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Aspects of mutual engagement: School of engineering and industry collaborations

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ABSTRACT

This paper is a case study of collaboration between a large steel company and a university's school of engineering. Our aim is to contribute to understandings of engagement between employers and higher education institutions and explore some of the complexities of such collaborations in their initiation and propagation. The analysis derives from case study research of a Centre of Excellence, as a collaborative venture. What becomes evident in the analysis is the often uneven and complex nature of collaboration and the difficulties that derive from the specifics of (higher education and industry) sector (contractual and organisational, as well as learning) practices, policies and cultures. Of central importance to propagating a relationship is moving beyond initial customer–supplier relationships towards more deeply embedded forms of engagement. The aim in this respect is to develop and diversify collaboration activities. This, we argue, necessitates close consideration of the respective partners' operational goals and structures – across, we suggest, three aspects of mutual engagement – and the way in which they are accommodated and mutually recognised within (and beyond) contractual relationships.

KEYWORDS

Employer engagement; contractual arrangements; work-based learning; key performance indicators

Introduction

Engaging with employers is important in a number of ways for engineering education. For example, commentators, such as Lamb et al. (2010), identify that such collaborations are an essential part of creating more employer-relevant degrees. However, employer engagement and optimising integration is not without its difficulties. Indeed, the Wilson Review (2012), which comments more widely on university and business collaborations, identifies a range of barriers to successful partnership, including: networking problems, the ineffective exchange of people and knowledge, inflexibility in collaborations, poor considerations of employability and so on (see Fairweather, 1988; Mead, Kathy, Jimmy, O'Mary, & Parish, 1999; Salter, Tartari, D'Este, & Neely, 2010; Vaidya & Charkha, 2008 for related discussions). It is with such considerations in mind that this paper aims to explore some of the complexities of employer engagement, focusing particularly on the way collaborations are

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initiated and then propagated – as distinct phases of engagement based on different forms of contractual relationship.

Arlett and Dales (2008) make a number of recommendations and observations on engineering departments' engagement with industry. They highlight a number of good practice cases and recommend for further such collaborations to be identified and explored. This paper explores one such case. The case study in question is the *Steel Centre of Excellence in Energy Optimisation, By Product and Waste Management* (SCE), which is hosted by a School of Engineering located in a Russell Group university. The Centre's objective is to explore energy and materials efficient technologies, which contribute to a steel company (referred to as Steel Co. from here on) becoming more competitive and a better corporate citizen.

A particular focus of the Centre is skills development and training. During 2010, for example, SCE was involved in delivering refresher training and practical skills development in High Voltage Systems to Steel Co.'s electrical engineers. The Centre's academic staff also developed a Basics of Combustion Course (BCC). Essentially, this course was designed to improve site safety whilst addressing the future business challenges of reducing the carbon footprint of steel manufacture. The evidence for the paper and the analysis of the SCE that follows derives from an evaluation conducted of the BCC.

Existing research (e.g. Arlett & Dales, 2008; Arlett, Lamb, Dales, Willis, & Hurdle, 2010; Lamb et al., 2010) concerned with understanding collaborations such as the SCE identifies a number of factors important to their success, such as a mutual commitment to the collaboration's purpose and a shared understanding between the Higher Education Institution (HEI) and industry of each other's policies and practices i.e. working arrangements. Our aim is to add to such understandings by examining in critical ways a case that has been recognised as successful. In making our analysis, we provide an assessment of the factors that are important in progressing towards sustainable forms of collaboration based on deeply embedded mutual engagement.

The analysis focuses on an initial phase of SCE engagement and its contractual basis, whereby the School was tasked with delivering Work Based Learning (WBL) programmes (e.g. the BCC), alongside other research and development (R&D) activity. As part of this, we explore the specific conditions upon which initial 'servicing' forms of (customer–supplier) engagement – for which the School is first contracted – might develop towards the propagation of fuller and more expansive and mutually productive (and bilateral contractual) relationships. In making our analysis, we draw attention to potential barriers to these forms of more fully integrated collaboration.

