it important to source locally?

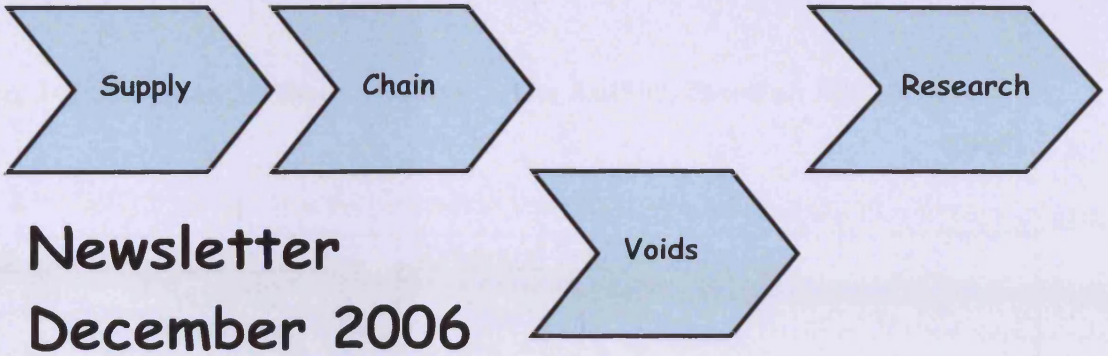
5. What are the 3 motivators for you/your company to use/locate at Parc Aberporth?

6. What 3 issues do you perceive in using/locating to Parc Aberporth?

7. To date, what has your experience been of the dealings you have had with the Welsh Assembly Government and/or the WWUAVC?

8. Have you any other comments to make about 'Parc Aberporth'?

Thank you for your time.



Newsletter December 2006

The Supply Chain Voids (SCV) research project is sponsored by the Welsh Assembly Government. It commenced during June 2006. The scope for this exploratory research began by addressing the priority business sectors as designated by the Welsh Assembly Government in '*Wales: A Vibrant Economy*', published November 2005. These include:

- Automotive
- Aerospace
- Agri-food
- High Technology
- Pharmaceuticals/bio-chemicals
- Financial Services
- Creative (eg Film/Music Industry)
- Construction
- Hospitality, leisure and tourism
- Social care

High Technology is defined as the following:

- Biosciences
- Electronics (incl Opto-Electronics)
- Information and Communication Technology (ICT)
- Materials
- Nano and Micro Technology
- Combined/Converged Technologies (eg materials and manufacturing technologies)

Following detailed research and analysis between June and October 2006, it has now been agreed that the scope should reduce to three sectors for further investigation. These are:

- **Financial Intermediation and Insurance Services**
- **Biosciences**
- **Aerospace**

The next stage is to issue a summary report to stakeholders and industry informants who have engaged in the research to date. The academic work that complements this report is being written up during December 2006.

Three companies in each of the selected sectors need to be identified, with the agreement of sector experts, in order to carry out structured, face-to-face interviews. This will assist in the identification and quantification of any supply chain voids. It is anticipated that this phase will commence in January 2007.

I am extremely grateful to all those experts who have given their time and advice during the first phase of the research. I also look forward to continuing to work with the key stakeholders from the selected sectors.

Merry Christmas and best wishes for 2007.

Toni Whitehead
Doctoral Researcher
whiteheadta@cardiff.ac.uk
Tel - Mobile: 07835-143864
Tel - University: 029 2087 6818

Appendix J- Discounted Methods (Sources: The Author, based on Saunders *et al.*, 2003)

Methods	Alignment to Research Questions/ Objectives (H/M/L)	Reason(s) for Non-Selection
Probability or representative sampling	L	Commonly used with survey-based studies, therefore not appropriate to case study and Research Questions.
Non-probability sampling - Quota	L	Associated with interview surveys of large populations, therefore not relevant to this case study or Research Questions.
Non-probability sampling - Snowball	L	Although this method was used in the literature search, it is not appropriate for the selection of companies or case SCVs.
Non-probability sampling - Convenience or haphazard	L	This is random sampling and not appropriate to the case study or Research Questions.
Non-probability sampling - Self selection	L	No companies self-selected themselves to take part in the study, hence this method is not relevant.
Non-probability sampling - Purposive - Extreme Case or deviant; Critical Case or Typical case.	M	Unusual or extreme cases not relevant. Cases that are likely to make a dramatic point are not sought. More than one case is required, rather than illustrative case that is possibly representative. This study is interested in the identification of themes and trends.
Questionnaire (Large Scale)	L	Inappropriate method to answer Research Questions. Superficial level of data obtained when depth is required. Not required by sponsors as lots of data already collected.
Observation	L	Observation is concerned with the behaviour of those subjects under observation. This study is not interested in behaviour.

