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## Abstract

There is no commonly accepted typology to describe the field of Systems Thinking. It may be viewed from a number of different perspectives. This is interesting as systems and systemic problem situations may themselves be considered as conceivable from a number of different perspectives or “dimensions”. The more complex a systemic situation, the more relevant becomes taking a range of different dimensional views in its analysis. Critical Systems Thinking (CST), a domain within Systems Thinking, supports multi-dimensional analysis of systems and offers approaches to support practitioners in selecting and combining multiple systems thinking methods for this purpose.

A detailed review of the Critical Systems Thinking literature and the multiple-systems-thinking-methods approaches therein reveals that there is a problem. Much debate surrounds the validity of the theory upon which these meta-methodologies are founded. According to Zhu (2011), “Combining multiple methodologies works in practice, but not yet in theory.”

The need to find a reliable approach to selecting and combining multiple systems methods for the purpose of resilience research has led to the proposal of a systems-theory-based meta-methodology as an extension to CST. The proposal is a fusion of the multi-methodology ideas of Jackson, Mingers and Brocklesby with ideas for the conceptual dimensions of systems and levels of complexity of Angyal, Emery and Trist, together with the systems archetypes idea of Senge. It is hypothesised that the proposed new meta-methodology is useful for supporting resilience research. The thesis concludes with suggestions for future work required to develop the hypothesis further.

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## 1. Introduction

This thesis is about the use of multiple systems thinking methods. This is relevant when analysing a complex problem situation.

### **CuReSS as an example**

An example of such a problem is the CuReSS Project, an EPSRC- and ESRC- funded scoping study which explored the development of a blueprint for enterprise resilience based upon existing knowledge about resilience within the human body. Whilst designing the CuReSS project approach, the complexity of the problem situation was brought into focus and generated concerns regarding the choice of a suitable methodology.

A major factor for CuReSS is that resilience in itself, as a concept, is complex. There are many aspects to it, and the emphasis placed upon specific aspects within any single definition of resilience varies, depending upon which domain you sit in. This makes resilience difficult to define in general terms, and without an explicit definition of what something is, it is unlikely that it can be identified and analysed. For the purposes of the CuReSS project, resilience was taken to be, *“ensuring an enterprise has the current and ongoing capacity and capability to continue to achieve its specified (or unspecified) purpose(s) in the face of predicted and unpredicted exposure to hazards, disruptive events and continual stress”* (Wright et al. 2012). Another factor is the complexity of the human body, or biological metaphor, itself.

As an example of a complex system, the human body is made up of trillions of cells organised into interconnected organs and systems, controlled by interdependent regulatory mechanisms, all of which change over time and behave in often unexpected and emergent ways. In addition, existing knowledge about the human body resides in a number of different medical and biological science domains, each of which takes its own view of how the body works. Because of this complexity, it is difficult to pinpoint any simple or single way of analysing resilience in the biomedical metaphor.

To translate knowledge from the biomedical metaphor into a social domain such as the domain of organisations and communities, it is necessary to understand the nature of those 'enterprises'. These are complex, interrelated and interdependent systems which are themselves part of a wider hierarchy of systems. Networks of individuals and agents within the systems operate collectively and independently, and the behaviour of these systems is often unpredictable and emerges out of the complexity. This represents another complex situation which is difficult to understand by taking only a single viewpoint, or by using any simple analysis methodology. Resilience in one organisation may be something quite different when applied in another.

It was clear from this knowledge that enterprise resilience based upon a biomedical metaphor would be a complex, multi-dimensional, viewpoint-and-context-dependent construct and the selection of a methodology to develop a blueprint for it would need to offer ways of conquering the complexity.

## Contribution

Thinking about which methodology to use gave rise to two important questions, for which there were not necessarily any ready-made answers. The first question was, *“What methodology can be used to resolve a complex systems-thinking issue such as how to develop a blueprint for enterprise resilience?”* This leads to the next question of, *“How can we understand the complex problem situation we are trying to address in the first place, so that we can select an appropriate methodology?”*

This thesis contributes to this understanding by providing a critical evaluation of mainstream multiple-systems-thinking-methods approaches which are aimed at complex problem situations. It brings together prevalent ideas from the systems thinking domain and enhances knowledge in this area by evaluating and making useful comparisons between the two main rival approaches; by identifying and evaluating alternative viewpoints; and by proposing an alternative set of organising principles for multiple-methods systems thinking, based on the multiple dimensions by which we can conceive of systems and the multiple levels of complexity of situations as determined by the boundaries we choose.

Upon investigation comes the discovery that there are a range of systems methods available, all of which are different, designed for varying purposes and have been based upon a variety of assumptions. The validity of each approach is thought by some to be specific to the context for which it was developed, indicating that using systems approaches in novel contexts could potentially be problematic. Systems methods each have their limitations in terms of breadth of application and usefulness, and there are also examples in the literature of where methods have



been used in combination in order to address problem situations of greater complexity.

This begs another, more specific, question, “**What reliable approach or method can be used to guide the selection of a suitable methodology or defensible combination of methodologies to help understand and resolve a difficult complex problem situation, such as that of the CuReSS Project?**”

A suitable approach for selecting the most appropriate method or consistent and defensible combination of methods from this extensive range was not apparent.

Two mainstream meta-methodologies, Critical Systems Practice and Multi-Methodology were reviewed in detail but neither were found to be satisfactory.

A significant challenge to the validity of the theoretical assumptions inherent in these meta-methodologies has been made by, amongst others, Zhu (2011). This leads to a further inquiry as to a suitable set of organising theoretical principles upon which to base a multiple methods approach.

Supported by the notion that complex systems problems should be analysed with the dimensions of complexity and systems in mind, this thesis concludes with a proposed meta-methodology for multi-systems-methods design, which it is hypothesised may be useful in supporting resilience thinking.

### **Focus of effort**

This thesis is not directly about resilience, nor about enterprises, nor about the biomedical metaphor, but it is born out of a study of these things, and is directly about systems thinking. It is focussed on trying to answer questions surrounding

complex situations; specifically, how to understand them, and how to select and combine appropriate systems methods, in particular where single systems methods alone are insufficient.

## **2. Background**

This chapter provides an overview of the world of systems thinking, at the same time demonstrating that there are multiple ways in which it may be perceived; a concept which is relevant as systems themselves can be perceived in multiple ways. The objective of this section is to establish the focus for the detailed literature review by identifying which area of the systems thinking domain is most likely to hold the answer to the problem being investigated.

### **Systems Thinking as a Domain**

The systems thinking domain has been established for a significant time, beginning around the Second World War (Jackson 2009; Ramage and Shipp 2009; Flood 2010; Jackson 2010; Mingers and White 2010). The field is made up of both academics following theoretical systems thinking, and practitioners applying systems thinking methodologies to real-world problems.

Systems thinking is a discipline in its own right which has developed over time, and is “trans-disciplinary”(Jackson 2010) in that it is applicable to and connected across multiple disciplines. Systems thinking can be thought of in terms of key thinkers and schools of thought, or seen as a series of approaches based on a range of philosophical paradigms, metaphors or social theory. It can also be seen as a range of methods which are suitable for application to a variety of specific problem situations. Considering the context of systems thinking helps to provide grounding upon which to build an understanding of the problem area. The field of systems thinking can probably best be understood by examining it in a number of different ways, to help draw out some of the main themes, and in particular, to help understand the basis for the most recent developments in the field. What follows

next is an examination of Systems Thinking from a variety of these different viewpoints.

### **Schools of thought**

Ramage and Shipp (2009), in their book, *Systems Thinkers*, cluster the systems thinking domain according to seven groups of closely-related authors. Certainly, subjective clustering of authors cannot be thought of as definitive schools of thought, however close comparisons can be made with other systems thinking groupings identified elsewhere in the literature.

For Ramage and Shipp systems thinking is made up of: General Systems Theory being “...concerned with issues of open systems, emergence, boundary and hierarchy” ; Early Cybernetics being a “...highly influential approach based on the concepts of feedback and information, and the parallels between human and machine behaviour...” ; Later Cybernetics , described as being a group of authors who took the early cybernetics work in new directions at a later date; System Dynamics being based “...on computer modelling of systems with a high degree of feedback and circularity”; Soft and Critical Systems being “...a highly applied approach that arises from the use of systems engineering and operations research to human systems...” ; Complexity Theory being, “...an approach to the modelling of highly complicated and interconnected systems using techniques derived from the physical sciences, with a focus on self-organisation, emergence and nonlinearity”; and finally Learning Systems being, “...common focus on the way people learn and the systems within which they learn.”

The usefulness of Ramage and Shipp's overview of the field of systems thinking, which is described in their book in further detail, is in the possibility of being able to view the field from historical and themed perspectives and in the context of the personal interests and contact networks of the authors concerned, providing a rich and multi-dimensional overview.

Figure 1 has been drawn to illustrate the field of systems thinking, based upon Ramage and Shipp's description. The model is adapted from (Wikipedia) (*Complexity*. Accessed 09.03.2012) and shows the contribution of ideas by many of the authors and some of the significant connections and influences between authors and ideas.

Whilst not claiming to be complete, the model aims to illustrate how various "camps" of systems thinking have developed in parallel and over time, often branching out into other disciplines, and how the field of systems thinking has developed towards where it appears to be today, a discipline made up of the total of these (and other) parallel approaches and ideas.

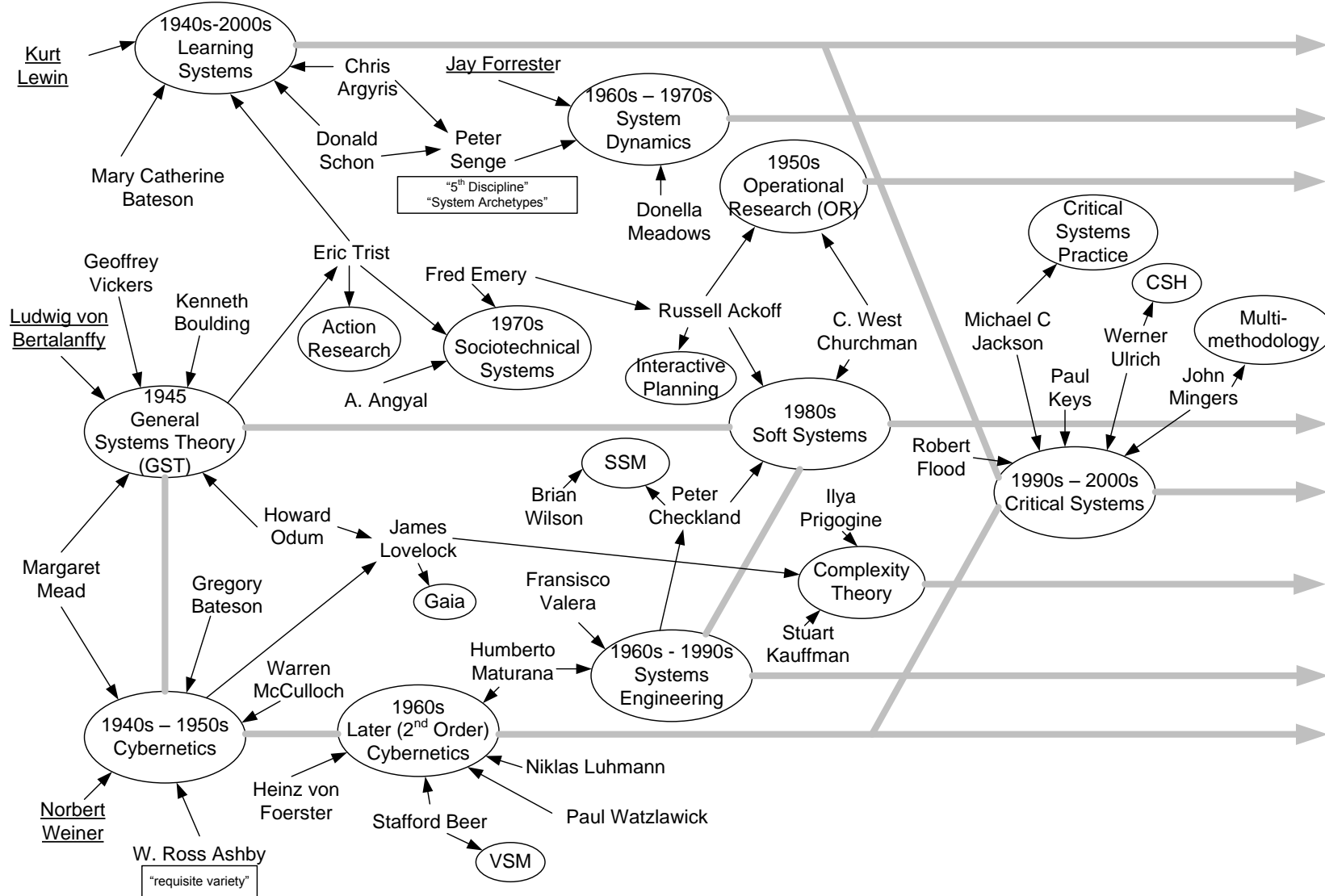
## Camps

The notion of systems thinking being divided into camps is supported by Jackson (1994), who comments, "Systems thinking should be able to present itself as the discipline capable of offering a holistic response to a very wide range of management problems. Instead, different groupings of academics and practitioners lay claim to the systems label but share little overall intellectual vision." These camps have been described as academics versus practitioners, soft systems thinking

versus hard systems thinking, cybernetics versus soft systems thinking, etc.

(Jackson, 1994)

Figure 1: The Field of Systems Thinking



## Historical Perspective

As well as taking the perspective of schools of thought, systems thinking can be considered in terms of its historical development. According to Flood (2010), “Systems thinking emerged in the twentieth century through a critique of reductionism... with systems thinking the belief is that the world is systemic, which means that phenomena are understood to be an emergent property of an interrelated whole.”

Flood (2010), in reviewing the contribution of systems thinking to action research, traces the development of systems thinking from General Systems Theory, through Cybernetics and on to the work of Gregory Bateson and organism metaphors of systems. He then moves on to discuss Applied Systems Thinking and refers in particular to System Dynamics. Reference is made to the “socio-ecological perspective” or “open systems theory” and the link to the Tavistock Institute of Human Relations through the work of Trist and Bamforth, including how Trist and Emery joined forces to make significant contributions to Action Research. Later, he talks about how thinking moved beyond the biological model, which was criticised for placing too much emphasis on structure and form. This led to the Soft Systems movement in terms of the works of Checkland and Churchman. Flood calls it “systemic thinking”, where “there is a growing rejection of the notion of a concrete social world that comprises real social systems, as people come to appreciate a quite different systemic quality to their existence.”

Flood’s view concludes with developments beyond soft systems thinking, “Following on, the main criticism of soft systems thinking is that it neglects certain difficulties in achieving open and meaningful debate... A new approach to systemic thinking called critical systems thinking emerged in the 1980s with these concerns firmly on its agenda.”



## Theories and Methodologies

By contrast, in a recent publication, Mingers and White (2010) categorise what they call “the systems approach” according to the main systems theories and methodologies.

They describe systems thinking as being formed from a collection of ideas including “parts/wholes/sub-systems, system/boundary/environment, structure/process, emergent properties, hierarchy of systems, positive and negative feedback, information and control, open systems, holism and the observer.” The systems thinking domain began with the recognition by von Bertalanffy (1950) that these concepts were applicable across many disciplines and general systems theory (GST) was developed.

Mingers and White highlight a number of distinct systems thinking theories/methods: Complexity Theory, “Chaos and complexity are the results of a Kuhnian revolution that emphasises instability, far-from-equilibrium, sudden change, sensitivity to initial conditions and complex behaviour from simple models (and vice versa)”; Cybernetics as, “...the scientific study and mathematical modelling for an understanding of regulation and control in any system”; System Dynamics as being “a very powerful set of concepts for understanding and modelling complex systemic behaviour... At its heart it concerns the results of the interplay of two forms of feedback loop”; Soft OR and PSMs as a single category being, “a family of interactive and participatory modelling approaches...[which] support [in framing and definition of the issues constituting the problem] through modelling and group facilitation with a view to stimulating dialogue and deliberation about the problem domain, and reaching shared understanding and joint agreements with respect to it”; and finally describe a category of critical systems and multimethodology being, “...which method should be used when?”

Mingers and White describe how the systems approach moved towards combining these theories/methods, “[it] eventually moved from the question of selecting a single method to recognising the value of combining together different methods, not just soft but especially employing both hard and soft methods together. This is known as multimethodology or coherent pluralism. It is argued that... different methods can better address the different phases of an intervention.”

The benefit of Mingers and White’s analysis is that they show how the different methods in systems thinking aim to provide insights from different perspectives. This may be useful in understanding the benefits and limitations of the various approaches and in selecting suitable methods for application to problem domains. They also demonstrate how recent work in the field has been towards finding ways of drawing together the different perspectives and using them in complementary ways, an approach which is practically intuitive but is thought by some to be theoretically problematic (see Jackson below).