In our analysis, we identify three important aspects of mutual engagement: (i) performance measures, (ii) policy and practice procedures, and iii) cooperation and trust charters (contracts) – the precise nature of which determines to lesser or greater degrees the collaboration lifecycle and the potential for enlarging its scope. Cutting across the three aspects are three separate (lifecycle) phases of engagement: (i) initial, (ii) propagation or exit, and; (iii) embedded/partnership or exit, with each phase based on either unilateral or bilateral contractual arrangements (See Discussion and Figure 3). In making our analysis, we do not aim to offer to solutions to breakdowns in collaboration, but to better understand the phases and aspects (or working arrangements) upon which collaborations might be sustained.

The research

The source of data for what follows is an evaluation of the SCE's BCC course, conducted between July 2009 and March 2010. The BCC is aimed at the strip products workforce based at two of Steel Co.'s production sites. A set of four specific BCC evaluation objectives were agreed with Steel Co.'s Learning and Development Department and the SCE:

(1) *Evaluate the delivery of the module*: assess the delivery of the module content and identify ways in which it might be improved to better facilitate the workers' learning experience.
(2) *Evaluate the relevance of the module content*: assess the relevance of BCC content to the workforce's workplace experiences and ensure that the content of module was relevant and appropriate to the work and employment of participants.
(3) *Evaluate worker experiences of the training course*: assess workers' experiences of the training course and identify areas of best and poor practice.
(4) *Evaluate the contribution of the training course to site/company productivity, efficiency (including carbon efficiency) and health and safety imperatives*: assess contribution to wider business objectives, particularly in terms of improved productivity, efficiency gains (e.g. energy consumption, sustainability, maintenance and health and safety practices/risk assessment dynamics).

The evaluation report *Basics of gas combustion training: an evaluation* (Stroud, 2010) presents the findings. The evaluation is one part of a performance measure procedure aimed at demonstrating whether Key Performance Indicators (KPIs) – in this case in relation to SCE's delivery of WBL – have been met. It is a confidential report, but this paper employs an account of the evaluation findings to comment specifically on the SCE, as well as on HEI-industry collaborations more broadly.

Methodology

The data is derived from case study research employing individual and group semi-structured interviews, as well as observation of BCC training. Case study research fails to offer the generalisability offered by quantitative approaches, such as surveys, but its strength is in-depth exploration of issues (Yin, 2014). Case study research is often used to explore the dynamics of relationships within industry, and Steenhuis and de Bruijn's (2006) exploration of productivity and organisation improvements in aircraft production provides one such example.

The BCC evaluation might have focused quantitatively on the meeting of specified company skill needs, but the aim here was wider and necessitated a qualitative assessment of broader training experiences and working relations/conditions that informed engagement with the course and the SCE. Thus, whilst a clearly structured approach was required, the research required the freedom to explore the potential range of contributory factors to improvements in efficiency and health and safety (as the principal aims of the BCC). An important aspect of this was developing a critical understanding of the SCE, as responsible for the development and delivery of the BCC (as well as other WBL programmes and R&D activity).

Yin (2014) writes extensively on case study research, and identifies four key issues: reliability, internal validity, construct validity and external validity. There is not room here to provide much depth of discussion in relation to such concerns, but on matters of reliability it is important to provide detail of the case study procedure (see below). On matters of validity, and the generalisability (external); operational measures (construct) and understanding of causal relationship (internal), it is imperative to demonstrate (by use of evidence and its explication) clearly the interpretation of the relationships that are claimed to be made, as well as the extent to which the findings can be applied and have relevance.

Participants from one of Steel Co.'s integrated production sites took part in the evaluation. Demographic data were collected on the interview participants' age, gender, country of birth, ethnic background, job title, section, length of service and educational qualifications. The schedule of interview questions, which provided the framework for a 'thematic analysis' was organised across the following four themes:

(1) personal career/qualification and skill profile;
(2) general training experiences;
(3) BCC/SCE training content, and delivery;
(4) a general assessment of training, work and employment at Steel Co. and with SCE.