Dates	Stage of Research	Method(s)	Respondent(s)	Types of Data	Recording and Analysis Methods	Ty
Jan 06 - end of research project	All Stages - Literature search and critical review	Literature search using metalib, internet, etc., literature review	Literature (Background cognative theories, foreground including WAG strategies)	Relevant literature/references	Spreadsheet. Details of literature reviewed. Alignment to Research Questions.	Al to Qu ga su re
Jun - Oct 06	Background to the study	Secondary Data - Table of Characteristics	Purposive - WAG, ONS, WERU, IWA, Industry Fora, Other Industry Informants, Other academic	Secondary Data - Macro level, Industry, Sector, Economic, Qualitative from MSQA.	Spreadsheet. Quantitative - categorical and numerical, Qualitative - review of MSQA data.	Co Ar Qu Qu Lit In wi (In te
Jun - Oct 06	Background to the study	Unstructured Interviews	Purposive - Industry Fora, WAG Sector Experts, Academics	Primary Data - indicative SCVs	Spreadsheet. Themes for SCVs relating to Numbers, Products, Services, possible Sources of Supply etc.	Co Ar Qu Qu Cu Ol in to Va Re (In te
Oct 06 - end of research project	All Stages - Environmental analysis	Secondary Data - e.g. Literature (including academic and industry/sector reports)	Purposive - Various sources	Secondary Data - External environmental data for three priority sectors.	Spreadsheet. PESTEL, SWOT and TOWS analyses. Affinity Mapping technique to align/reduce topics for PESTEL and SWOT. Triangulation with other methods e.g. results of Semi-structured and Structured Telephone interviews.	Co Ar Q Q Va re Se In
Jan - May 07	Comparative Case Study	Semi-Structured Interviews	Purposive - Heterogeneous - Individual Companies - Purchasing Manager or equivalent	Primary Data - Micro level in Companies e.g. employee numbers, purchasing budgets, DMU activities, specific high and low value immediate SCVs	Spreadsheet. Quantitative and qualitative data - patterns, themes. Triangulation with other methods e.g. PESTEL, SWOT, TOWS and alignment to literature.	Co Ar Cu O In wi (In re wi In

Nov 07 - Jan 08	Comparative Case Study	Telephone Interviews	Purposive - Homogeneous - Individual Companies - Purchasing Manager or equivalent	Primary Data - Micro level in Companies e.g. employee numbers, location of HQ, further investigation of selected immediate SCVs	Spreadsheet. Quantitative and qualitative data - patterns, themes. Triangulation with other methods e.g. PESTEL, SWOT and TOWS and alignment to literature.	Comp Analy Cumu Objec Interp with F (Indiv respo with V Indus
Jun 08	Comparative Case Study	Semi-Structured & Structured Telephone Interviews, Secondary data (company web sites etc.) for Benchmarking.	Purposive - Heterogeneous - Individual Companies - Purchasing Manager or equivalent	Primary Data - Micro level in Companies e.g. employee numbers, purchasing budgets, motivations to move to Wales, specific high and low value potential SCVs	Spreadsheet. Quantitative and qualitative data - patterns, themes. Triangulation with other methods e.g. PESTEL, SWOT, TOWS, Benchmarking and alignment to literature.	Comp Analy Cumu Objec Interp with F (Indiv respo with V Indus

PHD (1)

approved 5/7/06

CARDIFF BUSINESS SCHOOL ETHICAL APPROVAL FORM: PHD THESIS RESEARCH

(For guidance on how to complete this form, please see http://www.cardiff.ac.uk/carbs/research/ethhome.html)

For Office Use: Ref **Meeting**

Does your research involve human participants? **Yes** ■ **No** ■

If you have answered 'No' to this question you do not need to complete the rest of this form, otherwise please proceed to the next question

Does your research have any involvement with the NHS? **Yes** ☐ **No** ■

If you have answered **Yes** to this question, then your project is not of relevance to the Cardiff Business School Research Ethics Committee and ethical approval **must** instead be sought from the appropriate NHS Local/Multi-centre Research Ethics Committee. Otherwise, please complete this form.

Name of Student: Toni Whitehead

Student Number: 016185302

Section: CARBS – Cardiff University Innovative Manufacturing Research Centre (CUMRC)

Email: whiteheadta@cardiff.ac.uk

Names of Supervisors: Prof Peter Hines – Primary Supervisor, Dr Pauline Found & Dr Sharon Williams

Supervisors' Email Addresses: peterhines@hotmail.com, foundpa1@cf.ac.uk, sow@aber.ac.uk

Title of Thesis: An Investigatory Study into Supply Chain Voids in Wales

Start and Estimated End Date of Research: 1 Jul 06 – 30 Sep 09

Please indicate any sources of funding for this research: The research is sponsored by the Welsh Assembly Government (WAG) Department of Enterprise, Innovation and Networks (DEIN).

1. Describe the Methodology to be applied in the research

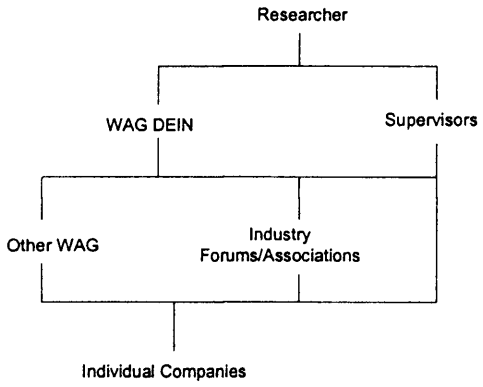
The research philosophy is critical realism. The approach is inductive/retroductive and is to be developed as the research evolves. The research strategy is that of a Case Study, comparing the sourcing strategies, processes and supply chain voids across 3 companies within the top 3 priority business sectors in Wales. The research timescale will be longitudinal. Data collection methods include the collection of primary and reference to secondary data. Focus groups will be used to verify and validate findings throughout the project. A small scale questionnaire will be used in the initial stages to capture data on supply chain voids at the same time that sector data and analysis takes place. During the case study phase, semi-structured interviews and participant observation will be used to identify strategies and processes and see how they work. Draft versions of both the questionnaire and semi-structured questions are available if required but it is believed that there are no ethical issues associated with them.