### **A multi-dimensional view**

Michael C. Jackson, in a number of publications over the years (1987; 1991; 1994; Lane and Jackson 1995; 2000, 2003a; 2006; 2009, 2010), has built up his own multi-dimensional view of systems thinking. His work, in part, looks at the field in terms of a progression historically towards dealing with increasing situational complexity and diversity of stakeholder viewpoints. Lane and Jackson divide the field according to the aims of the approaches. Jackson and Keys have contributed to systems thinking with the development and refinement of the System of Systems Methodologies (SOSM), a classification system for systems thinking methods based upon the fit of methods to

given problem situations. Jackson has also viewed systems thinking in terms of the metaphors and paradigms used by the thinkers and practitioners. Some of the most recent developments, to which he himself has contributed, have been in Critical Systems Thinking, where ideas for methods which support critical awareness and the holistic approach have been hotly debated. (Mingers and Gill 1997; Harwood 2011; Jackson 2011; Mingers 2011)

## 8 strands of systems thinking

In Lane and Jackson (1995), reference is made to the “systems movement”, and in trying to describe what systems thinking is about, they write, “The field of systems science, the objects of systems research and the interpretations of the term ‘systems thinking’ are both broad and diverse.” ...“The movement as a whole can be recognised by a commitment to holism rather than reductionism and to organising knowledge in cognitive systems, structured frameworks expressing certain intellectual norms (simplicity, regularity, uniformity, comprehensiveness, unit, harmony, economy, etc.) that people have found useful in thinking about and acting in the world.”

Lane and Jackson describe eight distinct areas within the systems movement, namely, *General System Theory*, “...widely known as GST, offered a meta-methodology of holism which aspired to embrace different sciences by discovering concepts, laws and models applicable to systems of all types.”; *Organisations as Systems*, “This strand of systems thinking seeks to understand organisations and societies in terms of their interacting subsystems and relationships with the environment.”; *Hard Systems Thinking*, “Hard systems thinkers seek to model their (real-world) system of concern with a view to optimising its performance in pursuit of some predefined goal. The invention of the

notion of a model, used to replace the natural scientists' laboratory experiments, was perhaps its greatest achievement.”; *Cybernetics*, “Its primary concern, applied to management, is with the structure of organisations and information and control systems.”; *System Dynamics*, “...system dynamics emerged from a social science tradition concerned with continuous processes and the dynamic behaviour of feedback loops.”; *Soft Systems Thinking*, “Soft systems thinking seeks to extend the sphere of application of systems ideas to problem situations in which objectives are ill defined and systems too complex to model mathematically. It puts human beings and ethical questions at the heart of the systems approach.”; *Emancipatory Systems Thinking*, “A new area of interest for systems thinking which deals with ways in which systems approaches can be used in coercive situations to assist less powerful groups.”; *Critical Systems Thinking*, “Critical systems thinking is a relative newcomer to the systems fold and argument still rages about its exact nature... basing itself on critical reflection and social awareness, on complementarism and on an ethical commitment.”

Jackson and Lane make clear distinctions between the different systems thinking strands, based upon the aims of the approaches. This is perhaps more beneficial for selecting methods for specific purposes than an historical perspective might be. However, since 1995 when this analysis of systems thinking was made, ideas have moved on, and the boundaries within systems thinking have become more blurred.

### Types of problem

Jackson (2003a), in his book *Systems Thinking: Creative Holism for Managers*, talks about the difference between theoretical systems thinking and how that developed into applied systems thinking. The reason for the development was increasing attention as to

whether theoretical systems thinking can be applied to tackle practical real-world problems. When attempting to classify systems thinking, it may be relevant to think about the practical situations which systems thinking is being applied to.

Jackson and Keys' grid of problem contexts, also known as the System of Systems Methodologies SOSM (in Jackson 2003), aims to categorise systems thinking methods according to the type of problem they may be suitable for. Problems can be split according to whether they seek to fix simple systems or complex systems. Participants in those systems form the other axis in the grid. Situations can be thought of as different depending on the participants. Unitary participants are those working towards the same goals and objectives and agree on what these are. Pluralist participants each have different views on the objectives and goals of the system but are able to come together and agree on collective objectives and goals. At the far end of the scale are coercive participants. They have a range of different viewpoints, goals and objectives but it is difficult or impossible for people to come together and openly express those viewpoints and reach any kind of consensus.

In SOSM Jackson and Keys place systems methods upon the problem context grid, according to how they feel they may be applied to the various contexts. So where there are simple systems with participants having agreed objectives, one should use hard systems methods. For more complex systems with agreement on objectives, cybernetics, systems dynamics and complexity theory apply. For pluralist participants, whether systems are simple or complex – soft systems approaches apply, as their purpose is to bring together different viewpoints. Emancipatory systems thinking apply to simple

systems with imbalances of power i.e. coercive. Postmodern systems methods apply to complex coercive situations.

Overall the SOSM is a way of describing relationships between the different approaches and of understanding what individual approaches can do and how they fit against different problem contexts.

### Metaphors and Paradigms

Jackson (2003a) talks about creativity and systems and he draws from the work of Morgan in particular to talk about the different metaphors used in systems thinking, looking at the different systems approaches and identifying the different metaphors they are based upon. The original thinkers developed and used “metaphors” to explain organisational systems: (Organisations as...) machines, organisms, brains, flux and transformation, cultures, political systems, psychic prisons, instruments of domination and carnivals. According to Jackson, systems thinking approaches can be categorised according to the metaphors employed.

Jackson (2000) presents, in contrast to “8-strands of systems thinking” of the systems movement, **four** types of systems thinking for problem solving, based on how each contributes to social theory. Namely: *functionalist*, *interpretive*, *emancipatory*, and *postmodern*. This perspective is a departure from thinking about the purpose of systems methods, and a move towards dividing the field according to the philosophical assumptions made by the various thinkers. This change in perspective has been at the root of much debate around paradigm incommensurability and the theoretical difficulties

in combining systems methods. Adapting from Deetz, he describes the features of these paradigms in more detail, which are paraphrased below:

The Functionalist paradigm's basic goal is to demonstrate law-like relations among objects. It hopes for efficiency, effectiveness, survival and adaptation. The organisation metaphors most relevant are machine, organism, brain, flux and transformation. People with this view are interested in addressing problems of inefficiency and disorder, with the organisational benefits being control and expertise. Examples of functionalist systems thinking include organisations-as-systems, hard systems thinking, system dynamics (SD), organisational cybernetics, living systems theory, autopoiesis, and complexity theory.

The Interpretive paradigm's basic goal is to display unified culture. It hopes for recovery of integrative values. The organisation metaphors most relevant are culture and political system. People with this view are interested in addressing problems of meaninglessness and illegitimacy, with the organisational benefits being commitment and quality of work/life. Examples of interpretive systems thinking include Interactive Management, Social Systems Design, Strategic Assumption Surfacing and Testing (SAST), Interactive Planning, Soft Systems Methodology (SSM).

The Emancipatory paradigm's basic goal is to unmask domination. It hopes for reformation of social order. The organisation metaphors most relevant are psychic prison, and instruments of domination. People with this view are interested in addressing problems of domination and consent with the organisational benefits being participation and expanded knowledge. Examples of emancipatory systems thinking

include critical systems approach, Team Syntegrity, Critical Systems Heuristics (CSH), and oblique use of systems methods.

The Postmodern paradigm's basic goal is to reclaim conflict by emphasising novelty and disorder. It hopes to claim a space for lost voices. The organisational metaphor most relevant is carnival. People with this view are interested in addressing marginalisation, conflict and suppression with the organisational benefits being diversity and creativity. Examples of postmodern systems thinking include Participatory Appraisal of Needs and the Development of Action (PANDA).

In addition, Jackson (2000) describes *Critical Systems Thinking* as an over-arching school or meta-methodology, within which is placed Multi-methodology, the System of Systems Methodologies (SOSM), Total Systems Intervention and its later refinement, Critical Systems Practice. This school of systems thinking aims to apply multiple systems approaches from the perspectives of multiple social theory paradigms for application in complex situations, "with the intent of ensuring holistic appreciation and intervention".

Schwaninger (1997) refers to two simplified paradigms which exist in systems thinking, which are often referred to as "hard systems thinking" and "soft systems thinking". Hard systems approaches derive from what is described as a "positivistic perspective" where people adopt an objective view of the world where the observer is independent of that being observed, where there is a belief in a "true" representation of reality. Soft systems thinking approaches derive from what is described as a "hermeneutic perspective" where people adopt a subjectivist view. There is a belief that reality is viewed by people



through individual perspectives and the interrelationships between the various perspectives need to be considered.

The benefits of viewing systems thinking from the paradigm perspective is in knowing the assumptions being made and the perspectives from which methods have been developed. This is useful for understanding the intended application and limitations of the various methods. The critical systems thinking school could be thought of as another paradigm, whereby assumptions are made about the benefit of combining approaches from a number of perspectives, the goal being to make those combinations, and the hope being to ensure “holistic appreciation and intervention”.

### **Emphasis of approach determined by paradigm**

Jackson (2003a) also talks about dividing the systems approaches into 4 types, “whether their primary orientation is improving A) goal seeking and viability, B) exploring purposes, C) ensuring fairness or D) promoting diversity” “these are not mutually exclusive properties but offer a reasonable guide as to where the main emphasis of an approach lies.”

Jackson says, that for Type A systems approaches, the measures of success are efficiency and efficacy and calls it a structuralist way of thinking. Type B systems approaches are dedicated to exploring and clarifying purposes. Success measures are effectiveness - are we actually achieving what we want to achieve? And elegance - do the stakeholders find what is proposed tasteful. Measures of success for Type C approaches are empowerment - are all individuals and groups able to contribute to decision making? And emancipation - are groups able to get what they are entitled to? Type D are postmodern

and seek to promote diversity in problem resolution, “Such approaches are in a sense anti-systemic in that systems of domination have to be challenged and broken down in order to let suppressed voices have their say, and these are less established than other systems methodologies”. Type D approaches justify their intervention on the basis of exception - what otherwise marginalised viewpoints have we managed to bring to the fore? And emotion - does the action that is now being proposed feel appropriate and good in the local circumstances in which we are acting?

Similarly, Flood (1999), describes four “windows” through which to consider a problem situation. “Organisational life might be made sense of in terms of the following four categories – systems of processes, of structure, of meaning, and of knowledge-power.

A “system of processes” is “all of the ordered flows of events undertaken for a particular activity.” The two central concerns about systems of processes are efficiency and reliability.

A “system of structure” refers to “organisational functions and various forms of co-ordination, communication and control.” The central concern about systems of structure is effectiveness.

“Systems of meaning may yield cohesion in cultural ways of living and/or tension arising from disagreement.” The central concern of systems of meaning is seeking agreement on improvement strategies.

“Systems of knowledge-power” relate to what is valid knowledge and valid action in a system. “Looking through the window of knowledge-power problematises what is seen through the other three windows.”

So, holistic systems thinkers see the world as being visible from many perspectives.

### **Refinement of the paradigm perspective**

In Jackson (2009) a different categorisation of applied systems thinking is presented. This is based upon three strands, namely, functionalist, structuralist and interpretive.

In *functionalist systems thinking*, models are applied, depending upon the level of complexity being addressed. Mechanistic models are used for the simplest situations, with organismic models used for systems of higher-level complexity. These are related to Boulding’s hierarchy of complexity.

In *structuralist systems thinking*, von Bertalanffy’s ideas of general models, principles and laws apply, whereby laws governing general phenomena of system behaviour are sought, regardless of level of complexity.

In *interpretive systems thinking*, the notion of GST is abandoned and emphasis is placed on individual ‘images’ of the world. Multiple stakeholders, problem-owners or customers are considered.

### **Critical Systems Thinking**

Again, an additional strand of *critical systems thinking* is referred to based on three principle ideas: Critical awareness of the different strengths and weaknesses of the individual systems approaches; recognition of the benefit to be gained in combining the

systems approaches; and, due to the potential impact systems interventions may have on social systems, a commitment to take social impacts into account.

Flood (1999) describes Churchman's perspective of critical systemic thinking. According to Flood, Churchman is often described as the main founder of the critical systems thinking movement. Churchman's approach is about "ethics, efficiency and effectiveness", and proposes four principles of systemic thinking:

"The systems approach begins when first you see the world through the eyes of another. The systems approach goes on to discover that every world-view is terribly restricted. There are no experts in the systems approach. The systems approach is not a bad idea."

Of the "sub-sections" of systems thinking examined, the area of Critical Systems Thinking, with its emphasis on the combination of methods appears to be the most relevant area for further inquiry.

### **Background Summary**

So, in summary, there are different ways of categorising the field of systems thinking, and views on how it should be categorised vary and have changed over time. Regardless of which typology is used, it can be concluded there are a number of current systems thinking approaches which have developed historically through the ideas of a large number of authors, that these can be related to a range of different metaphors and paradigms, and that they exist today in, what can be thought of as, a trans-disciplinary field. Much debate surrounds the differences between the approaches and the field has fragmented over the years with various "camps" forming. The most recent branch of the field, critical systems thinking, aims to draw together the approaches.

A detailed literature review follows with the aim of establishing if there are any existing frameworks or methodologies which guide the use of multiple methods. The Critical Systems Thinking tradition in particular, with its commitment to pluralism or “complementarity” will be examined in more detail. This domain is most likely to provide the information sought, for example, according to Jackson (2010),

*“The emergence of critical systems thinking has allowed the transdiscipline of systems thinking to mature by setting out how the variety of systems methodologies available can be used together in a coherent manner to promote successful intervention in complex societal problem situations.”*

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### 3. Related Work

This chapter describes the detailed literature review, providing a critical assessment of, in particular, the Critical Systems Thinking literature, and presents whether a suitable framework or methodology for the use of multiple methods is available to support the requirements of the CuReSS project example.

In focusing the literature review, it is worth thinking once again about the specific question being asked,

*“What reliable approach or method can be used to guide the selection of a suitable methodology or defensible combination of methodologies to help understand and resolve a difficult complex problem situation, such as that of the CuReSS project?”*

This can be broken down into a need to find:

*a) A reliable means of understanding the complexity of the problem being addressed* and

*b) A reliable means of selecting the right type of methods and, if necessary, a means of combining them to provide the requisite coverage that the problem situation demands.*

By ‘reliable’, it is meant an approach which is understandable, relevant, applicable, repeatable, has clear theoretical underpinning, and a good track-record in application, as these are features which would give confidence in the approach. This perspective was developed from knowledge gained from the background review.

Critical systems thinking was identified in the initial background study as being the domain most likely in which to find a suitable approach.

*“How can we understand the strengths and weaknesses of these different systems approaches and use them creatively, in combination? Critical systems thinking tries to answer this question and to provide practical guidance about how to use systems theories, methodologies and methods together in an intervention.” (Jackson 2006)*

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As to the purpose of Critical Systems Thinking, Jackson, amongst others, says that in modern systems thinking there is value in being able to look at the problem situation from all of the different paradigms and, if you can understand how each of the systems approaches can contribute to each of the dimensions of the problem situation, you can take a more holistic approach. This viewpoint will be explored in further detail later on.

*“The purpose of contemporary critical systems thinking and practice is to learn about and harness the various systems methodologies, methods and models so that they can best be used by managers to respond to the complexity, turbulence and heterogeneity of the problem situations they face.” (Jackson 2010)*

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## Commitments of Critical Systems Thinking

The main notion of critical systems thinking (CST) is that critical reflection around the applicability and use of systems approaches needs to be taken. In answer to the problems of fragmentation in systems thinking, critical systems thinking developed around the 1980s as another strand, which aimed to consider the strengths and weaknesses of systems methods and to develop ways of relating them to each other.

According to Jackson (1991), by the 1990s CST had come to embrace five major commitments: critical awareness, social awareness; emancipation; theoretical pluralism; and to methodological pluralism. Later Jackson (2010) refines this to three: “the basic philosophy of critical systems thinking ...can be described by **three** commitments—to

‘critical awareness’ (of the strengths and weaknesses of different systems approaches), ‘pluralism’ (the use in combination of different systems methodologies and methods) and ‘improvement’.” Improvement can be thought of in terms of fixing the problem but also in terms of positive impact upon society.

### **Combining methods in practice**

An investigation was undertaken to identify instances where systems thinking methods have been used in combination.

A variety of publications exist where multiple systems methods have been used in practice, for example, System Dynamics and Organisational Cybernetics have been used together (Schwaninger 2004; Schwaninger and Ríos 2008). Strategy Modelling (Soft OR) and System Dynamics are combined for workshop planning and implementation (Ackermann et al. 2011). Soft Systems Methodology (SSM) and Cybernetics (VSM) are used for autonomic system design (Bustard et al. 2006). Group Causal Mapping and Soft Systems Methodology (SSM) were combined to design a research study (Hindle and Franco 2009).