All of the themes have relevance to the paper's analysis, but theme four's wider scope provides the most useful data. Questioning was concerned with interviewees' knowledge of, opinion of and relationship with the SCE – be it through the BCC or otherwise[1].

Eleven group interviews (comprising between 2 and 4 persons) were conducted involving twenty-five workers from the Blast Furnaces, Power Plant and Reheat Furnaces. Additionally, an interview was conducted with the Energy Optimisation (EO) Manager, who provided impetus for the development of the BCC. Discussions were also held with the Centre's Technical Manager, who acted as liaison between the SCE and Steel Co. for the purposes of the evaluation, and a member of the University's Gas Turbine Research Centre (GTRC), who was responsible, in part, for developing and delivering the BCC. Further interviews were conducted with three Section Managers, (two from the Reheat Furnace and one from the Blast Furnaces).

Further to the interviews, the morning of the third day of the training course was observed, which involved a 'hands on' practical workshop on the combustion of steelworks 'process gases'. Nine workers were participating in the course at the time of observation. The research provided key insights not only into the BCC, but also data on the particularities of the SCE collaboration.

It should be noted that documentary analysis is also an important part of case study research, particularly in regard of the content analysis of important documents. The analysis here is concerned with contractual arrangements, but access to contracts was not permitted. The discussion that follows in regard of these arrangements is based on discussions with key informants (e.g. EO Manager, Technical Manager).

Results

The SCE is part of one university's School of Engineering and was fully funded by Steel Co. for three years (2009–2011), drawing down £1.1 m. It has since been approved for further funding on a reduced basis. The success of the partnership led to it being awarded

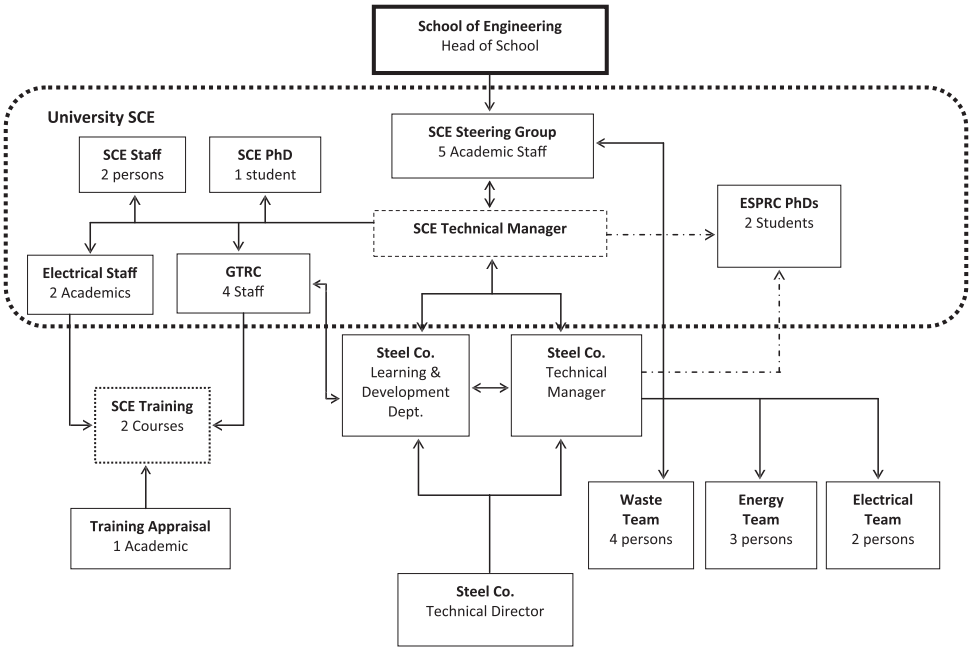

Figure 1. SCE relationship to School of Engineering and Steel Co. (until 2011).

the University's 2010 Innovation Prize, which celebrates successful collaborations forged between the University and industry.