2. *Describe the participant sample who will be contacted for this Research Project. You need to consider the number of participants, their age, gender, recruitment methods and exclusion/inclusion criteria*

Participants will include:
Members of projects in the WAG DEIN eg Accelerate Wales, etc, approximately 10 people;
Industry Forum/Association representatives, approximately 12 people.
WAG sector managers and Account Managers, approximately 20 people;
Approximately 500 Welsh companies across the priority sectors for the questionnaire, contacted via Industry Forums/Associations/WAG sector managers;
3 Case Study companies comprising up to 10 managers in each.

Gender and age are not yet known.

Recruitment methods will be via WAG DEIN, face to face meetings, telephone calls and e-mail. The following diagram shows the main route for contact.



Those organisations to be included are set by the priority sectors identified in Wales A Vibrant Country, 2005. The sample will be purposive.

3. *Describe the consent and participant information arrangements you will make, as well as the methods of debriefing. If you are conducting interviews, you must attach a copy of the consent form you will be using.*

In order to make potential participants aware of the research and its importance, presentations, introductory letters and e-mail and telephone contact will be made (already commenced in WAG DEIN/Other WAG departments and Industry Forums). Potential participants will be made aware of their 'rights' and how data will be confidentially managed in accordance with Saunders et al (2003) and they will be asked to consider and sign the appropriate consent form – copies attached. All participants will be debriefed following the research via presentations and copies of relevant reports of the findings.

5. ***Please complete the following in relation to your research:***

		Yes	No	n/a
(a)	Will you describe the main details of the research process to participants in advance, so that they are informed about what to expect?	■	☐	☐
(b)	Will you tell participants that their participation is voluntary?	■	☐	☐
(c)	Will you obtain written consent for participation?	■	☐	☐
(d)	Will you tell participants that they may withdraw from the research at any time and for any reason?	■	☐	☐
(e)	If you are using a questionnaire, will you give participants the option of omitting questions they do not want to answer?	■	☐	☐
(f)	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	■	☐	☐
(g)	Will you offer to send participants findings from the research (e.g. copies of publications arising from the research)?	■	☐	☐

PLEASE NOTE:
If you have ticked **No** to any of 5(a) to 5(g), please give an explanation on a separate sheet.
(Note: N/A = not applicable)
There is an obligation on the lead researcher to bring to the attention of Cardiff Business School Ethics Committee any issues with ethical implications not clearly covered by the above checklist.

Two copies of this form (and attachments) should be submitted to Ms Lainey Clayton, Room F09, Cardiff Business School.

Signed

Print Name TONI ANN WHITEHEAD

Date 22nd JUNE 2006

SUPERVISOR'S DECLARATION

As the supervisor for this research I confirm that I believe that all research ethical issues have been dealt with in accordance with University policy and the research ethics guidelines of the relevant professional organisation.

Signed A.F Clarke. (Primary Supervisor)

Print Name PROFESSOR PETER HINES DR Andrew Clarke (FOR PETER'S)

Date ~~JUNE 2006~~ 4 July

STATEMENT OF ETHICAL APPROVAL

This project has been considered using agreed School procedures and is now approved.

Signed (Chair, School Research Ethics Committee)

Print Name J. Solomon

Date 6/7/06

4. Please make a clear and concise statement of the ethical considerations raised by the research and how you intend to deal with them throughout the duration of the project

The ethical considerations relating to the research span the whole timescale of the project and align to access issues, through data collection and the appropriate management of confidentiality relating to the participants and the data and information they provide. Both the participants and data/information must be treated appropriately throughout the research project in accordance with the guidance in Saunders et al (2003) and Part 5 of this form.

The data collected during the questionnaire phase and semi-structured interview phase is to be treated in a confidential manner.

PLEASE NOTE that you should include a copy of your questionnaire if you consider the questions raise ethical issues.

CARDIFF BUSINESS SCHOOL
RESEARCH ETHICS

Consent Form - Confidential data

I understand that my participation in this project will involve the sharing of secondary data held within the records of the Industry Forum/Association that is confidential in nature and not accessible via the web site. Participation will also involve acting as an intermediary in the first instance between the researcher and the members of the Industry Forum/Association.

I understand that participation in this study is entirely voluntary and that I can withdraw from the study at any time without giving a reason.

I understand that I am free to ask any questions at any time. If for any reason I experience discomfort during participation in this project, I am free to withdraw or discuss my concerns with Professor Peter Hines as the primary supervisor of this project.

I understand that the information provided by me will be held confidentially, such that only the Researcher – Toni Whitehead can trace this information back to me individually and the company. The information will be retained for up to 5 years when it will be deleted/destroyed. I understand that I can ask for the information I provide to be deleted/destroyed at any time and, in accordance with the Data Protection Act, I can have access to the information at any time.

I also understand that at the end of the study I will be provided with additional information and feedback about the purpose of the study.

I, _____(*NAME*) consent to participate in the study conducted by Toni Whitehead of Cardiff Business School, Cardiff University with the supervision of Professor Peter Hines.

Signed:

Date:

CARDIFF BUSINESS SCHOOL
RESEARCH ETHICS

Consent Form - Confidential data

I understand that my participation in this project will involve the sharing of secondary data held within the records of the Industry Forum/Association that is confidential in nature and not accessible via the web site. Participation will also involve acting as an intermediary in the first instance between the researcher and the members of the Industry Forum/Association.

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I also understand that at the end of the study I will be provided with additional information and feedback about the purpose of the study.