Mingers (2000) has written about the use of combined methods and identified a variety of relevant works across a range of problem domains including: organisational interventions; information systems development; technology resources planning; and resource planning and service modelling in the Health services. In this work he puts forward two main reasons for the combining of methods in practice, namely, the complexity of real-world problems and the multiple stages of interventions which each require different approaches.



Ormerod, in Mingers and Gill (1997), discusses seven cases of mixed methods application. These were mainly for strategy determination in a range of contexts and include the use of Cognitive Mapping with SSM and Strategic Choice, and VSM with SSM.

A survey was conducted by Munro and Mingers (2002) to establish the prevalence of using systems methods in combination. The survey found 167 separate instances of practitioners using methods in combination, with the majority of respondents involved in mixing methods in practice. Most used two methods in combination and use of three methods was less common but still significant. Soft methods were most commonly used in combination, with few interventions involving both hard and soft methods. The reasons for combining methods were vague, such as “necessary”, or “appropriate”. The choice of methods again was vague but included reasons such as “familiar”. Munro and Mingers conclude that the choice depended to a significant extent on the particular experiences and competencies of the practitioners involved. Interestingly, the combinations tended to be ad hoc, often involving multi-disciplinary teams, and often choices evolved as projects progressed. There was no “framework” or “set of rules” being used to guide practitioners in their use of multi-methods, although practitioners felt the combined methods to be successful.

Midgley, in Mingers and Gill (1997), criticises the practitioners’ or “pragmatists” approach for being atheoretical, and argues that this means combined methods approaches have the potential for costly errors in the social domain. It is argued that it is important to understand why methods work or don’t work. It is also argued that without a theoretical language, it is difficult to pass on knowledge. Midgley is also concerned for long-term consequences and that what may appear to be successful in the short-term

may have long-term problems yet to be discovered, and these could be far worse than the original problems. Finally, Midgley is concerned that without understanding why combined methods work, practitioners applying ad-hoc approaches may be “lending support to authoritarian practices”.

What was clear from the review is that multiple methods are frequently used in practice. However there appears to be limited consistency about the way in which problem situations are appreciated and about the way in which systems methods are selected and combined. There was little evidence of theoretical underpinning to the combined methods being employed. According to Midgley, in Mingers and Gill (1997), “critical systems thinkers are concerned to develop methodological pluralism in a theoretically informed manner.” This leads on to further investigation to identify any existing theories associated with complex problem appreciation and multiple methods use, which may provide a formal basis upon which decisions about combining methods can be made.

### **Theoretical approaches to combining methods**

A number of proposed theoretical approaches have been identified which aim to support the selection and combination of systems thinking methods. These include:

- System of Systems Methodologies (Mingers and Gill 1997; Jackson 2000, 2003a);
- Total Systems Intervention (Jackson 2000, 2003a);
- Creative Design of Methods (Midgley in Mingers and Gill (1997));
- Critical Appreciation (Midgley cites Gregory in Mingers and Gill (1997));
- Critical Systems Heuristics (Ulrich et al. 2010);
- Systemic Intervention Midgley in Mingers and Gill (1997));

- Integrative Systems Methodology (Schwaninger 1997; Schwaninger 2004);
- Critical Systems Practice (Jackson 2003a; Jackson 2010);
- Multi-methodology (Mingers and Brocklesby 1997).

Whilst there is much written to describe and, in parts, critique these theories (some more so than others), little has been written about how these approaches are being applied in practice, and their relevance to practitioners. Clearly there is scope to investigate the ideas of the various authors in more detail, to evaluate the merits and limitations of what each proposes in relation to this inquiry, and this will be the next step.

Each of the approaches was examined further to establish their relevance to this inquiry and below (Table 1) is a tabular analysis of the examination. The table includes a brief description of each approach, the perspective from which each approach has been developed (in terms of the problems it presents as being significant), how the approach addresses its problem space and what questions it leaves unanswered. To the right of the table, comment is made as to whether the approach provides: a) a reliable means of understanding the complexity of the problem being addressed, or b) a reliable means of selecting the right type of methods and of combining them to provide the requisite coverage.

**Table 1: Examination of Critical Systems Thinking approaches**

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
The System of Systems Methodologies (SOSM)	Jackson and Keys in 1984	A matrix with system complexity and participants on the axes upon which systems methods are placed in order to understand their potential contribution and relevance to different problem situations	What methods are suitable for what?  Not intended as a “rule book” but as an “ideal” against which critical reflection of methodology choice can take place.	Appreciation of varieties of problem situation  Strengths and weaknesses of methods relative to problem situations  Relationships between systems methods in terms of placement relative to each other upon the matrix	Some systems methods can be applied flexibly to various problem situations, so don’t fit easily on the matrix.  Combining systems methods is not addressed, nor choice of parts of methods.  Single methods do not address the full complexity nor all of the stages of intervention  Generates a “paradigm incommensurability” problem due to the philosophy employed.	a) provides a perspective on problem contexts which depicts them in terms of the number of possible states and the participant landscape – this is a two-dimensional view and limits complexity to a simple scale of simple – complex, providing no further insight into situation system complexity. b) There is difficulty in positioning systems methods onto the matrix. It provides no guidance for combining methods. Its own paradigm incommensurability problem is unanswered.

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Total Systems Intervention (TSI)	Jackson and Flood in 1991	Meta-methodology with three phases, creativity, choice, implementation. Use of metaphor analysis to appreciate the problem situation. Methods chosen according to SOSM by mapping on the metaphors.	What is the type of problem being dealt with?  What methods are appropriate?  How to mix methods from different paradigms?	Appreciate problem situation in terms of metaphors.  Strengths and weaknesses of systems methods according to SOSM.  Select “dominant” methodology to use at various phases.	As above, but methods are “combined” by using one dominant and others supporting according to stage of intervention  Was much criticised for not addressing its own paradigm problem.  Much criticised for “freezing” methodologies to their original intended purposes and discouraging flexibility.  Criticised for limits to boundary judgements imposed by the matrix.	a) Relies on the SOSM grid as a means of understanding problem contexts, and therefore is limited in the dimensions considered. b) Does not facilitate using methods flexibly for unconventional purposes. The paradigm incommensurability problem remains unanswered. Combination of methods is limited to dominant and supporting, which may limit variety in the methodology due to the limits of the single dominant method chosen.

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Creative Design of Methods	Midgley in 1990	Problem situation expressed as a series of systemically interrelated research questions, each potentially needing a different method or part method to address. Questions may evolve. Synthesis is generated through answering the “system of questions”	Most research problems are complex enough to warrant multiple methods.  What is the problem boundary?  Which methods help answer which questions?  How to handle “paradigm incommensurability”?	Appreciation of the problem boundary through use of CSH  Critical Systems Thinking is a new paradigm not a meta-paradigm, so paradigm incommensurability is not a problem.	Does not offer a guide to mapping systems methods to the various questions being asked – how do you know you’ve picked the best one for the job?  How to ask the right questions.	a) Allows for an understanding of the problem boundary, but not necessarily to appreciate the complexity of the problem situation. b) System of questions provides the flexibility for matching the research/analysis to the problem effectively – however, provides limited guidance on the questions which should be asked – this requires some insight into the complexity, and therefore the dimensions which the questions should be considering. Provides no reliable means of mapping methods to answer the questions – likely that people will stick to the methods they are familiar with, whether they can best answer the questions or not, and regardless of the multiple dimensions of the problem as these are not identified.

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Critical Appreciation	Gregory in 1992	Aimed at research and interventions. People should develop constellations of methods appropriate to the situation provided all four dimensions (experiment and observation, two-way comms with others, revealing one's own assumptions, and revealing assumptions at the level of society) are addressed in every research.	<p>What dimensions of the problem should be considered?</p> <p>Making sure methods chosen cover all necessary dimensions.</p> <p>Appreciating the paradigms associated with the methods</p>	<p>Theoretical basis for the four dimensions.</p> <p>Critical appreciation of the problem.</p> <p>Recommends critical awareness of what the methods can deliver in each dimension.</p> <p>Paradigms are individual and not fully knowable by others and therefore incommensurability is not a problem needing to be addressed, rather appreciation is required of the paradigms.</p>	<p>Guidance on which method fits which dimension is not provided.</p> <p>How methods are combined together is not answered.</p>	<p>a) Provides four dimensions with theoretical basis, but these appear to be related to the process of research (analysis) rather than of appreciating the complexity of the problem itself. The dimensions do not define a systemic problem context but a systemic intervention.</p> <p>b) Provides guidance on appreciating the methods being used, this avoids any paradigm incommensurability issue, but not how to fit methods to dimensions nor how to combine them.</p>

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Critical Systems Heuristics (CSH)	Ulrich in 1983	An approach for boundary judgement identification and debate based upon heuristic. Aims to inform critical practice, regardless of methodology used. Process of boundary critique based on a set of questions.	What assumptions are made about a problem context?  What assumptions are made about what any selected methods can do/tell us?	Provides a means of surfacing boundary judgements and helps to focus on a problem context and disclose the limitations of the view being taken.	It is not a self-contained approach – it is designed to support other approaches to problem structuring and problem solving.	a) Is a heuristic for boundary critique, which enables appreciation of the problem space from where to draw the boundary, but this then leaves a level of complexity which needs to be appreciated more fully. b) Offers no methodology beyond boundary critique to help creatively address the problem i.e. select methods. Is more useful for incorporating into some meta-methodology for a mixed methods approach. This is not a mixed-methods methodology or meta-methodology.



Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Systemic Intervention	Midgley in 1997 (in Mingers and Gill) building on Critical Appreciation	<p>A methodology for critical and systemic research.</p> <p>A cycle of Critique, Judgement and Action involving critical boundary judgement, system of research questions and related systems methods to answer them, and the actions taken as a result of the judgements made.</p>	<p>What is the problem situation? What is included and who's perspectives should be considered?</p> <p>What questions do we need to ask of this situation?</p> <p>What methods can help answer those questions?</p> <p>Do different original paradigms matter?</p>	<p>Proposes boundary critique as a means of appreciating the problem situation.</p> <p>Proposes critical awareness of the strengths and limitations of systems methods is required in the methodology in order to import ideas.</p> <p>Paradigm problem is made irrelevant by the position that everyone has their own perspective and we cannot fully understand others' perspectives but import their ideas into our own, as per Gregory above.</p>	<p>Does not offer a method for boundary critique.</p> <p>A framework for developing a system of research questions is not included.</p> <p>No guidance is included on which methods are suitable to answer which questions, and so selection remains problematic.</p>	<p>a) allows flexibility in boundary critique in that no method for this is prescribed. Does not guide the development of the system of research questions – how to know the right questions have been asked relative to the problem?</p> <p>b) Does not provide guidance on method selection but allows flexibility through the notion that we are able to import ideas from others into our own paradigm.</p>

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Integrative Systems Methodology	Schwaninger	<p>Heuristic for achieving requisite variety.</p> <p>Different methodologies are synthesised to overcome limitations of each.</p> <p>The use of System Dynamics and Viable Systems Model</p>	<p>How can requisite variety be achieved to match the complexity of a problem situation?</p> <p>How to take sufficient care of the context in which the problem situation has arisen and in which any solution is to be embedded?</p> <p>How to take sufficient care of the content of the problem?</p> <p>How to synthesise different methodologies to overcome individual limitations.</p>	<p>Objectivist and subjectivist perspectives are both included.</p> <p>Proposes the use of VSM and SD in combination.</p>	<p>Other systems methods are not included, and therefore it is not a generic framework but a prescriptive approach to be applied, regardless of the situation being addressed.</p> <p>Does not answer the question of how to synthesise other methodologies.</p>	<p>a) Does not offer a means of understanding the complexity of a situation – it makes this assumption for you by proposing two dimensions – content and context.</p> <p>b) Is an unconvincing framework which only combines SD and VSM. It does not offer much flexibility, and so cannot fulfil its own aim of achieving requisite variety.</p>

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Critical Systems Practice (CSP)	Jackson in 2000 building on TSI and SOSM	Meta-methodology to ensure 4 social theory-based paradigms (functionalist, interpretive, emancipatory and postmodern) all receive full attention. Uses a set of 4 generic methodologies within which methods may be used in combination. 4-stage approach (creativity, choice, implementation, reflection) designed to support an intervention.	How to respond to paradigm incommensurability?  How to take a holistic approach?  What are the stages of an intervention?  How to identify significant concerns, issues and problems in the problem context?  How to select methods?  How to mix methods?  How to combine methods from different paradigms?	Paradigm incommensurability is addressed by recommending 4 paradigms which must each be considered and used to critique each other. 4 generic methodologies are applied to each of 4 prescribed stages of intervention. Systems methods are selected on the basis of their fit to a paradigm and stage, which is established through a critical analysis of each systems method (similar to SOSM).	Allows for a dominant paradigm – this could be considered a pragmatist view, which undermines the theoretical underpinning which proposes only 4 ideal-type paradigms.  Paradigms remain incommensurable – hence 4 paradigms must be used, but how can an individual work in 4 paradigms? Individuals have only one mind.	a) Provides a means of considering a problem situation. But, it does not provide a means of appreciating the complexity of the problem situation critically and selecting requisite variety in a combination of methods. Complexity is limited to 4 fixed paradigms, each with distinct aims (i.e. variety). Appreciation will only ever be in terms of achievement of those aims. b) The approach fixes methods to paradigms which does not allow for methods to be used for alternative aims. Generic methodologies are constructed based on what existing methods are designed to do. They draw together and reinforce assumptions about intervention aims. The method is aimed specifically at intervention projects, making it difficult to apply to research projects. Whilst reflection is promoted, it does not encourage critique and challenge of its fundamental assumptions – the 4 paradigms. This is ok if users subscribe to the “paradigm incommensurability” perspective – but this is not the only way of thinking.

Approach	Author(s)	Outline	What problems are identified which need to be fixed?	What problems the approach claims to fix	What problem the approach leaves open to be fixed	Relevance to the questions? (merits and limitations) a) reliable means of understanding the complexity of the problem b) reliable means of selecting the right type of methods and of combining them
Multi-methodology	Mingers	Meta-methodology to ensure 3 worlds of knowledge are addressed (material, personal and social). Uses a matrix of worlds and stages of intervention to help define the problem space. Methodology decomposition and matrix mapping is used to identify, select and combine relevant methodologies, tools and techniques.	<p>How to deal with the richness of the real world?</p> <p>How to combine methods in whole or part or from different paradigms?</p> <p>How to overcome paradigm incommensurability?</p> <p>How to fit methods together?</p> <p>What about the range of skills and knowledge required by practitioners to use many methods?</p>	<p>Takes a multiple perspective approach to deal with richness, and uses a matrix to analyse.</p> <p>Uses methodology decomposition to understand the components of systems methods and mixes and matches them across the various stages/dimensions in the matrix.</p> <p>3 worlds need to be considered and these relate to knowledge rather than social theory paradigms, so can accommodate paradigms.</p> <p>Helps organise and frame what needs to be known/what tools to be used.</p>	<p>How to fit methods together may still be problematic – are they compatible in practice? Limited evidence of application of ideas available.</p> <p>Still requires of practitioners extensive and diverse knowledge and expertise across many methods.</p>	<p>a) Provides a means of considering the complexity of the problem situation but only according to the 3 worlds; however it enables critical appreciation within each world.</p> <p>b) Methodology decomposition provides a means of understanding, comparing and combining systems methods, although little evidence is available that this works.</p> <p>Matrix provides a converter between the complexity of the problem and the requisite variety in the combined methods approach developed.</p> <p>But, the 3 worlds is not the only way of looking at a situation – not the only way of thinking.</p>

## Summary of Literature Review

There was evidence in the literature to show that the practice of combining systems methods is common, although there is limited theoretical support for what happens in practice, demonstrated by the inconsistencies in the approaches described. Theory to back up the use of combined methods has been called for and a variety of proposed approaches for combining systems methods exist in the literature.

Closer inspection of these approaches in relation to their suitability for this inquiry revealed many limitations: SOSM provided some support for appreciating problem situation complexity but no support for combination of methods; TSI relies upon SOSM as the means of understanding the problem situation, but lacks flexibility in the proposed uses for systems methods. It was early work, and has since been superseded by CSP; Creative Design of Methods is limited in its support for problem situation complexity appreciation and limited in support for selection of systems methods; Critical Appreciation is limited in its support for problem situation appreciation in terms of complexity and whilst it offers some support for systems methods appreciation, offers no support for method selection and combination; CSH provides limited support for complexity appreciation but no method for the selection and combination of methods; Systemic Intervention, as with others, offers limited support for complexity appreciation and no support for method selection and combination; Integrative Systems Methodology is a prescriptive approach to the combination of SD and VSM and offers no support to the selection and combination of other methods; CSP, however, offers support for complexity appreciation through a multi-dimensional approach, and offers some support for the selection and combination of methods. It appears limited in the

flexibility offered for the use of systems methods, the dimensions proposed have been challenged by other authors and it offers no support for the combination of parts of methods; Multi-methodology provides support for appreciation of problem situation complexity through multiple dimensions, it provides some support for method selection and combination, however the dimensions used (the three worlds) have received criticism from other authors.