Any collaboration between industry and HEIs tends to be initiated to meet a need within industry that a university can fill – most often this need is skills and/or knowledge-related and draws on expertise that might not reside within a company. At other times, it might be that a university requires industry to help develop more relevant industry-related courses (see King, 2007; Lamb et al., 2010). Other motives include collaboration on research objectives, often to supplement a workforce to undertake specific research projects or provide an industry context for university-led research, as well as undergraduate or postgraduate experience-led learning/research opportunities (see Arlett & Dales, 2008; Arlett et al., 2010).

The SCE works towards many of the above objectives and its collaboration is an example of a successful collaboration. The mutual trust that develops from such a collaboration precipitates other opportunities for widening support to a company, including applying for further research grant funding (this was viewed as important by both the School and Steel Co., with the latter viewing opportunities for cost reducing R&D activity). However, in the analysis of industry-HEI collaborations, it is important to understand the backdrop to initial forms of engagement, including, for example, the strategic priorities of both parties. In this particular case, for the School of Engineering, the demands of the Research Excellence Framework (REF), particularly in terms of impact, provide a clear incentive for collaboration. The School also stands to benefit from opportunities to co-fund Ph.D. research and create more industry-related degrees. For Steel Co., at a time of rising positive cash flows and environmental and energy-related long-term strategic issues, the basis and rationale for investment is also clear.

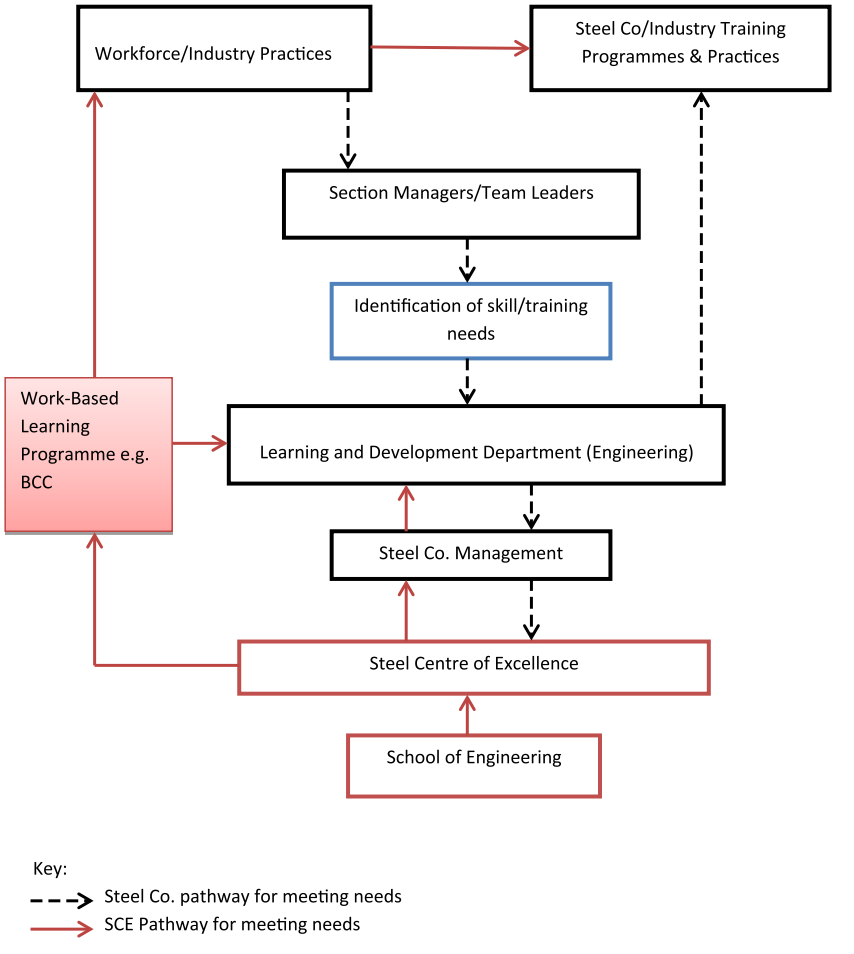

Figure 2. Patterns of engagement in the identification and meeting of skill needs.