I, _____(*NAME*) consent to participate in the study conducted by Toni Whitehead of Cardiff Business School, Cardiff University with the supervision of Professor Peter Hines.

Signed:

Date:

Individual Companies
Via Industry Forums/Association or direct
City
County
Postcode

** February 2007

Dear Mr/Mrs etc,

Research into the Lack of Local Suppliers in Wales

I have been commissioned by the Welsh Assembly Government Department of Enterprise, Innovation and Networks (DEIN) to carry out research into supply chains within the * sector. The importance of this research is also supported by the * Forum.

The aim of the research is to derive practical benefits for companies within industry sectors in Wales, through targeted assistance by the Welsh Assembly Government.

In order to progress with the research and identify opportunities for assistance, I am required to carry out semi-structured interviews with Purchasing Managers or equivalents. These are to be carried out in companies within the * sector in Wales, in order to gain an understanding of their purchasing patterns within Wales. A brief introduction to the research and the completion of the interview questions should take no more than 1.5/2 hours maximum. Your company has been recommended by * to assist in this activity.

I am aware of the need to treat findings as confidential and can assure you that this will be the case throughout and after completion of the research project. No source, individual or organization will be identified, or comments attributed without the express permission of the originator. A summary report of the research findings will be produced at the end of the project and provided to each of the participant companies and Industry Forums/Associations.

I hope that you are able to help and would be grateful if you could contact me to arrange a suitable appointment/nominate a suitable person with whom to arrange an appointment. I shall contact you within the week to arrange a suitable appointment. If you require any further information, please do not hesitate to contact me on the telephone numbers or e-mail address detailed below.

Yours sincerely,

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Appendix N - Refined PESTEL Analysis for the Bioscience Sector

Political	Economic	Social	Technological	Environmental	Legal
Universal healthcare systems (e.g. UK) slow or unable to introduce latest treatments owing to e.g. cost (Johnson *et al*, 2006, p624) and approvals process	Biosciences industry is restructuring/consolidating through merger and acquisition (M & A) activities (CW, 25 Jan 2008 & Johnson *et al*, 2006, p622).	Cheaper generics bring more drugs to broader markets.	**Increased use of freeze drying and contract testing** owing to reduced development of synthetic compounds towards larger development of biological entities (CW, 18 Jan 2008 & 25 Jan 2008)		Small biotechs out-licence drugs and form strategic alliances with other companies in the supply chain (Johnson *et al*, 2006, p622)
Generics actively encouraged in some markets e.g. EU. Prescriptions print the generic rather than branded form (Johnson *et al*, 2006, p625)	Outsourcing and CRO opportunities are emerging following restructuring of the industry/companies (CW, 25 Jan 2008)	Ageing populations increasing in western countries (Johnson *et al*, 2006, p624)	Increase in small biotech start-ups, backed by venture capitalists to exploit opportunities created by molecular technology and genetic engineering (Johnson *et al*, 2006, p621)		Globalisation affected by internationalisation of regulatory processes e.g. European Medicines Evaluation Agency (EMEA) established to enable more regulatory approvals across EU (Johnson *et al*, 2006, p626)
	Some companies creating smaller, nimble R & D units like small biotechs in-house (Johnson *et al*, 2006, p629)	Over 65s consume 4 times as much healthcare per head as under 65s (Johnson *et al*, 2006, p624)	Globalisation of the industry assisted by the international convergence of medical science and practice, influenced by ICT, international travel and information exchange (Johnson *et al*, 2006, p626)		Companies must engage early with regulatory authorities in the R & D process (BioWales - Ipsen Biopharm 12 Mar 2008)
	Credit crunch is making banks etc. more risk conscious in their investment/loan activities (x-ref to Finance & Insurance PESTEL).	Increasing patient expectations (Johnson *et al*, 2006, p624)	Proteonomics has the potential to increase the number of drug targets discovered by orders of magnitude, offering immense promise in the search for more effective and less toxic therapies (Johnson *et al*, 2006, p628)		
	Venture capital in short supply to support small biotechs (x-refer to Financial & Insurance PESTEL)	Patients not getting the drugs required to treat certain diseases (e.g. breast cancer) owing to cost and non-approval by e.g. The National Institute for Health and Clinical Excellence (NICE) in the UK (BBC News 31 Jan 08 - Avastin)	Pharmacogenetics exploit genetic knowledge to understand why some patient populations benefit more than others from a therapy (Johnson *et al*, 2006, p628)		
	R & D issues include long timescales, high costs, failure to recoup investment, limited timescales within which to recoup investment and product pipelines drying up (CW, 25 Jan 2008; Johnson *et al*, 2006; BioWales Conference - Astra Zeneca 12 Mar 2008)	Life expectancy increased by over 20 years in the 20th century (Johnson *et al*, 2006, p632)	New medicines in future will come from Governments and Academia, but Academia for e.g. cannot 'commercialise' and scale-up, therefore partnerships are required with large companies (BioWales - Astra Zeneca 12 Mar 2008)		
	75% of the world's patents for the best sellers expire between 2007 - 2011 (CW 25/1/08, BioWales Conference - Astra Zeneca 12 Mar 2008)	Health services made available on a wider basis i.e. via the internet, in Boots the Chemist and small pharmacies, GPs etc			
	Increased competition from generics (CW, 25 Jan 2008)				
	High profit margins for biotech companies (CW, 25 Jan 2008)				
	Lower profit margins from CROs (CW, 25 Jan 2008)				