Most apparent with the approaches was the differences in theoretical background offered up by the various authors. Ideas are drawn from diverse sources and disciplines, and the emphasis placed by the authors upon the various systems and critical systems thinking ideas varies. None appear to have a widely published track-record of application, and this would suggest that the various theories are yet to be fully validated and methods established in practice.

Some of the approaches are more easily understood than others. Those which appear more relevant are those where ideas have been operationalised beyond theory into methodology and which may be applied and repeated by practitioners. The two approaches which appear to come closest to providing the framework being sought are Critical Systems Practice (Jackson) and Multi-methodology (Mingers). Each has its merits but both have limitations. As yet, no single theoretical framework has emerged as being strongest or most widely accepted and adopted.

*“Combining multiple methodologies works in practice, but not yet in theory.”*

(Zhu 2011)

It makes sense at this point to enquire about and consider the two approaches further in order to determine if they offer any insight into the best way to appreciate complex problems or combine systems methods. In the next section, the two approaches, Critical Systems Practice and Multi-Methodology are analysed further.

## 4. Analysis

In the previous section, Critical Systems Practice (CSP) and Multi-Methodology (M-M) were highlighted in the review. This chapter compares these two main approaches to selecting and combining multiple systems methods, and uses the CuReSS project as an example to see how M-M works in practice.

### Comparison between Critical Systems Practice and Multi-methodology

The two approaches of CSP and M-M were compared to identify the similarities and differences between them.

**Table 2: Comparing the “perspectives” within the meta-methodologies:**

	M-M		CSP	
<b>Theoretical origins</b>	Habermas Searle		Burrell & Morgan Alvesson & Deetz	
<b>Perspectives</b>	Material world	Objectivity We observe	Functionalist	‘improving goal-seeking and viability’
	Personal world	Subjectivity We experience	Interpretive	‘exploring purposes’
	Social world	Intersubjectivity We participate in	Emancipatory	‘ensuring fairness’
			Postmodern	‘promoting diversity’

Both approaches use a given number of “perspectives” which must be considered in order to be holistic. The literature review uncovered that taking a number of different



perspectives on a situation is a valid approach to understanding complexity. The question remains, however, about what these “perspectives” should be.

CSP is based on the critical systems thinking tradition, which has its roots in the systems thinking discipline. However, the foundation upon which pluralism is proposed by Jackson comes from the social theory domain; specifically, Burrell and Morgan’s 1979 framework and Habermas’ epistemological theories on knowledge (Mingers and Gill 1997; Jackson 2010). This theoretical position has been brought into question elsewhere in the literature. For example, Mingers and Brocklesby (1997) cite a range of works where there have been “strong attacks on the paradigm incommensurability advocated by Burrell and Morgan”.

The CSP approach outlines the need to “appreciate the complexity and heterogeneity of problem situations” (Jackson 2010), and recommends that radically different views of the world must be brought to bear, as derived from alternative paradigms.

Jackson prescribes a finite set of four paradigms: functionalist, interpretive, emancipatory and postmodern. How the appreciation should be done is not clear but there is a suggestion that appropriate metaphors or creativity enhancing devices be used. A set of “generic methodologies” are provided which apparently “represent each of the four paradigms”.

CSP recommends a choice is made of suitable systems methodologies and methods to address the problem situation. It is suggested that this would entail “a review of the strengths and weaknesses of the different methodologies and methods, conducted using paradigm analysis, metaphor analysis, past experience, etc.” The frameworks offered in the

meta-methodology to assist with this are the “generic methodologies” and “the System of Systems Methodologies” (SOSM) which was developed within the original TSI. SOSM has been criticised by other authors (Midgley, Mingers, Gregory) as being prescriptive and rigid, and of restricting the use of methods outside of their original areas of application.

There is little evidence in the literature to demonstrate the practicality of CSP, or the validation of the ideas put forward. Jackson attempts to defend the meta-methodology by rooting it upon paradigms from social theory. The relevance of these paradigms to systems thinking can be questioned, and alternative perspectives exist, specifically the use of three “dimensions” by Mingers and Brocklesby in their Multi-Methodology approach (1997), and the use of four dimensions by Gregory (Mingers and Gill 1997) in her Critical Appreciation approach. Zhu (2011) criticises the use of the four paradigms by stating that the 1960s views of Khun (the originator of the paradigm theory) have ceased to be a useful device and can be discounted, saying, “Paradigm is a man-made instrument, not a god- or nature-given metaphysical fixture.” Zhu also states that Burrell and Morgan’s conceptualisation of paradigms ignores Khun’s later account that paradigms are only partly incommensurable, and that there is overlap. “...mixing-methodology is theoretically justifiable because paradigms are incommensurate only to a degree.”

Mingers and Brocklesby’s “Multi-Methodology” approach is offered as a “framework for mixing methodologies” (Mingers and Brocklesby 1997; Mingers and Gill 1997)

The principles of M-M’s pluralism come, like Jackson’s CSP, from the critical systems tradition, however the “dimensions” or different perspectives prescribed by the framework are based upon the works of Habermas and Searle (Mingers and Brocklesby 1997). The

prescription is less rigid than CSP, in that, rather than proposing a finite set of paradigms that exist, M-M proposes that different dimensions should be considered and suggests that “it is useful to distinguish three worlds...” and “The distinction is... purely analytic. Real world situations of human activity will involve all three.” The dimensions which we are encouraged to consider are formed from distinctions between conceptual “worlds”. The relevance of these “worlds” to every complex situation is not clear. Alternative dimensions are proposed elsewhere.

M-M proposes that, in order to be comprehensive or holistic, an approach should consider all three “worlds” and all four phases of an intervention. The recommended means of understanding a problem situation is by mapping it against a matrix of “worlds” and “phases”, however, this mapping could be subjective. Supposedly if all dimensions should be considered, in order to be holistic, the matrix in its entirety would be applicable every time. There remains a degree of subjectivity as to what parts of the matrix might be relevant to any given situation.

The framework proposes that systems methods can be mapped against the worlds and phases of the matrix, to identify which area of intervention each systems method could be applied in. There is, however, no guidance about the mapping of methods, and how to identify which region of the matrix any given systems method might fit against. The example mappings provided in the literature (Mingers and Brocklesby 1997; Mingers and Gill 1997) appear to be subjective, and therefore it is difficult to support this idea.

There is little evidence in the literature to demonstrate the practicality of M-M, or the validation of the ideas put forward. Mingers and Brocklesby attempt to defend the meta-

methodology by rooting it upon Habermas' three "worlds", however Jackson and Zhu both claim that this theoretical position can be brought into question (Jackson 2003b, 2011; Zhu 2011). The relevance of these worlds to systems thinking can be questioned as there is no evidence to show that every complex systems situation may be able to be conceptualised in this way. Alternative perspectives on dimensions exist, specifically the use of four "paradigms" by Jackson in his CSP approach (Jackson 2000), the proposal of four "windows" by Flood (1999) and the proposal of four different "dimensions" by Gregory in her Critical Appreciation approach (Mingers and Gill 1997). There is much debate about paradigm-incommensurability: Eden et al (2009) and Pidd (2004), which calls into question the validity of mixing methods from different paradigms. However, as before, Zhu (2011) criticises the argument of paradigm incommensurability entirely.

**Table 3: Comparing the “phases” of the meta-methodologies:**

		Task	Tools	Outcome
Phase 1				
	CSP “Creativity”	To highlight significant concerns, issues and problems	Creativity-enhancing devices employed to ensure that the perspectives of the four paradigms receive proper attention	Dominant and dependent concerns, issues and problems
	M-M	Consider problematic situation	Three worlds, four phases of an intervention (Appreciation, Analysis, Assessment, Action), questionnaire	Matrix appreciation of the problem situation
Phase 2				
	CSP “Choice”	To choose an appropriate generic systems methodology or methodologies and a variety of suitable methods, models and techniques	Methods for revealing the strengths and weaknesses of methodologies, methods, tools and techniques, including paradigm analysis, previous experience, etc.	Dominant and dependent generic systems methodologies and appropriate methods, etc chosen for use
	M-M	To choose and combine suitable systems methods, tools and techniques	Methodology decomposition, matrix mapping	Multi-methodology design of suitable methods, tools and techniques mapped to problem situation

Phase 3				
	CSP “Implementation”	To arrive at and implement specific positive change proposals	Generic systems methodologies and appropriate methods, etc. Employed according to the logic of CSP	Highly relevant and co-ordinated change, which secures significant improvement in the problem situation according to the concerns of the different paradigms
	M-M	To arrive at and implement specific positive change proposals	The multi-methodology approach designed in phase 2	Highly relevant and co-ordinated change, which secures significant improvement in the problem situation according to the concerns of the relevant worlds and phases of intervention
Phase 4				
	CSP “Reflection”	To produce learning about the problem situation, the meta-methodology itself, the generic systems methodologies and the methods, etc. used	Clear understanding of the current state of knowledge about these	Research findings that, for example, feed back into improving earlier stages of the meta-methodology
	Multi-methodology	N/A	N/A	N/A

Both approaches outline a number of distinct phases of the meta-methodology. The first three phases are remarkably similar; however CSP offers a fourth phase of “reflection” for the purpose of learning and developing the meta-methodology further through practice. This need to reflect is true to the tradition of critical systems thinking, however, it could also indicate the incompleteness or un-validated nature of the CSP meta-methodology, such that it needs to be developed in practice.

### **Case Study: Multi-Methodology for thinking about Resilience in CuReSS**

The M-M approach was tried out within the CuReSS project as a means of designing a bespoke multiple-methods approach for developing a blueprint for organisational resilience. The aim of this exploratory case study was to determine if the multi-method approach could help guide the development of the research method and if it was a useful and possibly “assured” or “with-confidence” way of organising thinking about the situation.

The steps of the meta-methodology were followed:

1. Context appreciation
2. Identify relevant phases and dimensions
3. Analyse potential of methods available
4. Map methods to problem according to potential
5. Select methodology(ies) most relevant
6. Fill gaps with methods, techniques and tools from other systems methods
7. Describe resulting multi-methodology design, demonstrating how it addresses the phase-dimensions of the project

M-M guides the user to consider the context of the project from three perspectives. A questionnaire, adapted from Mingers and Gill (1997) was used to guide this thinking (Table 4). In the context of the CuReSS problem situation: the domain of interest was the human body, interconnected networks of enterprises, and communities; the range of available theories and methods available to us were those from the domain of systems thinking; and the constraints were our own understanding and experience as agents in the project. Our focus was on concepts of resilience and how resilience might be improved.

**Table 4: Questionnaire to guide thinking about context**

What is the project team's level of critical awareness/understanding of potential methods?	Reasonable critical awareness of SSM, and SD. Less so with VSM. Much less with other methods.
What is our experience and skill in using them?	Skilled in use of SSM and SD.
To what extent can we work in varied paradigms?	Preference for soft methods, able to work with hard methods.
What might we be able to use in this situation?	SSM Wilson, SSM Checkland, SD, VSM, Dependency analysis, cognitive mapping, critical systems heuristics
What methods might be relevant to this situation?	Need to find out
What has initiated this project?	Need for more resilient organisations and communities. Research.
What, if any, is the history of interactions in regard to this situation?	Lit review reveals government and national infrastructure papers relevant to resilience, but no blueprint or guidance that organisations and communities are able to make use of was discovered.
Who do we see as clients/victims/problem owners?	Organisations and communities
What resources and powers do we have?	Project team. Able to make recommendations, provided justified. No direct powers with organisations and communities.
What methods are we experienced in that may be useful?	SSM, SD



What might we have to learn?	VSM, dependency analysis, cognitive mapping, critical systems heuristics
What is the culture of the situation with regards to methods?	This situation is not widely published
What is the history of past methods use?	Have used SSM Wilson Root Definitions and Enterprise Model to develop definition of resilience
What methods are likely to be useful in this situation, given the particular tasks or concerns initiating the intervention? E.g. Is the task technical or strategic, well-defined or messy, uncontentious or political?	Not well defined. Potentially contentious.
To what extent are the values embedded in the methods appropriate to the situation?	Need to find out
Does the project team's history with this situation suggest particular methods?	SSM, SD, VSM

The questionnaire reveals the project team's preference for soft methods, and experience in SSM and SD. The team has knowledge of a range of other methods, to greater or lesser degree. There may be a need to learn about other methods. A need to understand the relevance of methods to the situation and what values embedded in those methods might be appropriate is also revealed.

The project was analysed in terms of the prescribed phases and dimensions of the M-M matrix in order to determine its requirements for systems methods. This resulted in the matrix shown in Table 5.

The matrix provided the framework from which to think about the project. In trying to decide what was relevant, each part of the matrix was examined. There was an initial need to uncover what was meant by "resilience". This could be a personal world consideration as there are many viewpoints on what resilience as a concept might be and

how it may be manifest in reality (Wright et al. 2012). In other words, people have their own individual beliefs and definitions of resilience. The project requires a method for appreciating the different viewpoints and bringing them together in order to capture a meaningful definition of resilience from which the project may proceed. This led to the identification of project requirements in the personal world across all four phases.

The premise of the project was that knowledge about how the human body is resilient could give insight into how communities and organisations might be resilient. Knowledge of the human body resides in the material world and therefore the project requires methods to help appreciate, analyse and assess the material world of the human body. This includes appreciating the physical structures, arrangements and processes, together with underlying causal relationships. This knowledge needs to be assessed and an understanding of what it means for resilience developed.

Finally, in order to translate our knowledge of resilience in the human body into knowledge about resilience in social organisations and phenomena such as communities and enterprises, an assessment of the social world is required together with a means of translating the knowledge across from one domain to another, presenting it in terms of ways of changing or improving practices and culture.

**Table 5: The CuReSS project requirements as per M-M matrix**

	<b>Appreciation of</b>	<b>Analysis of</b>	<b>Assessment of</b>	<b>Action to</b>
<b>Social World</b>			Ways of changing existing practices and culture	
<b>Personal World</b>	Individual beliefs, meanings, values and emotions	Differing world-views and personal rationalities	Alternative conceptualisations and constructions	Generate understanding, personal learning and accommodation of views
<b>Material World</b>	Material and physical processes and arrangements	Underlying causal structures	Alternative physical and structural arrangements	

The potential to address these requirements was analysed across a range of systems methods. The selection of which methods to analyse proved to be subjective, and based on best guesses from members of the team. The reason for this is that there is no definitive reference guide of decomposed and matrix-mapped methods available. In order to be comprehensive, it would be necessary to analyse all systems methods to ensure that due consideration has been given to each. However, with so many methods available across the domain of systems thinking, this would not be feasible within the timeframe of the project, and is not practical. A decision was made to focus on the methods which team members knew best, and to use the problem situation matrix to guide research into possible alternatives which the group might be less familiar with, but should learn about and consider.

The systems methods identified as being well known to the group were:

“Checkland” Soft Systems Methodology (Checkland and Scholes 1990; Checkland 1995; Tsouvalis and Checkland 1996; Mingers and Brocklesby 1997; Pidd 2009);

“Wilson” Soft Systems Methodology (Wilson 1984; Checkland and Scholes 1990; Mingers and Brocklesby 1997; Wilson 2001);

Viable Systems Model (Beer 1979, 1981, 1984, 1985; Espejo 1987; Mingers and Brocklesby 1997; Jackson 2003a; Pickering 2004; Yolles 2004)

System Dynamics (Coyle 1977; Senge et al. 1994; Barlas 1996; Sterman 2000; Jackson 2003a; Schwaninger and Grösser 2008; Pidd 2009)

In order to understand them better in the context of the M-M, each method was subsequently analysed according to M-M methods decomposition technique. (See figures 2, 3, 4, and 5 respectively).

Attempts were made to translate the decomposition models into the M-M matrix so that they could be mapped against the project matrix and assessed for suitability. This proved to be somewhat problematic, and examples are given below.

### **Soft Systems Methodology (SSM) (Figures 2 & 3)**

SSM is a useful approach to problem structuring and is good for bringing together different viewpoints of a problem situation so that some kind of consensus or agreement can be reached. This methodology was potentially relevant to the project, so SSM was chosen for decomposition and assessment against the project requirements.

There are two main types of SSM, so both Checkland's and Wilson's approaches were examined. Both strands of SSM derive from the same philosophical principles and have the same methodological stages, however as the two approaches have diverged historically, different practical techniques and tools have been developed to support each.

This is an interesting insight in comparing the two approaches. Using the methodology decomposition diagram, the similarities and differences between the approaches became clearer. Wilson has developed SSM for practical application and as a result, a greater range of tools are available to assist the thinking at the various stages, depending on the context of application.