At its initiation, the SCE was funded for four core staff, including a Technical Manager, Technician, Research Associate and Ph.D. student. However, as Figure 1 indicates, the Centre's structure is a lot broader and draws on expertise of numerous academic and industrial staff. All members of the SCE are existing School of Engineering staff, some having been recruited to the School for their particular expertise as researchers or managers (e.g. SCE technical manager), and two further (EPSRC funded) Ph.D. students also work on Steel Co. related projects.

The collaboration has resulted in concrete outcomes, with the development of WBL programmes, such as the BCC, as well as ESPRC and SCE funded Ph.D. research. The relationship at its initiation was essentially a customer (Steel Co.)–supplier (School of Engineering) relationship and for this reason necessitated a comprehensive *service level agreement* (SLA) between both parties. The SCE was thus based on a unilateral SLA/contract and, as the EO manager commented, the continuation of the collaboration depended upon 'customer satisfaction' and the SCE – or more precisely the School of Engineering's SCE staff – meeting

specified KPIs. This arrangement suggests however, something of an unequal relationship, particularly in relation to what was otherwise termed 'collaboration'.

An important phase of this initial engagement was meeting skill needs and Figure 2 illustrates the way skill/training gaps/needs are identified and met within Steel Co. It highlights the patterns of engagement in the process and illustrates where SCE and the School of Engineering become part of the process. Steel Co. identifies skill needs (e.g. gas combustion) and SCE is then engaged to meet them (e.g. BCC), thus feeding back into company/industry (workplace and training) practices as required. The development of the BCC (i.e. meeting a skill need) provides one concrete example of how the foundations of such relationships might be unevenly constituted at the outset. The analysis in this respect is concerned with the extent to which important aspects of collaboration are developed – through shared understandings and an appreciation of the factors that constitute effective working relationships – or constrained, where the relationship is reduced to a servicing arrangement (see Arlett et al., 2010).

A version of the BCC was being developed by Steel Co. prior to SCE involvement, but the Centre provided the necessary expertise to complete its design and delivery, and meet an industry-defined skill need. The KPIs are met should the course be assessed to address 'combustion issues' at the site and be favourably received by workers and management, including section managers and others at more senior levels. A range of evidence (e.g. the outcomes of the BCC evaluation, competency assessments administered to course participants by SCE training staff, Industry-SCE progress meetings, etc.) indicated this to be the case i.e. KPIs were met. Further, there was overwhelming interview evidence to suggest that the BCC offered value-added (e.g. "*this is much better than the training we normally have… it really helps us understand our work environment")*. It exemplified the way HEI expertise augments industry learning cultures and might provide the basis for a 'step-change' in the way Steel Co. thinks about or meets its skill needs (for discussions of 'types of change' see Arlett et al., 2010 p. 22) – a positive outcome beyond that specified by the SLA and with potential to develop the collaboration in particular ways.

However, evidence from key informants (e.g. the EO Manager) suggested that the relationship was viewed by industry as no more than 'customer-supplier' i.e. the delivery of a training product. Indeed, whilst it was acknowledged that benefits might well flow from integrating HEI pedagogies into programmes of company workforce development, at this 'initial' phase meeting KPIs by means of the transfer of knowledge (i.e. combustion expertise) defined the basis of the collaboration. As such, the scope of engagement (and potential for its development) is limited by contractual specifications (i.e. meeting the terms of the SLA). To move beyond this initial phase requires the partners to understand, in mutual ways, factors that constitute an effective working relationship (and where practicable underwrite them contractually). There are three aspects that we identify in our analysis that cut across this. Partners need to be mutually agreed on (i) what constitutes success, (ii) where possible begin to develop more closely integrated policy and practice procedures (where interests and responsibilities overlap), and (iii) address imbalances in contractual arrangements (including with regard to resources).