Remaining Economic Factors				
Increased collaboration between companies/academia to develop and bring products to market (Johnson *et al*, 2006)	Low cost competition from India and China. (WAG Deputy Finance Minister (DFM) speech to South Wales Innovative Modern Management (SWIMM) 15 May 08)	Rules are changing in the pharmaceuticals sector - from competition and collaboration to 'co-opetition' (BioWales - Wockhardt 13 Mar 2008)	Increasing number of PhDs in China and India therefore companies will need to access these skills and use companies based in these countries (BioWales - Astra Zeneca 12 Mar 2008)	Market growth opportunities for CROs (CW, 25 Jan 2008)
Astra Zeneca and Boots Centre for Innovation seek (small) partners who can develop new molecules etc for new products. They can then work with them to bring new products to a wide market. New products and speed are the priorities for the future ('Open Innovation') (BioWales - Astra Zeneca 12 Mar 2008; Boots Centre for Innovation 13 Mar 2008)	Asian companies entering the European market via acquisitions of small biotech businesses with established European/US drug development/supply accreditations in place (e.g. Wockhardt, Wrexham in Deloitte & Touche, 2006)	Increase in Genomics companies (Johnson *et al*, 2006, p628)	Product life cycles shortening (Johnson *et al*, 2006, p635)	Companies improving SCM/adopting tools/techniques to e.g. release the value trapped in high inventories (Johnson *et al*, 2006, p623)
Pharmacoeconomic evaluation studies carried out to demonstrate the value added offered by new drugs as a result of improved efficacy, safety, tolerability or ease of use (Johnson *et al*, 2006, p625)	Introduction of 'disease management initiatives' with companies placing their products as part of the solution Johnson *et al*, 2006, p625)	Companies are restructuring manufacturing/number of sites and placing them in strategic locations offering tax advantages e.g. Puerto Rico, RoI (Johnson *et al*, 2006, p623)		

Key:

Colour	Code	Totals
	Aging Population	5
	Preventative Medicine	Nil
	Earlier Diagnostics/Treatments	10
	Changing Business Model	22
	Preventative/Diagnostics/Treatments	2
	Aging Population/Changing Business Model	2

Appendix O – Refined SWOT Analysis for the Bioscience Sector

Prioritised - Bioscience Sector - Internal Factors (Wales)	
Strengths	**Weaknesses**
• Net gains in the number of jobs in the Bio sub-sector "Infrastructure" in the UK over the past 3 years. (Freeze Drying & Contract Testing fall into this sub-sector).	• Low cost competition concerns specific companies
• Land and property costs, loyal workforce, highly skilled labour, lower labour costs and public sector funding welcomed by specific companies	• Slower growth in the Pharmaceutical sector in Wales (compared to Biotechnology firms/Medical Device Manufacturers
• Recruitment of staff from local universities in Wales welcomed by specific companies in South Wales	• Labour shortages for GMP trained/skilled staff in support of Diagnostic Technologies
• Medical Technologies are the strongest Bio sector in Wales	• Small chemical drug companies are seeing an erosion to profits owing to high earning drugs going off patent with cheaper generics taking market share, marked reduction in new drugs being approved for sale, pressure from purchasers e.g. NHS to reduce costs
• Strong In-vitro diagnostics and drug discovery sub-sectors in Wales with several continuing to grow, floating on the stock exchange, buying competitors and others receiving investment from overseas investors	• A number of high profile job cuts in large pharmaceutical companies recently owing to the trend for retaining core activities (i.e. Intellectual Property (IP)) and contracting out non-core activities (i.e. manufacture, testing, etc.
• Wales is the leading manufacturer of assays (analysis of substances) in the UK	• A lack of 'research phase' companies in Wales who can test if molecules stop enzymes working on the target cell/organ etc.
• Strong regional network of Bio companies in South Wales	• Lack of fermentation capability in Wales
• Significant strengths in Systems Biology with academic expertise at the Cardiff Gene Park, Swansea University Institute of Life Sciences, Boots Centre for Innovation, Cardiff University School of Bioscience and University of Wales, Bangor. In addition, Wales is home to GE Healthcare which is 1 of the largest systems biology companies	
• Business Parks and Incubators in Wales i.e. Techniums and Business Parks, Bangor Bioincu, CBTC 1 & 2, Cardiff Medicentre	
• Medical devices are a strength in Wales	
Prioritised - Bioscience Sector - Extent to which Internal Factors (SW) are relevant/capable of dealing with External Factors (OT)	
Opportunities	**Threats**
• Increased use of Freeze Drying and Contract Testing owing to reduced development of synthetic compounds towards larger development of biological entities	• Competition from other Bio regions, business parks and incubators i.e. Biocity Nottingham, Biopolis Singapore, Biopolis Grenoble France, Munich
• Aging population creating challenges for the NHS and other sectors in Wales.	• Competition from other UK regions who also prioritise Biosciences in their RED strategies i.e. Advantage West Midlands (2007)
• M & As with/of Welsh companies	• M & As with/of Welsh companies (Possible loss of Welsh HQ)
• Venture capitalists targeting high quality start-ups with novel IP	• Takeovers in the Bioscience sector in Wales now dominant
• Strength in Medical Technologies means that companies outside Wales now require quality engineers with diagnostic and industry regulatory experience which Wales can support and offer a high retention rate for skilled staff. Therefore opportunities for inward investment.	• Asian companies from e.g. India looking to enter the European market via acquisition of small biotech companies with established EU/USA drug development/supply accreditations.
• Companies from outside Wales looking to partner on assay development for research, manufacture or joint development. Collaboration opportunities.	• Continuing M & A of pharmaceutical companies, consolidation of cross-border activity between Biotech companies
• Companies from outside Wales looking for gene discovery expertise. Collaboration opportunities.	• Challenges in raising finance to support growth especially £500k - £2m and general concerns facing the economy in 2008/9 (See Fin/Ins PESTEL & SWOT).
• Cluster development for CROs including contract manufacture, testing, marketing, sales activities within Wales, owing to the trend for companies to concentrate on core activities and contract out non-core activities (Inward investment, other opportunities)	• Large companies (if in Wales) considering consolidation of core operations and outsourcing or forming spin-out companies for non-core activities
• As profit margins for CROs are smaller than major biotechs and operating costs are more important, Wales may have a more attractive offering in terms of skills, property and grants	• Favourable corporate tax offerings from e.g. RoI and Singapore encourage major biotech companies to locate there
• Advances in genomics could present opportunities	• Highly risky and lengthy R & D process
• Invitro Diagnostics being pursued by IBW as estimated turnover (T/O) growth rate is 36%/T/O £133m	• Product life cycles shortened