It was not clear, however, from undertaking the methodology decomposition, exactly how the SSM methodology could be used and which specific tools and techniques would be most useful. It was more the case that, as the project progressed, questions emerged that required techniques to help the analysis and deliver the answers. It was more of an exploration in the use of the methodology, applying various tools or techniques which were identified by examining the gaps in the methodology as they arose and referring to the decomposition diagrams to identify "fillers".

SSM was mapped onto the matrix. (Table 6) Example mappings for SSM were available in the literature, but without full rationale to support the choices made. The mapping of methods against the M-M matrix can be brought into question as there is no guidance as to how this should be done. It was felt that there was some degree of subjectivity in the

mapping. How should the methodological stages be mapped against the phases in the matrix, for example?

The chosen mapping for SSM was overlaid against the project requirements matrix and the coverage examined. Whilst SSM allowed for thinking about the personal world perspectives of resilience, it provided very little to support the material world perspective required to examine resilience in the human body, nor to support the translation of that knowledge into the social domain. Additional methods would clearly be required to fulfil the project requirements. This finding helps to demonstrate that the use of multiple methods is relevant to multi-disciplinary research.

## Other Methods

Other systems methods analysed in this way were Beer's Viable Systems Model (Figure 4) (Table 8) and System Dynamics (Figure 5) (Table 7).

Systems Dynamics (SD) was chosen at this stage because it is able to provide support for thinking about the material world, in particular for identifying the underlying causal relationships and structures in systems, and was relevant to the inquiry of the human body. However, SD alone was too generic a method to guide exploration into resilience. A tool to help identify resilience characteristics and events was needed.

Viable Systems Model was not chosen at this stage, following much debate. Whilst the method can be useful in both material and social dimensions, it is not necessarily useful for translating knowledge from one dimension to another. According to the M-M analysis of the method, having already found SD to be useful, VSM was not essential in order to complete the picture against our project requirements. VSM appeared at this

stage to offer an alternative approach to SD rather than a complementary one and so it was not selected as part of the mix. What is notable is that during the project, it became apparent from the preliminary findings from the human body that control and decision-making arrangements are important to resilience, and this aspect of the system could perhaps be better understood by using VSM for analysis. This demonstrates the problematic nature of this matrix-mapping approach when designing a project methodology. The mapping is subjective, but also the matrix definitions did not promote the team to think about the wider potential of the VSM in our project context. This was discovered as the project unfolded, rather than being predictable at the outset.

Once all the methods necessary to cover the full range of project requirements had been selected, a matrix was completed showing how they would work together in an overall multi-methodology design. (Table 11).

Figure 2: Checkland SSM

Methodology Decomposition: Checkland SSM

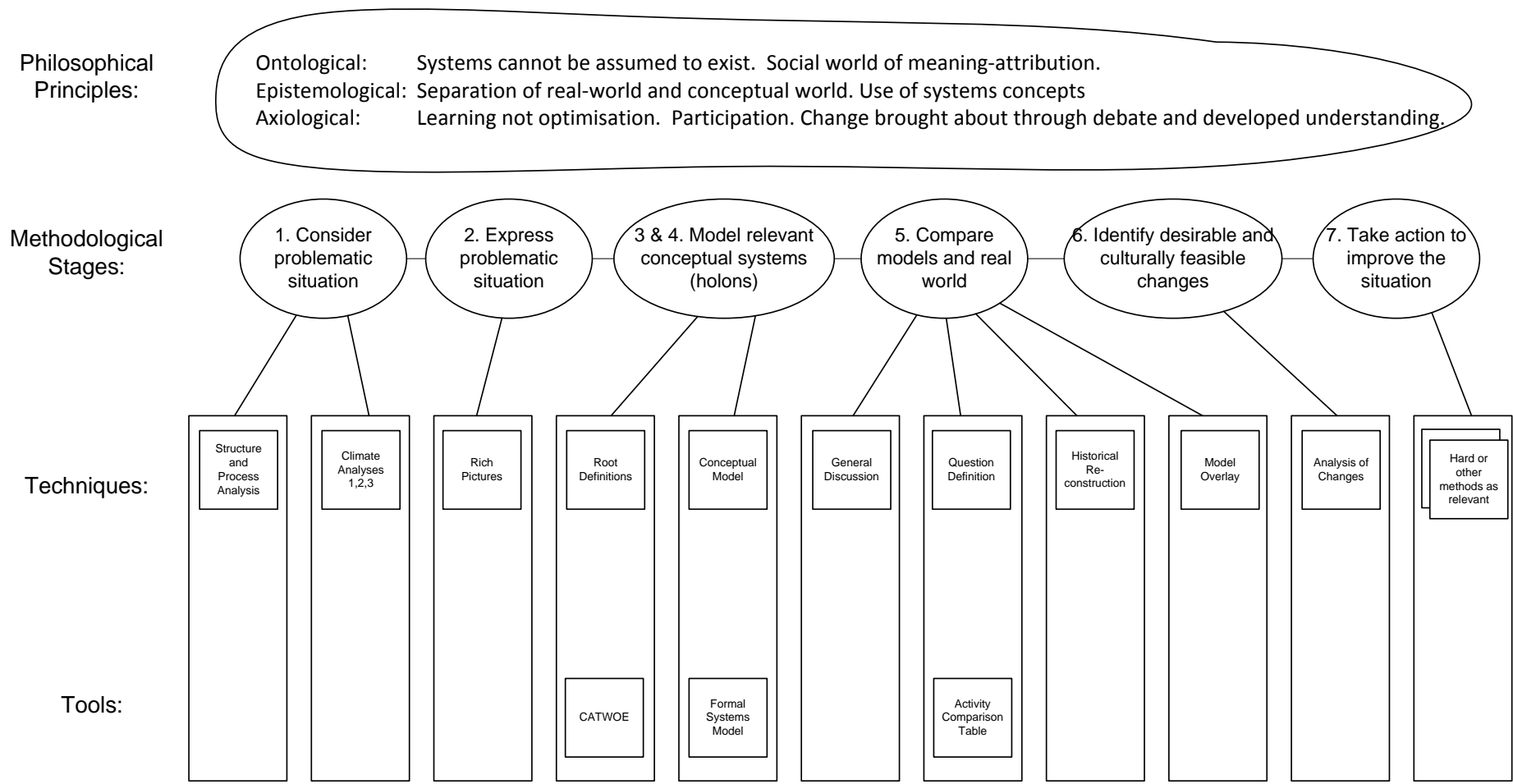




Figure 3: Wilson SSM

Methodology Decomposition: Wilson SSM

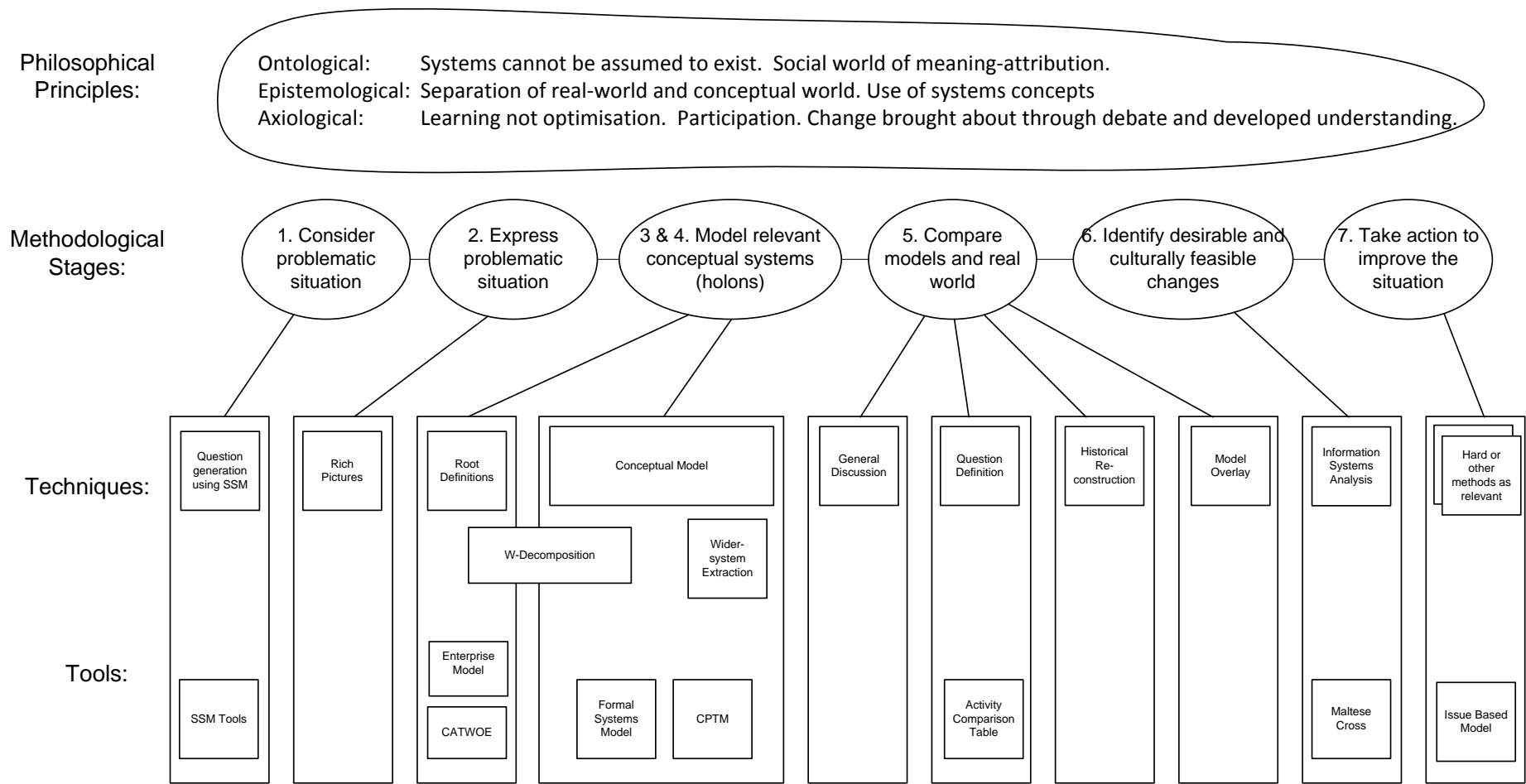


Figure 4: Viable Systems Model

Methodology Decomposition: Beer Viable Systems Model (VSM)

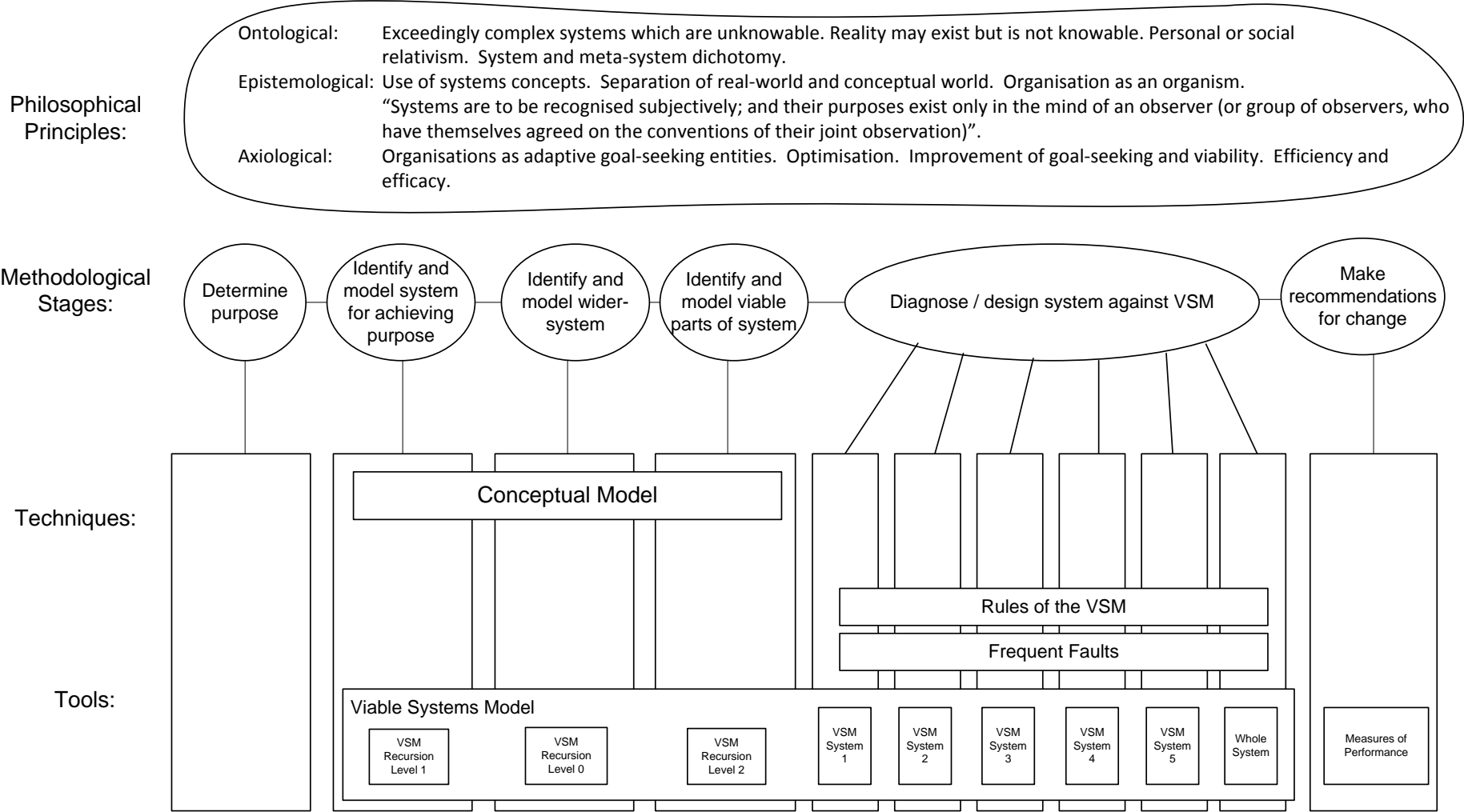
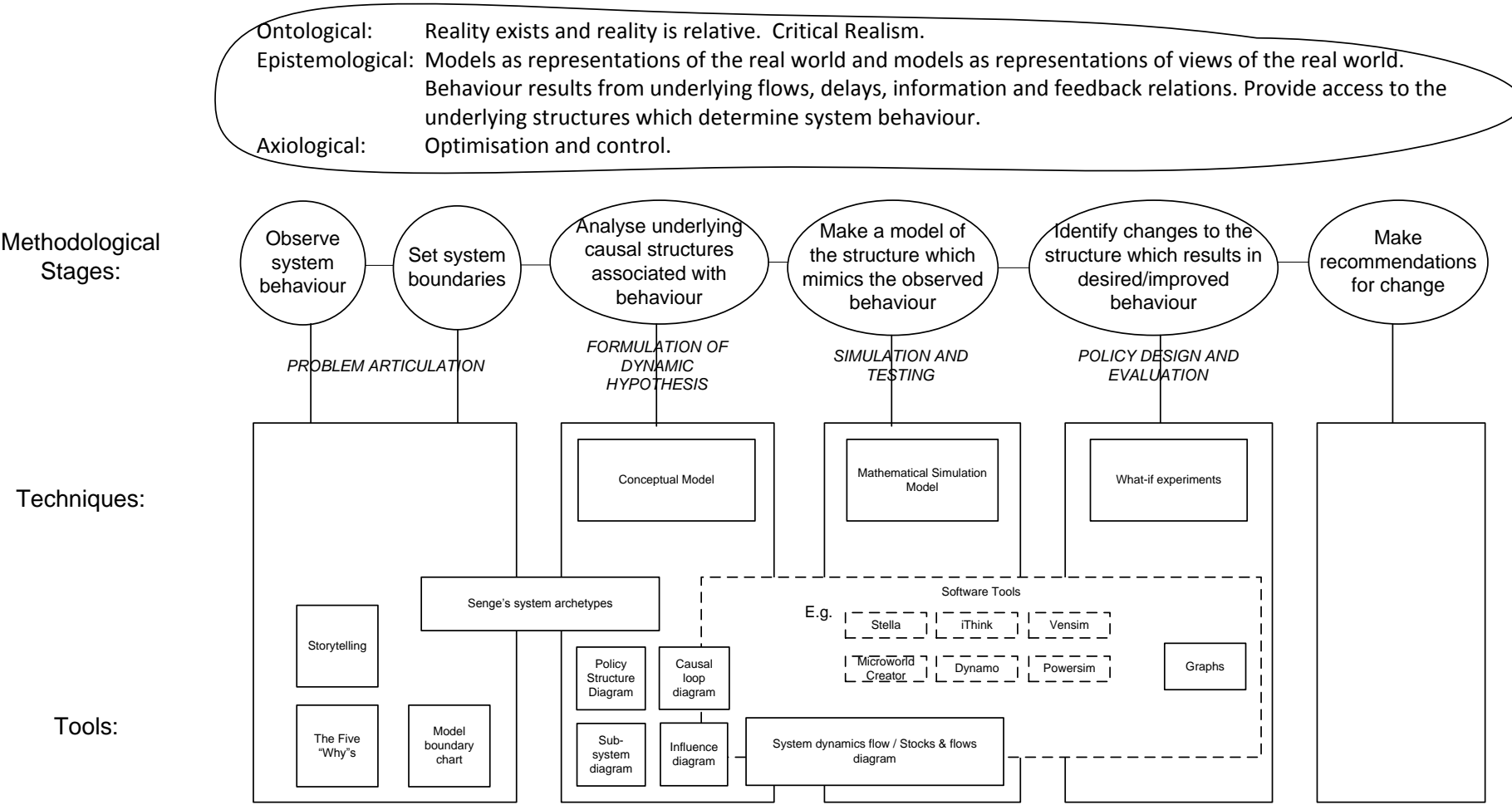