Arlett and Dales (2008) suggest effective working relationships between industry and academia are often not straightforward, with specific problems related to HEI capacity and resource allocation. Indeed, the BCC illustrates the latter point well, with a member of GTRC staff commenting that 'resources are already limited', particularly in terms of under-staffing,

which left him overstretched. Further, as suggested above, a shared understanding between the partners is essential, which requires overcoming differences in culture and language and this takes time, effort and commitment (Arlett & Dales, 2008). In this respect, Arlett et al. (2010, p. 23) identify the need for academics to better understand the priorities and drivers of industry. By the same token, industry needs to recognise and adapt to strategic and operational drivers of academia. In particular, there is a need for clear paths of communication, which work both ways.[2] Formal and informal reporting and communication creates awareness of ongoing activities and opportunities for both the company and university.

At one level, the Technical Manager suggests SCE has fairly clear formal patterns and paths of communication: the SCE reports to Steel Co.'s Technical Development Manager – via monthly written reports and progress meetings and quarterly steering meetings attended by representatives of both parties – who then reports to the Technical Director Steel Co. (see Figure 1). However, formal pathways require to be underscored by wider formal and informal networks of communication, particularly to the broader workforce and other layers of supervision and management. Evidence from the evaluation data indicated low levels of awareness amongst the workforce and section managers of the SCE, particularly with regard to its aims and objectives. Some regarded it with suspicion and scepticism, whereas others were quite unaware of the Centre ('just another contractor'). The consequence is that the benefits of the collaboration were not communicated well enough and pathways to propagating broader and deeper forms of collaborative working were blocked. Evidently, as was commented on by the Centre's Technical Manager, different layers of Steel Co. management did not always appreciate the wider context of the Centre's work and there was reluctance to always communicate SCE's input, particularly whilst employment levels were being adjusted for reduced output conditions – the SCE might be seen as a threat to jobs in this context.

Broader patterns of communication and the extent to which such networks penetrate a workplace perhaps reflect the status of the collaboration. More particularly, the status of the collaboration is a reflection of its 'contractual' basis. First, for Steel Co., as the EO Manager made clear, 'customer satisfaction' or meeting KPIs drives transition from the relationship built in the first phase towards engagement built on bilateral rather than unilateral SLAs. In being satisfied with the relationship, the EO Manager suggested Steel Co. is content for 'spin-off' project proposals to be generated and funded (for example, by a third party, such as the ESPRC), which consolidates the relationship and provides it with fresh foundations; one based on partnership rather than servicing. Ideally, new projects would reflect university and industry research objectives and the generation of results and knowledge would flow back to both parties, including in this case the School of Engineering's research and education programmes. A cycle of ideas for further collaboration based on mutual benefit is generated and the collaboration propagated. As commented by the Technical Manager, this is best exemplified by a SCE ESPRC project on the evaluation of a large energy-intensive site to determine if centralised electricity generation and steam distribution is preferable to local generation. This programme involves two Ph.D. students (one part-time Steel Co. employee and one School of Engineering student) and the information flowing from the project established the basis for a 'Large Scale Power Generation' programme supported by SCE and the GTRC.

The critical factor here, as outlined by the EO Manager, is that the partnership (or contract) is based on measures of success (KPIs) – first in terms of servicing needs (e.g. BCC) and then in propagating the relationship in other ways (e.g. generating research income).

The potential basis for collaboration thus shifts from a unilateral SLA to a bilateral SLA underscored by KPIs for measuring success (e.g. expanded research capacity, regular project proposal submission, the development of effective WBL and research student opportunities, and so on). However, the partnership in many ways remains an unequal one – as long as the collaboration depends on significant contributions from the industrial partner (in this case £1.1 m), its continued participation is likely to be determined only for as long as KPIs are met and cash flows remain positive. Indeed, the reduced level of funding was decided at a time when recession lessened demand for Steel Co. products, effectively diminishing the resources available for capital investment.