• *Systems Biology (study of complex interactions in biological systems i.e. cells) being pursued by IBW as estimated T/O growth rate is 2%/T/O £82m*	• *Product approval, pricing and promotion are subject to increasingly onerous regulation*
• Asian companies entering the UK and European market via acquisition	• R & D and sales costs have risen sharply
• Increased connectivity to higher education establishments and graduates would be welcomed by specific companies in South Wales	• Asian companies entering the UK and European market via acquisition (Possible loss of Welsh HQ)
• Improved links with NHS carve-outs and high tech SMEs would be welcomed by specific companies	• Venture capital in short supply to support small biotechs (x-refer to Fin/Ins PESTEL & SWOT)
• Large companies considering consolidation of core operations and outsourcing or forming spin-out companies for non-core activities	• Credit crunch is making banks etc. more risk conscious in their investment/loan activities (x-ref to Fin/Ins PESTEL & SWOT).
	• Education, skills and labour pools relating to the WAG/IBW priorities such as CROs, CMOs, may not be available/sufficient.
	• Education, skills and labour pools relating to possible WAG/IBW priorities such as preventative medicines, earlier diagnostics and treatments, may not be available/sufficient.

Priority enablers/issues affecting Welsh Bio Sector	
	Aging Population
	Earlier Diagnostics/Treatments
	Changing Business Model
	Preventative/Diagnostics/Treatments

Appendix P – Refined PESTEL Analysis for the Financial Intermediation and Insurance Sector

Political	Economic	Social	Technological	Environmental	Legal
Governments apply mechanisms in order to manage their respective economies (e.g. Interest Rates).	Principle markets for Wales are UK (London and SE England), North America (New York and East Coast), Australia, Japan, Europe (Netherlands and Germany) (IBW, 1 May 07)	There is a concern that not all lenders are treating their customers fairly when recovering bad debts (both secured and unsecured) (FSA, 2008).	Increase in use of IT leading to Data Centre/Disaster Recovery opportunities (salisbury house consulting Ltd, 2007)	Increased use of energy resulting from increased use of IT.	FSA regulate sector in UK. Other authorities regulate Financial services companies elsewhere.
Interest rates in the UK and USA have fluctuated over 2007/8, reducing significantly by 2009 affecting borrowers and savers. (Exchange rates also changed).	Market consolidation, M & As across EU/global markets in all Financial services areas, driven by legislation (Sarbanes Oxley 2002 Act in USA etc.) and operating cost efficiencies (IBW, 1 May 07)	Consumers encouraged to take out credit, e.g. based on low interest rates. Since mid - end 2007, Financial services companies have become more risk aware and some customers are being impacted (FSA, 2008, Egg, Jan 2008)	Chip and Pin technology to minimise fraud and crime	Data Centre companies i.e. IBM are developing 'green' IT hardware and processing technologies	Maintaining market confidence is a UK statutory objective, yet market confidence is difficult to measure and it is most visible at the extremes (FSA, 2008).
The Bank of Japan resumed its tightening cycle in 2008 (FSA, 2008).	In the UK there are major outsourcing opportunities and continued growth in smaller companies supporting niche products and services. These have spun-out of large corporate consolidations e.g. Jardine Lloyd Thompson (IBW, 1 May 07)	House repossessions are on the increase (FSA, 2008 and BBC News 8 Feb 2008)		Climate change/environmental awareness (Mann, 2007)	Compliance with Basel I and II in relation to risk infrastructure including policy, processes, systems and data management in the Financial services industry. Companies must have robust capital plans in place (FSA, 2008)
US Govt election 2008	Turner Report into Pensions set out to create major impetus into the future of savings and investments, creating new demand for services of Financial Advice and Life and Pensions providers (IBW, 1 May 07)	The FSA remain concerned about consumers' ability to understand increasingly complex products (FSA, 2008).			Most UK 'recognised bodies' are now part of large multi-jurisdictional groups and this increases the difficulty of regulating these groups (FSA, 2008).