Figure 5: System Dynamics

## Methodology Decomposition: System Dynamics



**Table 6: SSM mapping to matrix:**

	<b>Appreciation of</b>	<b>Analysis of</b>	<b>Assessment of</b>	<b>Action to</b>
<b>Social World</b>	Roles, norms, social practices, culture and power relations			
<b>Personal World</b>	Individual beliefs, meanings, values and emotions	Differing world-views and personal rationalities	Alternative conceptualisations and constructions	Generate understanding, personal learning and accommodation of views
<b>Material World</b>	Material and physical processes and arrangements			

**Table 7: System Dynamics mapping to matrix**

	<b>Appreciation of</b>	<b>Analysis of</b>	<b>Assessment of</b>	<b>Action to</b>
<b>Social World</b>				
<b>Personal World</b>				
<b>Material World</b>		Underlying causal structures	Alternative physical and structural arrangements	Select and implement best alternatives

**Table 8: Viable Systems Model mapping to matrix**

	<b>Appreciation of</b>	<b>Analysis of</b>	<b>Assessment of</b>	<b>Action to</b>
<b>Social World</b>		Distortions, conflicts, interests	Ways of altering existing structures	Generate empowerment and enlightenment
<b>Personal World</b>				
<b>Material World</b>		Underlying causal structures	Alternative physical and structural arrangements	Select and implement best alternatives

**Table 9: Five Stages of Resilience**

	<b>Appreciation of</b>	<b>Analysis of</b>	<b>Assessment of</b>	<b>Action to</b>
<b>Social World</b>	Roles, norms, social practices, culture and power relations			
<b>Personal World</b>				
<b>Material World</b>	Material and physical processes and arrangements			

**Table 10: Peppard & Ward Model mapping against matrix**

	Appreciation of	Analysis of	Assessment of	Action to
<b>Social World</b>			Ways of altering existing structures	
<b>Personal World</b>				
<b>Material World</b>			Alternative physical and structural arrangements	

**Table 11: Final CuReSS Multi-Methodology Design**

	Appreciation of	Analysis of	Assessment of	Action to
<b>Social World</b>			Peppard & Ward Model	
<b>Personal World</b>	SSM	SSM	SSM	SSM
<b>Material World</b>	5-Stages of Resilience	System Dynamics	System Dynamics Peppard & Ward Model	

## Evaluation of CuReSS M-M Approach

In practice, the development of the multi-methodology design was not a linear process, but iteration around analysing candidate systems methodologies, mapping their potential against the project requirements, selecting the best fit, then assessing the remaining gaps before going round the cycle again until all requirements had been covered. The gaps were not necessarily apparent at multi-methodology design stage, but emerged as issues were confronted and new questions surfaced as a result. This calls into question the usefulness of the meta-methodology as a means of designing a combined systems thinking methodology “up-front”.

A difficulty encountered in taking the M-M approach was in trying to ascertain how the various methods, techniques and tools could be “slotted-in” or “attached” to the multi-methodology being developed. It was not clear how the interfaces between the parts of the multi-methodology were to be made. Should the output of one method form the input to another method? How does the knowledge transition across the divides in the matrix if the requirements of the matrix are fulfilled by separate methods? These questions remained to a large degree unanswered by M-M.

## Analysis Summary

It is possible to pick out some themes or similarities across the two identified approaches (Jackson’s Critical Systems Practice (CSP) and Mingers and Brocklesby’s Multi-Methodology (M-M)). Both are attempts at developing formal meta-methodology which may provide a framework within which to apply mixtures of systems methods. Comparisons can be made between the proposed stages of the methodologies, the emphasis on using sets of multiple perspectives (albeit different ones), the use of types

of multi-dimensional matrix analysis for the purpose of mapping methods to situations, and approaches towards the evaluation and selection of systems methods according to how they satisfy dimensions and stages of intervention. Both make attempts to demonstrate how systems methods, tools and techniques can be applied in complementary ways to provide requisite variety. It could be argued that these common characteristics equate to desirable features to be incorporated into any multiple-methods approach.

M-M was implemented in the example project, CuReSS. This revealed further knowledge about the benefits and limitations of the approach:

Using the “methodology decomposition” technique is useful for developing an understanding of any systems thinking method. It helps to define and illustrate the various components of a method and uncover the assumptions upon which a method is based, which is useful for selecting appropriate methods. However, there are limits to the methodology decomposition technique in that it does not inform the user how a particular method or parts of that method may be best used in a specific context. Also it does not promote thinking about any wider potential of various systems methods.

The mapping of methods against the dimensions of the M-M matrix proved problematic, with limited support in the literature for the basis upon which methods are categorised, and in terms of the relevance of the prescribed dimensions.

Implementing M-M added weight to the argument that combinations of systems methods are useful in addressing complex situations.



The example project also revealed the ‘real world’ nature of analysing complex situations, in that it is not always possible to design a multiple methods approach up front. As projects progress, and methods are used for analysis, often further questions arise which require further methods or tools to resolve. These questions are not apparent at the outset. This drove the need for iteration and continual critique of the value of the methods being used. Munro and Mingers’ (2000) review of the use of combined methods revealed that often choices of methods evolved as projects progressed. Jackson refers to the need for this approach in his description of CSP:

*“The relationship between dominant and dependent methodologies can then change as the intervention proceeds in order to maintain flexibility at the methodology level... As long as we are explicit... that initial choice does not exclude us from introducing alternative methodologies, based on different paradigms, as required.” (Jackson 2003a)*

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The original question of this inquiry, therefore, has not been answered positively. Reliable organising principles to guide the appreciation of complex problem situations and the selection of relevant combinations of systems methods have not been found. A gap exists. Whilst both main approaches offer useful guidance, both have had their assumptions about complex situation dimensions challenged. What follows is a further inquiry to see if alternative relevant organising principles exist in the literature, against which holistic methodologies for dealing with complex situations may be structured.

## **5. Towards A Systems-Theory Based Approach for Combining Systems Methods**

### **Development of hypothesis**

Attempts to offer a way of bringing together systems methods often fall foul of the “paradigm clash” (Zhu 2011). Zhu argues that the “paradigm paradigm” is the cause of the problem, and if we can enter into a new “post paradigm paradigm” we can move forward and “get the job done”.

Midgley (Mingers and Gill 1997) says that “proponents of methodological pluralism claiming theoretical coherence must inevitably develop a position on the paradigm problem, otherwise they risk being accused of theoretically contradictory eclecticism.”

In his later work, Midgley (2011) states that “It is now largely accepted as uncontroversial amongst systemic action researchers that there is practical value in theoretical pluralism”. He describes the activity of pluralism as being, “seeing through multiple theoretical “lenses” that bring different (sometimes contradictory) assumptions into play”.

In describing the proposed consequences of the systemic perspective on theoretical pluralism, Midgley states that, “theories are more or less useful depending on the purposes of intervention that are being pursued.” This is a view supported elsewhere in the literature, quoted in particular by Barlas and Carpenter (1990) (in Barlas (1996)) who describe the holistic/relativistic school of philosophy where, “No model can claim absolute objectivity, for every model carries in it the modeller’s worldview. Models are not true or false, but lie on a continuum of usefulness.” According to Flood (1999), an

“ideal type” is described as a tool to stimulate debate, to generate insights and to enhance learning. The premise being that “the measure of utility will depend on the purpose to which the ideal type is employed and experiences of people using it in a range of different contexts.” It can be argued, as critical systems thinking is based upon holistic/relativistic philosophy, that this thinking must be taken into account. It is an aspect of the philosophical perspective which may explain why both Jackson’s CSP and Mingers’ and Brocklesby’s M-M appeared to be unsatisfactory when attempting to use them for the purpose of understanding resilience. Perhaps a different systems paradigm or “ideal type” would be more useful for developing a multi-method approach to exploring resilience.

This chapter aims to discover if there is an alternative view which has not yet been considered. Perhaps the answer lies within the systems thinking domain. Perhaps there are organising principles in systems theory which can get around the limitations of the existing approaches.

The question is asked, **“What are the relevant dimensions of a complex problem situation?”** Further inquiry was made in order to discover if anyone had published alternative complexity or complex systems dimensions which may be a more useful device than social theory. The next section includes and outlines the findings of this further review.

This chapter re-interprets the ideas of Jackson and Mingers and Brocklesby and puts forward an alternative hypothesis. The alternative approach being suggested is original in that it proposes the use of alternative existing theories of systems to support meta-

methodology, with the purpose of thinking about the complexity of the problem situation and for framing the development of a relevant multiple-methods methodology. Existing ideas are fused into a single meta-methodology which draws together relevant aspects of the two other approaches which have been examined, whilst using a different set of dimensions from which to consider system complexity.

### **Alternative Dimensions**

The backbone of multiple-methods approaches in Critical Systems Thinking is this idea of looking at a problem situation from multiple “perspectives” or “dimensions”. However, as was found in the review, there are various different viewpoints on what those dimensions should be, and for the purposes of resilience research, no single approach appears to have an entirely useful set.

As found in the analysis, both Critical Systems Practice (CSP) and Multi-Methodology (M-M) propose sets of dimensions, but each has received criticism about the relevance and usefulness of those dimensions. The experience of the CuReSS project was that M-M’s dimensions were not entirely satisfactory.

If resilience is a systemic characteristic and belongs in the systems domain, then it can be argued that the dimensions which must be considered when examining the problem situation of interest should be those related to systems.

In addition, if the resultant approach to the research is to have the requisite variety to help understand resilience in a complex systemic situation, then it can also be argued that the characteristics of complexity (as well of systems) must be represented in the range of dimensions for thinking proposed.

Other sets of dimensions which might relate directly to systems and complexity were sought in the literature and three candidates were found, namely Flood's "four windows" (Flood 1999), Angyal's "dimensions of dynamic wholes" (Baburoglu 1988) and Emery and Trist's "levels of complexity" (Emery and Trist 1965; Baburoglu 1988, 1992).

Firstly, Rethinking the Fifth Discipline (Flood 1999) offers alternative dimensions for critical systems thinking in the form of an "ideal type":

*"Organisational life might be made sense of in terms of the following four categories – systems of processes, of structure, of meaning, and of knowledge-power."*

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According to Flood (1999) the prefix of 'systems of' means there is an intention to be systemic with respect to each category. This idea held promise – one requirement is that the dimensions should relate to systems.

*"Systems of processes is a category concerned with efficiency and reliability of flows of events and control over flows of events. Systems of structure is a category concerned with effectiveness of functions, their organisation, co-ordination and control. Systems of meaning is a category concerned with people's viewpoints on the meaningfulness to them of what is going on and choices of improvement strategies. Systems of knowledge-power is a category concerned with fairness in terms of entrenched patterns of behaviour where what is said to be valid knowledge and proper action, is decided by powerful groups."*

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However, whilst concepts for systemic appreciation are provided by this metaphor, concepts for appreciating complexity (the other requirement) are not. This metaphor's usefulness outside of the organisational context can be questioned, too. For example, it

is difficult to see how the human body system can be thought of in terms of knowledge-power. This systems metaphor was dismissed as not satisfying both requirements of system and complexity, and as being potentially limited to the social domain only.

A second view which held promise for the idea of a metaphor for systems dimensions was discovered through tracing back to some of the ideas of the early systems thinkers, specifically through an article by Baburoglu (1988), whose work provided a signpost to the early work of Trist and Emery in the sociotechnical and action research traditions, and to the work of Angyal, an early systems thinker whose work was later taken up in the HR domain.

In his fifth-level extension of the Emery-Trist Levels of Organisational Environments, Baburoglu (1988) articulates the organising principles of the Emery-Trist framework and also outlines, from the 1940s, Angyal's conceptualisation of the "dimensionality of dynamic wholes". In this paper, Baburoglu demonstrates how the two frameworks may be related and combined. This synthesis of systemic thinking ideas offers a way of thinking multi-dimensionally about complex systems. This way of thinking (or paradigm) "...represents different aspects of the same reality viewed in different dimensions." It combines dimensions of both systems and complexity and therefore held promise.

Importantly, Baburoglu goes on to point out that, "the concepts that are offered do not have to be originating from one discipline or from a theoretical tradition." This generic framework supports the pluralist approach and the practice of bringing together methods from different disciplines or paradigms (or, how methodological pluralism in practice may be supported theoretically).

Baburoglu also emphasises that, “To force [concepts] into the mould of an established discipline such as psychology or into that of a theoretical tradition such as structuralism may amount to losing the meaning of a discourse on dimensions.”

So perhaps Emery and Trist’s or Angyal’s organising principles for thinking about system complexity are more relevant to an inquiry into resilience than Jackson’s or Mingers and Brocklesby’s as they provide dimensions to consider which relate directly to systems and complexity.

Despite Baburoglu, in his later work (1992), proposing that the Emery-Trist systems paradigm can contribute to the field of critical systems thinking, not much has appeared in the critical systems thinking literature until recently, when the material has resurfaced again with references made by Barton and Flood (Barton et al. 2004; Flood 2010).

The (re-)discovery of this paradigm provides an opportunity to take critical systems thinking forward again, into a single-paradigm, multi-dimensional world, for which it has strived for some time. Potentially, Baburoglu’s synthesis could provide the basis for a framework within which multiple-methods research and practice can be applied. The Angyal and Emery and Trist models are firstly reviewed individually, then in combination.

### **Angyal Paradigm**

Baburoglu cites Trist (1984) saying he “pointed out that Angyal (1941) made a novel contribution in conceptualising the interdependence between the system and the environment.” Angyal asserts that “The system and the environment are aspects of the same reality that can be separated only by abstraction.” Angyal referred to complex systems as “dynamic wholes”, and arrived at a concept of “dimensionality of dynamic

wholes". Angyal asserted that "wholes are never entirely undifferentiated but are always structured and articulated into parts" suggesting that "the multiplicity of parts is only possible in some kind of dimensional domain." This provides weight to the argument that problem situations need to be considered from a variety of dimensions.

Baburoglu explains Angyal's ideas further saying that, "the dimensional domain serves as a matrix for the arrangement of parts into definite patterns" and that Angyal used the term "constellations" to refer to patterns which reflect a specific arrangement of parts in any particular dimension. The use of dimensions therefore is a means of arranging or organising thinking about problem situations such that "patterns" can be described to convey one's knowledge or ideas about the situation.