Further, we might examine some of the specific 'contractual' conditions upon which the partnership operates, which are illustrative of the quite rigid and inflexible procedures that can stifle partnerships. For example, Steel Co.'s health & safety culture and systems meant that SCE was at first unable to work effectively on site – research is only ever as good as the representative nature of the data collected, but SCE was not initially able to collect its own samples. The Technical Manager suggests that the process of overcoming such "*teething issues*" was largely addressed by attaining Approved Contractor Status (ACS). This involved significant effort from both Steel Co. and the SCE to understand mutual requirements. Steel Co. wished to allow SCE researchers controlled access to the plant, but wanted to restrict access to other members of the university and its students. In effect, Steel Co. required a management system approach to Health, Safety and Environment for contractors. The implications of ACS status extend further. First, as a contractor, SCE is open to internal and external competition, bringing into question the notion of 'collaboration'. Second, the contractual relationship and its form discourage Steel Co. from taking 'ownership' of SCE – problematising ideas of partnership.

Thus, whilst the SCE collaboration developed beyond its initial phase and, in many ways, can be regarded as successful, the extent to which it can be defined as a partnership based on mutual gains and the development of shared understandings and goals is less clear. Indeed, whilst engagement might deepen and mutual respect might grow (e.g. in allowing greater access to the plant for SCE researchers), the collaboration relationship remains unequally constituted.

Discussion

The SCE collaboration might be regarded as an example of the type of 'good practice' case that Arlett and Dales (2008) tell us we need to know more about. However, both Arlett and Dales (2008) and Arlett et al. (2010) note that in developing collaborations, difficulties might derive from the particularities of HEI engineering departments and industry sector practices, policies and cultures. The SCE collaboration, for example, draws attention to differences in learning cultures, as well as communications issues. There are also 'external' factors, such as an industrial sectors vulnerability to wider economic conditions to be considered, which can see partnerships fall victim to programmes of retrenchment and rationalisation.

A particular focus of this paper is the relationship between the type of contract upon which collaborations are based and the lifecycle of the collaboration. The SCE was founded upon a customer–supplier relationship, underwritten by a comprehensive SLA, unilateral in nature, and this structured the initial form of engagement – defining clearly project aims/

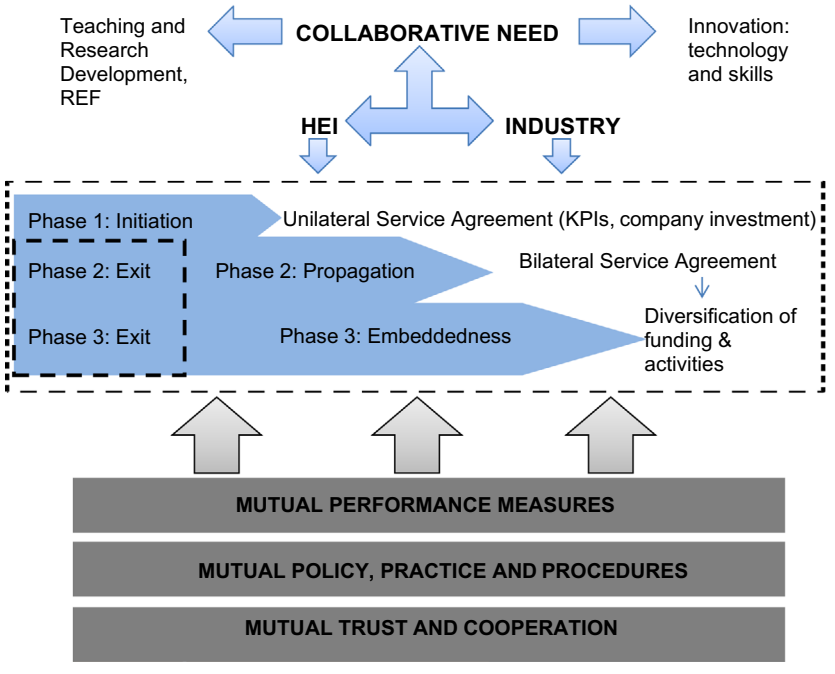

Figure 3. Phases of engagement and determinants of mutual engagement.

objectives and KPIs. Moving beyond this to something more closely resembling a long-term relationship based on partnership, and aimed at encouraging mutual benefits and gains, required the diversification of activities and funding sources – still underscored by KPIs for measuring success, but now underwritten by a bilateral service agreement.