Capital markets and financial policies under pressure 2008	Ongoing movement of US companies to UK (London) as part of global growth strategies and European market penetration (e.g. Citigroup, Lehman Brothers, Fortis Bank, MBNA and First Data (IBW, 1 May 07). (Impacted by credit crunch 2008 onwards).	A lack of planning for retirement (FSA, 2008).			Government's Personal Account proposals (from 2012 all employers will have to provide a workplace pension and automatically enrol all of their employees who meet the required criteria). (However, until then there is a risk that consumers or employers will delay decisions about retirement saving) (FSA, 2008).
UK Labour Government due to remain in power until 2010.	Movement of European companies into UK in pursuance of growth and penetration strategies e.g. AMB AMRO, Deutsche Bank, ING Group, Bank of Ireland (IBW, 1 May 07). (Impacted by credit crunch 2008/9)	Concern that consumers are unable to make an informed decision about the cost and appropriateness of insurance cover, and are unaware of limitations and exclusions (FSA, 2008).			Despite increased regulatory intervention, some firms are making little progress in improving their insurance sales practices. FSA are seeking to impose punitive regulatory measures where standards fall below the required level and consumers are not being treated fairly (FSA, 2008).
UK Government 'nationalised' Northern Rock 18 Feb 08.	Higher inflationary pressures, weaker outlook for the US economy and more fragile financial markets have contributed to a more vulnerable outlook for the UK economy and financial markets (FSA, 2008).	Ageing population and longer life expectancy (Mann, 2007)			
Transfer of some legislative powers to devolved administrations may lead to changes in taxation incentives. The Government of Wales Act 2006, Schedule 5, Section 94, Field 4 covers economic development. (DFM Speach to SWIMM 15 May 08, WAG pursuing downward variation in Corporation Tax)	More difficult financial market conditions are likely to persist for some time, which increases the downside risks to firms and makes the financial sector more vulnerable to future shocks (FSA, 2008)	High property prices up to 2007 leading to grown-up children staying at home and a demand for smaller properties (Mann, 2007).			

UK and other governments bailing out banks 2008/9	There is a risk that credit conditions will tighten further, which would increase the existing pressures on consumers' finances and spending (FSA, 2008).	Highly aspirational and materialistic lifestyles (Mann, 2007)			
	The financial market dislocation is affecting the real economy, e.g. through a reduction in the amount of credit that is available for some consumers and some corporates, which will adversely affect consumption and investment plans in the future (FSA, 2008).	Rising power and influence of females (Mann, 2007)			
	Tighter credit conditions, in the form of a reduction in the availability of credit and higher credit costs, are likely to reduce spending in the UK (FSA, 2008).	High customer expectations and individualistic needs (Mann, 2007)			
	As economic conditions deteriorate, and house prices fall, profit growth for some financial firms will slow (FSA, 2008).	Greater determination to live life to the full (Mann, 2007)			
	Interest rates cut Dec 07, Feb 08 and 2009 to manage inflation. Such cuts take time to feed through the economy (FSA, 2008).	Greater travel/holiday time (Mann, 2007)			
	Higher interest rates affect the affordability of debt repayments, particularly mortgage repayments. During 2008, approximately 1.4 million fixed-rate mortgages came to the end of their fixed-rate term, impacting consumer spend (FSA, 2008).	Climate change/environmental awareness (Mann, 2007)			

	Concerns already persist over household-debt levels, and the number of individuals experiencing debt-servicing difficulties has increased sharply. More difficult conditions for consumers could have significant implications for financial firms (FSA, 2008).				
	Increased re-possessions in UK (FSA, 2008 & BBC News 8 Feb 08). FSA research indicates that current consumer distress is focused on particular consumer groups rather than on particular types of lender.				
Remaining Economic Factors					
The financial market dislocation has resulted in an increase in uncertainty and risk aversion, which pose risks to the UK economic outlook, lower consumer confidence, putting further pressure on domestic demand (FSA, 2008).	The financial market infrastructure continues to be subject to considerable change and the consolidation and most UK bodies are now part of large multi-jurisdictional groups. (FSA, 2008)	In the US, falling housing construction and higher energy prices are likely to exert downward pressure on domestic demand. US consumption of goods from around the world could also be affected (FSA, 2008). (Witnessed in e.g. China 2008/9)	The FSA (2008) consider 3 alternative scenarios and the likely impact of them being realised in the UK in 2008/9. These are: Availability of Credit, Fall in Property Prices and Inflationary Pressures.	There is a risk that banks may attempt to maintain profits and returns to shareholders by undertaking high-risk activities without full risk assessments and without having the appropriate systems and controls in place (FSA, 2008).	Banks are likely to respond to pressures on profitability etc. by cutting costs, but scope may be limited by the extent of previous cost cutting and by the pressures on staff dealing with the other issues faced by the industry (FSA, 2008).
Some business models in financial institutions are under strain as a result of adverse market conditions (FSA, 2008)	Some companies are parting company with a minority of customers who are seen as risks (e.g. Egg (Citibank), BBC news, Feb 08)	Pressures on profitability are likely to continue in 2008. (FSA, 2008)	Inflationary pressures resurfaced in Europe in 2007 as a result of rising food and energy prices (FSA, 2008). (Subsequently, inflation reduced).	Global financial market conditions weakened considerably in 2007 as investors reassessed risks in their portfolios and risk premia began to rise (FSA, 2008).	The market's pricing and value of risk had been underestimated up until 2007. (FSA, 2008)
In 2008, UK and US consumer spending slowed due to lower mortgage equity withdrawal, tighter credit conditions and as variable-rate mortgages were reset (FSA, 2008).	While emerging markets have benefited from globalisation, many are more vulnerable to contagion effects from developed economies. (FSA, 2008).	Market participants and consumers may lose confidence in financial institutions and in the authorities' ability to safeguard the financial system (FSA, 2008) (e.gs. Northern Rock (Nov 07) and Societe Generale (Jan 08)	Global financial markets could be more vulnerable to external shocks and the impact of shocks on firms could be bigger than it was in previous years (FSA, 2008)	The global operating environment remains tight and it is unlikely that conditions will return to what investors have experienced in recent years (FSA, 2008).	Global financial markets need to adjust to new conditions that reflect reduced availability of cheap credit and higher volatility than experienced in recent years (FSA, 2008).