Figure 6 is a proposed representation of Angyal's dimensions of a dynamic whole. The diagram aims to illustrate how the different dimensions are only different conceptualisations of the same reality, or are each only separate "lenses" or "windows" by which we can "view" or think about a situation. This is similar to Flood's idea of four dimensions. It is Flood (1999) who coins the phrase "four windows":

*"Deepening systemic appreciation by employing the four categories can be likened to opening up four windows on an action area. Looking through each of the windows results in four different impressions of organisational issues and dilemmas."*

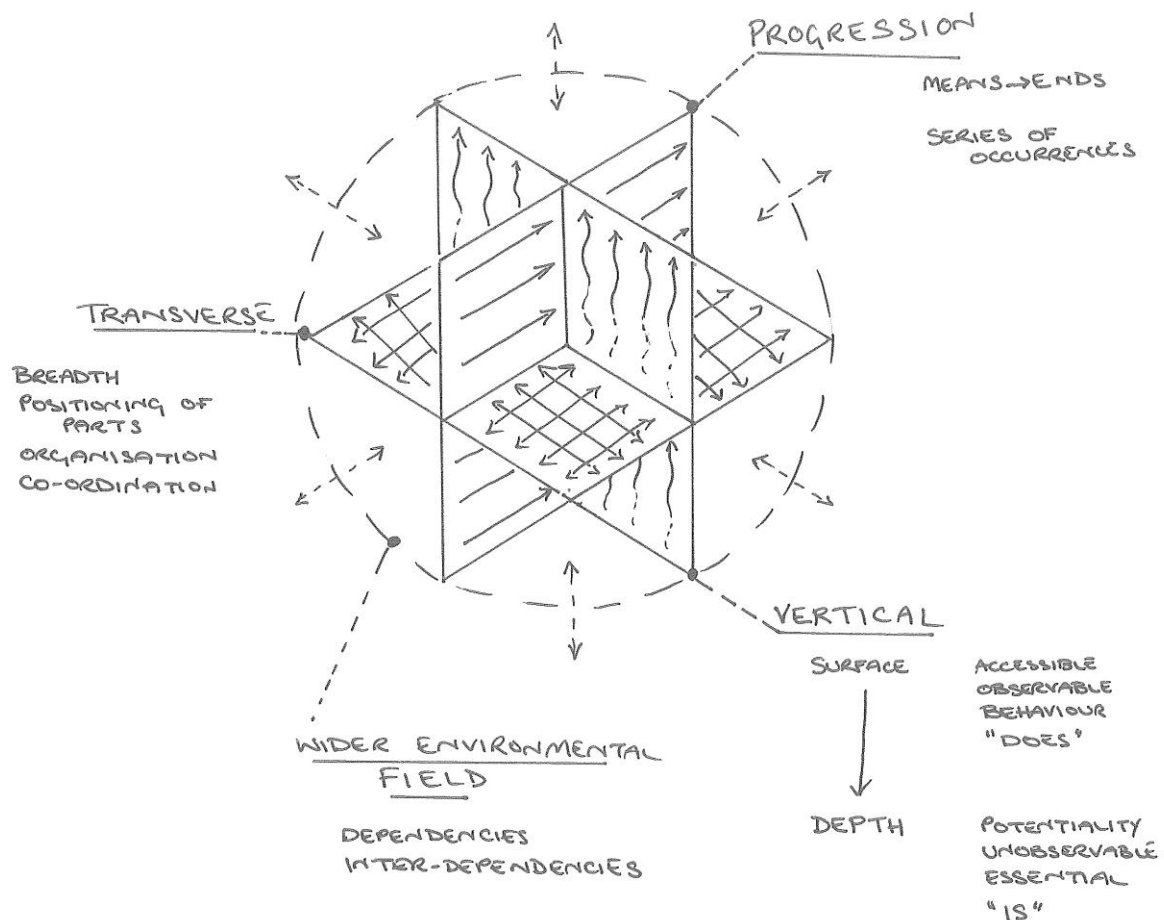
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The dimensions are not separate parts of a dynamic whole, but are different ways of imagining the nature of the same dynamic whole:



- In the *progression* dimension, we conceive of means to ends, of the situation as a series of occurrences. Something leads to something else. Time is a parameter in the progression dimension.
- In the *vertical* dimension, we conceive of depth to surface. Underlying unobservable arrangements result in or cause observable or accessible behaviour. We can think of the difference between what something “is” and what something “does” (as a result of what it is). Underlying causal structures can be conceptualised.
- In the *transverse* dimension, there is breadth or positioning of parts. We can conceive of how a situation is arranged, or organised or co-ordinated.
- In the dimension of the *wider environmental field*, we can conceive of the interdependencies of our systems in focus. There are relationships amongst the constellations of parts within the system and with the system and its environment. These relationships can be conceptualised as dependencies and interdependencies.

**Figure 6: Dimensions of System**



### Extension to Critical Systems Thinking

It is proposed here that these ideas can be used as an extension to the current thinking about a meta-methodology, in order to support the design of a multiple methods approach to resilience research. The “dynamic whole” of a complex systemic problem situation can be conceptualised through its set of dimensional domains. The “constellations” or patterns of arrangement in each of those domains can be surfaced through the use of systems methods, each potentially belonging to one (or even more) of the dimensions. Systems methods can be understood and therefore selected on the basis of their relevance to the dimension of focus.

Each dimension represents a “different aspect of the same reality” (Baburoglu 1988), which is viewed from each of its dimensions. As Angyal felt “the concepts that are offered do not have to be originating from one discipline or from a theoretical tradition...”, differences in the theoretical position or assumptions of the chosen systems methods are no longer important on the level of their compatibility with each other or their “fit” to a set of social-theory paradigms, but are now important only in determining which dimension (or dimensions) each could be useful in supporting.

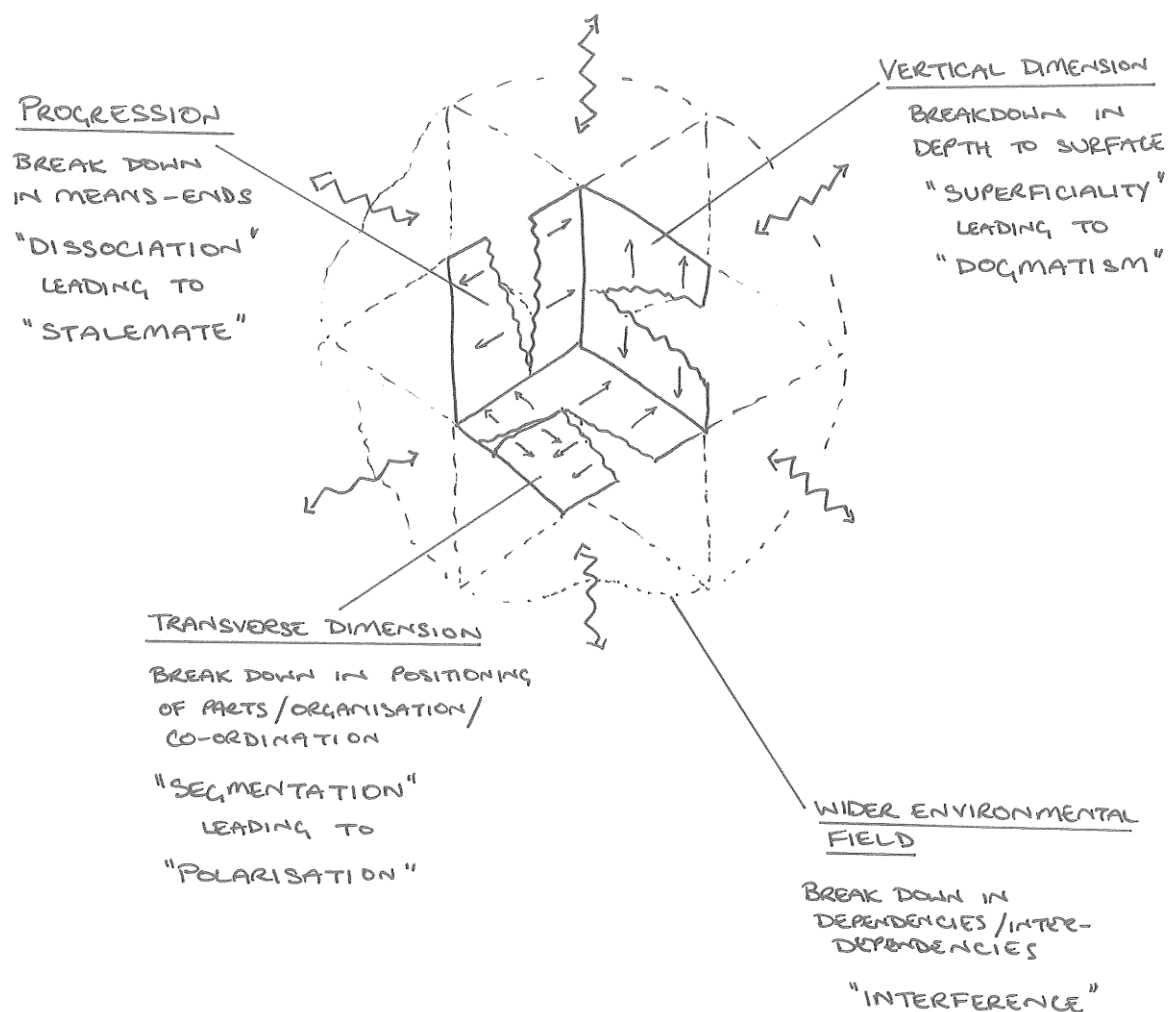
When it comes to resilience, Angyal’s theories of “system adaptation to turbulence” (in the environment) (Baburoglu 1988) become especially relevant. According to his thinking, systems adapt in response to turbulence (changes in the surrounding environmental dynamic). Failure of the system to adapt well results in disturbances to the organisation or integration of dynamic wholes, namely interference between systems and segregation.

Segregation, according to Angyal, causes discontinuity on each dimension. As a result, maladaptive patterns arise, namely stalemate, polarisation and monothematic dogmatism. These “patterns”, if observed/observable, would indicate a maladaptive system. Failure to adapt well impacts upon survival and hence represents less than ideal resilience. It is proposed here that if systems methods can be used to surface patterns within each of the domains of the dynamic whole of our problem in focus, these maladaptive states can be identified, and even avoided or remedied, resulting in resilience or improved resilience.

There is some correspondence between Flood's four windows and Angyal's four dimensions, but they are not entirely comparable. Angyal's 'progression' dimension of means to ends can be related to Flood's 'systems of processes' where there are flows of events. Angyal's 'vertical' dimension where there is depth to surface can be related (loosely) to Flood's 'systems of meaning'. Angyal's 'transverse' dimension where there is positioning of parts can be related to Flood's 'systems of structure'. However, there is no direct correspondence between Angyal's 'wider environmental field' where interdependencies may be conceived and Flood's 'systems of knowledge-power' where the concern is emancipation.

The emancipatory tradition, where balance of power and concern for fairness are of primary importance, is part of the school of critical systems thinking, however it can be argued that inherent in this thinking is the assumption that power always needs to be overcome. In Angyal's model, power may or may not require re-balancing. Power imbalance would be viewed as a maladaptive system state which can be surfaced in one (or more) of the systems dimensions, but no assumption is made within the model that power imbalance always exists. It can be argued that, for Angyal, knowledge-power is not a dimension but a state or pattern within a dimension.

**Figure 7: Patterns of Maladaptation in Dynamic Wholes**



For resilience research, a meta-methodology for multi-methods approach design, which aims to achieve requisite variety of method through addressing each of the relevant dimensions of dynamic wholes is potentially feasible. The use of the maladaptive patterns as "systems archetypes" (in the tradition of Systems Dynamics (Senge et al. 1994) [See Figure 5: Systems Dynamics Method Decomposition Diagram]), in the form of a "plug-in systems technique", to guide pattern recognition and diagnosis would provide the resilience context necessary for system resilience inquiry. This idea brings forward

additional criteria by which systems methods should be selected for this purpose, namely on the basis of their relevance for surfacing patterns of maladaptation.

This thinking is consistent with Midgley's statement that, "theories are more or less useful depending on the purposes of intervention that are being pursued" (2011).

### **Emery and Trist Paradigm**

In "The Causal Texture of Organisational Environments" (Emery and Trist 1965), a different set of organising principles for complex environments are outlined on the basis of four "ideal levels". Each level is of increased order of complexity and connectedness and is of increased degree of causal texture. "Organisational environments differ in their causal texture, both as regards degree of uncertainty and in many other important respects. A typology is suggested that identifies four 'ideal types'". Complex problem situations can also be thought of in these terms.

Emery and Trist propose that in order to comprehensively understand complex system behaviour, it is necessary to have knowledge of all of the following dimensions (where 1 is the system and 2 is the environment):

L11 – the area of "internal interdependencies

L12 – the area of "transactional interdependencies" from the system to the environment

L21 – the area of "transactional interdependencies" to the system from the environment

L22 – the "causal texture" of the environment – the area of "interdependencies within the environment itself"

Emery and Trist suggest that the complexity of the situation is greater, depending on how many of the dimensions need to be taken into account. They also suggest an evolutionary development of systems which begins at the level of internal interdependencies, where the only considerations are what goes on inside the system, which can develop into a situation where the internal system, transactions with the environment and interdependencies within the wider environment are all relevant. In each case, the strategies necessary for adaptation are more or less sophisticated, relevant to the level of complexity.

Figure 8 illustrates the levels of complexity, and is adapted from Emery and Trist.

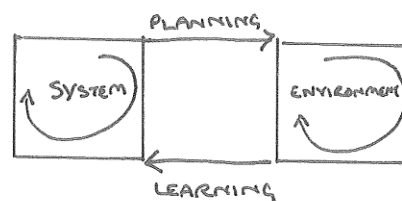
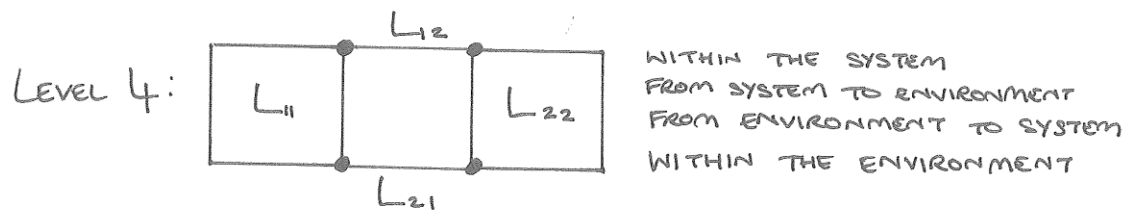
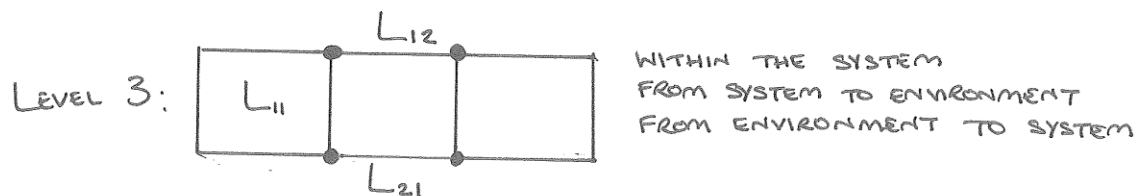
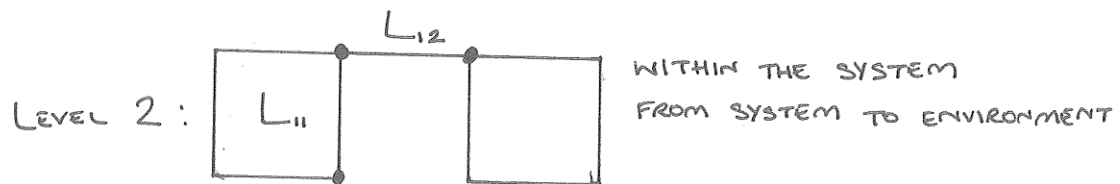
The Emery-Trist paradigm is interesting in that it proposes dimensions of complexity. The strength of Angyal's model is in the generic dimensions of system. Neither on its own is entirely satisfactory, however if combined, the two models may offer a set of organising principles which can meet the requirements of considering both system characteristics and the characteristics of complexity.

Figure 8: Levels of Environment in Increasing Order of Complexity and Connectedness

$L_1$  = THE SYSTEM

$L_2$  = THE ENVIRONMENT

—•— = CONNECTION



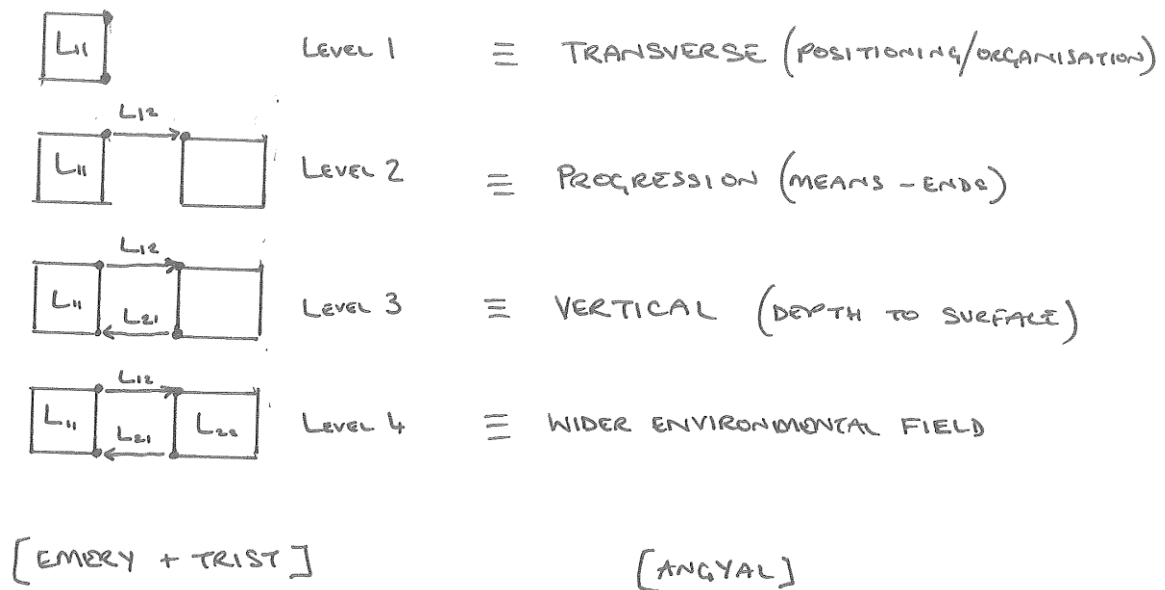
= A TURBULENT  
ENVIRONMENT  
+  
NEED TO ADAPT  
TO SURVIVE



## Potential Links between Angyal and Emery-Trist models

Baburoglu (1988) proposes that Angyal's dimensions and Emery-Trist's levels can be mapped to each other.