Our analysis of a collaboration lifecycle is represented by separate phases of (dis)engagement – each subject to unilateral or bilateral contractual arrangements, and principally based on KPIs. Further, we identify three specific aspects of working arrangements, which are important in constructing a basis to mutually beneficial relationships (see Figure 3):

(1) Performance measures: *A shared understanding of what designates success*. This requires agreed performance measures, which are sensitive to the priorities and drivers of each sector, and includes effective ways of reviewing progress, fully developed communication networks and the potential for a diversification of activities and funding sources (see Arlett et al., 2010). In the SCE case, shared understanding was not always clear. Thus, whilst KPIs might be met, as in the case of the BCC for example, and activities were seemingly grown and diversified, the evidence suggests that what constitutes success to each partner – beyond meeting KPIs – was viewed quite differently. Steel Co. was resource led (and to this extent risk averse) in its assessment (hence, continuation of the arrangement but on reduced funding), whereas the SCE was more focused on cultivating deeper and more expansive forms of engagement (e.g. the exchange of people and knowledge), but it seems to us that this has only been partially achieved (through, for example, new ESPRC funding applications).

(2) Policy and practice procedures: *The need for a form of marrying of policies and practices*. This necessitates flexibility from both parties. It is illustrated, for example, with regard to recognising and accommodating differences and standards in learning (e.g. BCC) and research (e.g. methodologies) cultures, as well as formal regulatory aspects (e.g. health and safety). More research is required here, but what evidence is available suggests that Steel Co. (as funders and hosts to collaboration) shape policy and practice at the expense of the SCE. On some matters, e.g. health and safety this might well be expected (see point 3), but the broader potential for 'marrying' policy and practice (e.g. incorporating more readily HEI pedagogical approaches into company training strategy) seems to be circumscribed by what some interviewees described as quite rigid structures of management and procedure, as well as some scepticism towards the collaboration (see point 1);

(3) Cooperation and trust charters: *Addressing 'contractual' imbalances.* Ultimately, such imbalances may threaten and undermine collaborations. For example, it is ACS status that seems to be the basis upon which important aspects of the SCE collaboration function, with it providing the framework for mutual trust and a cooperative and productive engagement. However, ACS can be withdrawn at any time. Thus, whilst acceding to company policy – albeit for the most part on understandable health & safety grounds – obtaining ACS suggests an unequal relationship, with the HEI 'contracted' to serve the company and distance the company from the collaboration (i.e. taking ownership). In no obvious way is the company required to understand HEI cultures and policies in quite the same way – even when utilising HEI expertise.

Understanding these aspects of collaboration is important for propagating a relationship and moving beyond initial customer–supplier relationships to more deeply embedded and mutually beneficial forms of engagement (see Figure 3). In our assessment, based on current evidence and levels of activity, the SCE is transitioning between phases 2 and 3 (of Figure 3), but further work requires to be done in relation to the three aspects of mutual engagement set out above.

More broadly, our analysis strongly suggests that in order to facilitate collaboration, a deeper recognition of the respective partners' operational goals and structures is required. Indeed, we argue that to move beyond initial forms of engagement and propagate mutually productive collaboration based on partnership (rather than servicing), a shared understanding of working arrangements, as well as close consideration of the 'contractual' basis of collaboration, is necessary. Failure to meet contractually agreed obligations would understandably mean termination of collaboration, but what might also put collaboration at risk and precipitate exit by one or other partner is a failure to properly consider the specific factors of effective working arrangements, contractual and otherwise.

Notes

1 For example, questions included: Can you tell me what you know about the SCE; How did you learn about the SCE; In what ways do you come into contact with SCE and its staff; What does the SCE bring of value to Steel Co., and so on.

2 Indeed, issues of 'communication' surfaced in the development of this very paper, which has been delayed because of the need to negotiate permission to publish the findings. The

discussions have been complex and lengthy and involved direct communication with various levels of management as well as through an intermediary.

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