FSA (2008) advise firms to improve their risk management processes in order to assess potential, future shocks	FSA (2008) advise firms on the importance of robust business continuity planning (includes Disaster Recovery etc.)	FSA (2008) advise rapid growth in the credit derivatives market, little of this confirmed electronically.	Increased financial pressures may lead to increased financial crime e.g. internet banking (FSA, 2008)	Investment banking faced an increasingly difficult operating environment in the second half of 2007. (FSA, 2008).	Commercial property prices began to fall in late 2007 and the housing market collapsed 2008 (FSA, 2008).
There is a risk that inadequate insurance premiums could lead to losses and strain on capital resources (FSA, 2008).	Corporate lending growth (excluding lending to other financial companies) has fallen in the year to August 2007. (FSA, 2008).	Investment banking earnings have tended to be more volatile than those of commercial banking operations. There is a concern that in some cases remuneration policies can work against the systems and controls that have been put in place in order to control risk (e.g. Rogue Trader, Societe Generale, Jan 08; FSA, 2008).	The retail intermediary industry plays an important role in helping consumers. However, the industry faces a number of issues which may affect this activity in current market conditions. (FSA, 2008).	Refinancing has become difficult for firms. In particular, private equity portfolio firms, which typically have greater leverage within their capital structures than public or other privately-owned firms, have been affected (FSA, 2008)	The improvements to life expectancy have potential implications for the profitability of annuity business and at the same time create a need for consumers to save more to avoid a shortfall in their income in retirement (FSA, 2008).
There is a lack of insurance/pensions planning for retirement (FSA, 2008).	Life insurers have reported a significant increase in pension sales (FSA, 2008)	General insurance premiums have been falling since 2003. However, consumers in flood-prone areas have seen higher premiums. (FSA, 2008).	In the retail arena, price comparison websites have increased competitiveness in an already competitive market, bringing benefits to consumers but presenting firms with a more difficult environment (FSA, 2008).	Conduct-of-business issues relating to distribution and, in particular, inappropriate sales of insurance products and misleading financial promotions are the most significant risks in retail general insurance (FSA, 2008).	A significant minority of consumers could experience financial problems because of their high levels of borrowing (FSA, 2008)

Colour	Code	Totals
	Credit Crunch	53
	Energy Costs	4
	Credit Crunch and Energy Costs	4

Appendix Q – Refined SWOT Analysis for the Financial Intermediation and Insurance Sector

Finance & Insurance Sector - Internal Factors (Wales)	
Strengths	**Weaknesses**
• Wales' proximity to London (IBW, 1 May 07)	• A number of Contact Centres established within SE Wales, as a result of WDA/IBW activity (in the Financial services and other sectors e.g. utilities) (Average salary is low but job numbers are significant).
• Skills and staff retention rates (IBW, 1 May 07)	• High energy costs in UK (and elsewhere) in 2008
• Lower staff costs and property costs in Wales (IBW, 1 May 07)	
• Strong University links in Wales (IBW, 1 May 07)	
• Growing diversity and community of established Financial sector in Wales including e.g. Zurich, ING, HSBC, Lloyds TSB (IBW, 1 May 07).	
• Price comparison web sites creating increased competition in the retail sector (Wales has at least 2 of these) (FSA, 2008).	
• Global companies delivering more profitability and productivity by greater use of technology and business solutions from Wales e.g. growth potential and cost efficiencies (IBW, 1 May 07)	
Finance & Insurance - Extent to which Internal Factors (SW) are relevant/capable of dealing with External Factors (OT)	
Opportunities	**Threats**
• Turner Report in the UK set to create new demand for services providing Financial Advice and Life and Pensions providers (Several in Wales) (IBW, 1 May 07)	• Low-cost economies in competition for low-cost/low-value activities for e.g. contact centres in India
• Inflation, interest rates and expiry of fixed rate mortgages in 2008 could lead to opportunities for debt management/consolidation (1 or 2 companies in Wales), equity release (1 company in Wales)	• Economic down turn/credit crunch could resulting in M & As, tax payer bail outs, reduced profits and cost cutting leading to the loss of jobs.
• Data Centre Services opportunities based on FSA guidance (Business Continuity planning, credit derivatives and equity derivatives and the increased use of automation/IT)	• Inflation, interest rates and expiry of fixed rate mortgages in 2008 could lead to a decrease in demand for retirement planning and pension products.
• Consumers demanding increasingly varied insurance products (holidays/dangerous sports/pets/health/etc.) (Mann, 2007)	• Inflation, interest rates and expiry of fixed rate mortgages in 2008 could lead to an increase in repossessions.
• Females becoming more important customers and more products are targeted at them (Mann, 2007).	• Relative strength of the £ could lead to companies transferring low-cost/low-value jobs to low-cost countries.
• Credit feeds the aspirational and materialistic needs of consumers (Mann, 2007)	• Increasing number of price comparison sites in the market. These could impact Welsh companies and jobs as skills are available in low-cost economies.

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