**Figure 9: Proposed illustration of how Baburoglu relates Angyal's Dimensions to Emery and Trist's Levels**



It is proposed here that one might challenge Baburoglu and, instead of mapping against each other directly, that each paradigm has the potential to be describing the same reality from a different perspective. It is possible to think of Angyal's dimensions of dynamic wholes as representing the ways in which a system can be conceptualised, they represent the systemic characteristics of the problem situation, whereas Emery and Trist's dimensions represent the levels of complexity associated with the boundary of the problem situation. Depending on where you draw the boundary of your inquiry, the dimensions  $L_{11}$ ,  $L_{12}$ ,  $L_{21}$  and  $L_{22}$  will either be in-scope or outside-of-scope. These levels, therefore, represent the complexity characteristics of the problem situation.

This thinking suggests that there are five dimensions which must be taken into account: the level of complexity of the problem situation, the transverse (positioning/organisation/co-ordination) characteristics, the progression (means-ends) characteristics, the vertical (depth-surface characteristics) and the extended field (interdependencies with and within the wider environment).

In order to determine the level of complexity of the problem situation, the four levels (dimensions) of Emery and Trist need to be assessed for relevance, and this depends upon the boundary of the problem situation. i.e. where does the 1 (the system) end and 2 (the environment) begin, and how much of the relationship between them do we want to take into account.

Boundary setting is an important concept in systems thinking:

Churchman (Flood 1999) argued that:

*“Boundaries are mental constructs (mental models). Mental constructs determine what is in view and might be taken into account at the moment and what is out of view and thus excluded from consideration.”*

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And, according to Ulrich (2005):

*“Boundary judgements determine which empirical observations and value considerations count as relevant and which others are left out or considered less important.”*

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This is also supported in the management science domain, whereby Kurtz and Snowden (2003) state that:

*“Boundaries are possibly the most important elements in sense-making, because they represent differences among or transitions between the patterns we create in the world that we perceive.”*

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Boundary setting is not easy and so methods for establishing the system boundary or for appreciating the problem situation would be useful within the approach. In order to define the level of complexity, boundary setting must be included as part of any proposed meta-methodology.

Having determined the level of complexity, and therefore the complexity characteristics which need to be considered, as before, systems methods can be used, this time based on their relevance to each of the dimensions of the dynamic whole, in order to surface patterns relevant to the inquiry (in this case, resilience), taking into account the requisite dimensions of complexity.

Table 12 is a representation of this idea, showing how each of Angyal’s dimensions can be considered at each of Emery and Trist’s levels of complexity.

		COMPLEXITY			
		system	planning	learning	environment
		L11	L12	L21	L22
SYSTEM DIMENSION	Transverse	positioning/organisation/co-ordination			
	Progression	means-ends			
	Vertical	depth to surface, causal patterns			
	Extended field	interdependencies			

**Table 12: Dimensions from which to consider a problem situation**

## Hypothesis: A new meta-methodology for resilience thinking

A new meta-methodology is proposed here, which applies this “alternative-dimension” thinking as an extension to the meta-methodology ideas of Jackson, Mingers and Brocklesby, for the purposes of investigating resilience. What follows is a fusion between the dimensions of dynamic wholes of Angyal, the levels of complexity of Emery and Trist, the stages of meta-methodology of Jackson, Mingers and Brocklesby, and the concept of “pattern recognition for diagnosis” from Senge’s system archetypes.

### Step 1: Multi-dimensional investigation:

- a) Boundary setting: the characteristics of the system in focus determine the level of complexity and therefore what needs to be investigated
- b) Analysis of a candidate set of systems methods to determine usefulness to inquiry: which dimension might they speak to? In the relevant dimension, does the method help to surface patterns or constellations of parts in that dimension? Are any additional tools or techniques required to fill any gaps? Selection of the relevant set which addresses the level of complexity established.
- c) Dimensional analysis: the use of selected systems methods in each of the four dimensions at the relevant level of complexity in order to surface “patterns” or constellations of parts in each dimension.

### Step 2: Diagnosis:

The use of patterns of maladaptation as “system archetypes” to diagnose situations of interest, e.g. low resilience or resilience.

### Step 3: Prescription:

An assessment of options for remedial action and identification of candidates for change

Stage 4: Treatment:

Implementation of change

This proposed new meta-methodology is only an idea. There is much work to do to test out if it can really work and be useful.

## 6. Conclusion

### Summary of work

In summary, the work set out to discover:

*“What methodology can be used to resolve a complex systems thinking issue such as how to develop a blueprint for enterprise resilience?”*

And

*“How can we understand the complex problem situation we are trying to address in the first place, so that we can select an appropriate methodology?”*

For the purposes of this thesis, the CuReSS project was used as an example of a complex problem situation and the questions were refined more specifically to:

*“What reliable approach or method can be used to guide the selection of a suitable methodology or defensible combination of methodologies to help understand and resolve a difficult complex problem situation, such as that of the CuReSS project?”*

A background review uncovered that the systems thinking discipline is a diverse field which draws together, and applies across many other disciplines, knowledge about systems and thinking. Many systems thinking approaches exist and historically the field has become fragmented. There are many ways in which the world of systems thinking can be described, such as by its historical development, its key authors, its “camps”, the

types of problems addressed, the various metaphors and paradigms employed. There is no common typology for the world of systems thinking.

Most recently, the strand of Critical Systems Thinking (CST) emerged as an attempt to reunify the fragmented discipline and to address some common concerns of systems thinkers. The principles of CST are: critical awareness of the different strengths and weaknesses of individual systems approaches; recognition of the benefit to be gained from combining systems methods; and a commitment to take social impacts of systems thinking endeavours into account.

A critical review of CST identified candidate approaches for the selection and combination of systems methods. However, each was based on different principles. There was evidence in the literature to show that the practice of combining systems methods is common, although there is limited theoretical support for what happens in practice, demonstrated by the inconsistencies in the approaches. None were identified as having a widely published track-record of application, although two main approaches were identified as being potentially relevant.

A detailed critical analysis and comparison between Critical Systems Practice (CSP) and Multi-methodology (M-M) revealed that both approaches have been challenged on the basis of their theoretical principles. Both approaches use a given number of “perspectives” which must be considered in order to be holistic. The literature review uncovered that taking a number of different perspectives on a situation is a valid approach to understanding complexity. The question remains, however, about what these “perspectives” should be. From the knowledge gained in comparing the

approaches, it can be argued that the desirable features of any multiple methods approach should include common characteristics such as: stages, sets of multiple perspectives, multi-dimensional matrix analysis, and the evaluation and selection of systems methods according to how they satisfy dimensions and stages of intervention.

A trial implementation of M-M within the CuReSS project revealed benefits of the methods decomposition technique but limitations to the matrix mapping approach. There were limited benefits in trying to design the project methodology in advance, when in reality progress was made by extending the range of methods used in response to surfacing needs. The approach also offered limited support for the “linking” or “combining” of the methods and tools selected into a coherent “whole”, but application of the methods decomposition technique from the M-M methodology demonstrated that this could be useful for the purpose of assessing the suitability of various systems methods.

The mapping of methods against the dimensions of the M-M matrix proved problematic, with limited support in the literature for the basis upon which methods are categorised, and in terms of the relevance of the prescribed dimensions.

Neither CSP nor M-M proved entirely satisfactory upon closer examination, and much of the discovered criticism was aimed at the different theoretical principles upon which each is founded. This demonstrated a need for further development in the field of CST in order to provide a more convincing theoretical underpinning for multi-methodology, supporting the argument of Zhu (2011) that multi-methodology does not yet work in theory.



The original question of this inquiry, therefore, has not been answered positively.

Reliable organising principles to guide the appreciation of complex problem situations and the selection of relevant combinations of systems methods have not been found. A gap exists. Whilst both main approaches offer useful guidance, both have had their assumptions about complex situation dimensions challenged.

The backbone of multiple-methods approaches in Critical Systems Thinking is this idea of looking at a problem situation from multiple “perspectives” or “dimensions”.

In his later work, Midgley (2011) states that “It is now largely accepted as uncontroversial amongst systemic action researchers that there is practical value in theoretical pluralism”. He describes the activity of pluralism as being, “seeing through multiple theoretical “lenses” that bring different (sometimes contradictory) assumptions into play”.

Midgley states that, “theories are more or less useful depending on the purposes of intervention that are being pursued.” Barlas and Carpenter (1990) (in Barlas (1996)) state, “Models are not true or false, but lie on a continuum of usefulness.” According to Flood (1999), “the measure of utility will depend on the purpose to which the ideal type is employed and experiences of people using it in a range of different contexts.” This added weight to the conclusion that an alternative systems paradigm would be more useful for developing a multi-method approach to explore resilience.

The question was asked, “What are the relevant dimensions of a complex problem situation?”

It was argued that, if resilience is a systemic characteristic and belongs in the systems domain, then the dimensions which must be considered when examining the problem situation of interest should be those related to systems. In addition, if the resultant approach to the research is to have the requisite variety to help understand resilience in a complex systemic situation, the characteristics of complexity (as well of systems) must be represented in the range of dimensions for thinking proposed.

In pursuit of alternative theoretical organising principles for multiple-systems-methods methodology design, the works of Angyal and Emery & Trist were considered, as interpreted by Baburoglu. Baburoglu's combination of models was challenged and an alternative combination of Angyal's dimensions of dynamic wholes and Emery & Trist's levels of complexity is proposed as a suitable set of organising principles upon which a meta-methodology may be based. New diagrams were developed to illustrate the ideas. The results are presented as a new meta-methodology.

The hypothesis developed through this work is that, based on Angyal's and Emery & Trist's combined models, complex systems should be considered in terms of the complexity of the system-in-focus, as determined by its boundary, and through each of the dimensions of a system: vertical, transverse, progression, and inter-connectedness.

It is proposed that this framework can be used as the basis for a meta-methodology for resilience thinking and perhaps may be generalised towards other complex problem situations thinking.

The main steps of this meta-methodology are:

- Multi-dimensional investigation
- Diagnosis
- Prescription
- Treatment

Further work is necessary to both fully develop the hypothesis and to assess the meta-methodology's usefulness in guiding thinking about complex situations, in designing multiple-systems-methods approaches and in surfacing knowledge about system resilience.

The pragmatist approach to combining multiple systems thinking methods has been accused of being atheoretical. The proposed meta-methodology is an attempt to respond to this challenge by presenting a systems-theory-founded approach.

The proposal is a meta-methodology which is intended to guide thinking about resilience in complex problem situations, and to help people design relevant approaches based on multiple systems methods which have the requisite variety to match the complexity of the problem.

The approach to pluralism is consistent with and speaks to one of the fundamental principles of critical systems thinking, in that multiple methods are necessary in order to be holistic. The systems principle used to guide the holistic thinking is the

“dimensionality of dynamic wholes”, a 1940s extension to systems theory by Angyal. The systems principle used to deal with situation complexity is Emery and Trist’s Levels of Organisational Environments, which is drawn from Open Systems Theory.

The approach recommends the use of relevant systems methods for boundary setting as a means of defining the complex problem situation, and the use of the four levels of organisational environments to identify the nature of the problem situation in complexity terms. The approach does not prescribe which systems methods are relevant or suitable for boundary setting. This could be interpreted as a weakness in that it leaves the decision open to the user and this may mean it becomes subjective. However, this could also be seen as a strength, in that it offers guidance with opportunity for flexibility (and therefore does not limit variety). The intention is that it is a framework or meta-methodology.

The new meta-methodology does not offer anything novel in terms of a means of analysing systems methods, tools and techniques. It recommends Mingers and Brocklesby’s methods decomposition approach. Systems methods can only be identified through investigation of the systems methods field and by virtue of the user’s existing knowledge. The benefit of the framework is in guiding the user to ask relevant questions about each dimension, which will require systems methods to answer them, prompting the investigation to find the methods and then analysing them to see if they are relevant.

The approach recommends that systems methods are selected on the basis of their applicability to each of the systems dimensions which need to be considered, as well as their ability to surface patterns within those dimensions. How this matching can be done, i.e. what specific questions to ask of the systems methods, is yet to be fully defined, and it would be necessary to develop this aspect of the approach further to make it more useable.

The requisite variety is achieved through considering all four system dimensions and the appropriate level of complexity, depending on the boundary of the problem. To be holistic, the set of methods chosen must at least contribute to thinking in all of these perspectives. The unique problem situation in focus will present challenges which will require additional methods, tools and techniques to be included. The systems methods decomposition technique enables identification of the components of methods and develops an understanding of how they may be applied to address challenges. There is no paradigm incommensurability to overcome, in that all methods, tools and techniques will be more or less useful in the dimension being considered and for the nature of the inquiry, and they may be selected on this basis.

Methods may be used in conjunction with other methods, tools and techniques as the situation demands. The meta-methodology does not specify how methods may be “combined”, i.e. fused together into a single method, particularly in a single dimension, and knowledge of how to do this, or if it can be done, is still open to inquiry. The meta-methodology does, however, provide a framework for how methods may be used “in

combination”, in order to take a multi-dimensional view of a situation, to provide a multi-dimensional answer. The aim is not necessarily to combine multiple methods to provide a single answer. The use of multiple methods is in order to provide a richer understanding of the problem situation, and this will be by looking from many perspectives. Any answer generated from this type of thinking will, by virtue of the approach, be a multi-dimensional understanding of a single reality, viewed through many “lenses”. Every question has many answers, depending on how you look at it. They can all be true, and all at the same time.

The belief here is that the meta-methodology can be defended. The ideas are drawn from systems thinking, which is widely accepted as a discipline in its own right. The dimensions come from concepts of systems and complexity, and can be traced back to the origins of the systems thinking tradition. The ideas aim to bypass altogether the recent “paradigm incommensurability” debate which has dominated the academic journals in this area, by adopting the stance that “paradigm incommensurability” is but a human construct, and one which is not universally accepted and is therefore open to challenge. The ideas are offered as an alternative paradigm for critical systems thinking, however, the proposed approach is yet to be fully developed and validated.

The belief is that the meta-methodology is straightforward enough to be understood by systems methods practitioners, however, the demands and challenges of using multiple systems methods, particularly for multi-disciplinary inquiry, cannot be easily overcome. Any practitioner wanting to take a holistic approach needs to become competent in the use of many systems methods, and in doing so, develop a critical appreciation for the

different paradigms from which those systems methods were developed, in order to fully appreciate their merits and limitations, and use them appropriately. Whether this belief holds true is yet to be validated, and further work is required to establish if this approach is useful in practice.

## Contribution

The main contribution of this thesis is a proposed extension to CST with the hypothesis that Angyal's multi-dimensional systems framework and Emery & Trist's levels of complexity may be applied in combination to provide a new set of organising principles for thinking about multiple methods approaches to dealing with complex systems situations. Part of the hypothesis is that Angyal's patterns of maladaptation may be used as diagnostics for surfacing system resilience characteristics, in support of resilience thinking problems. New diagrams to illustrate Angyal's systems dimensions ideas are presented.

In support of the critical analysis of CST, method decomposition worked examples have been developed which were previously unavailable, demonstrating that the method decomposition technique can be useful in understanding and analysing systems methods.

In studying and comparing the Critical Systems Practice and Multi-methodology approaches, a critical appreciation of their benefits and limitations has been developed, in particular the limitations of the approaches in relation to the sets of dimensions chosen, and for Multi-methodology, an appreciation of the limitations of the matrix-mapping approach.

## Proposed further work

There is a need to ascertain whether the proposed methodology can be applicable to real-world problems.

Areas for further investigation include:

Does the proposed combination of organising principles and meta-methodology provide a meaningful framework for multiple-methods methodology design?

Can systems methods be “mapped” to the multi-dimensional model? What approach can be used to do this? This is important as there needs to be a clear means of selecting appropriate methods to ensure each dimension is considered, and for the purpose of surfacing “patterns of interest”.

Which systems methods are useful for surfacing patterns of resilience and non-resilience?

Does a multi-dimensional analysis provide a richer understanding of system resilience so as to be meaningful and useful? The challenge is about grappling with complexity to develop something detailed yet understandable, meaningful and useful.

What are “maladaptive patterns”? and What are “adaptive patterns”? and can those patterns be uncovered or revealed using systems methods?

Further work may be undertaken to develop the hypothesis in greater detail and to assess the usefulness of the proposed meta-methodology.



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