IMPROVING INDUSTRIAL VALUE AND LONGEVITY OF SAFETY MANAGEMENT RESEARCH

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The construction industry has a poor safety record when compared with other UK industries. Industry and academia have responded and many industry led initiatives are now in place. Avenues of academic research have been to focus on simulating 'experts' responses to dangerous situations along with the development of managerial frameworks. However, many of these tools and systems prove to be unsustainable for 'real world' scenarios; enjoying only short-lived success or being so unyielding as to make progression from research to industrial use poor value for money. To counter this problem, a number of 'objectives' are introduced to address cultural, managerial and technical issues and restraints. This is based on critical reviews of other academic research along with a discussion of soft management and collaborative techniques. The ultimate aim of the proposed objectives is to strengthen the relationship between industrial and research partners by increasing the longevity of academic research applications and adding value 'at the sharp end' of construction work. Finally, a case study demonstrates how the 'objectives' can be used, and the strengths and weaknesses of this method discussed.

Keywords: health and safety, organizational culture, partnering, project management, value management

INTRODUCTION

Although improving, the UK Construction Industry still exhibits one of the most alarming safety statistics in comparison to other UK industries (HSC 2003). Various UK Government reports (Egan 1998; Health & Safety Executive 2000, 2003, 2004) have recognised the need for safety improvements in addition to an overall change in managerial practice and culture within UK companies. This situation has not been ignored: professional Institutions, collaborative industrial steering panels and researchers alike have all spent considerable time and effort on the problem and have all theorised as to the best 'tool' (including systems and frameworks) to achieve improvements in safety management.

The developments of safety management tools, systems and frameworks tend to rely heavily on "manual" data collection and interpretation. For example, investigating and drawing inferences from case studies such as paper based accident reports (Powell-Price, Bond and Mellin 1998, Chua and Goh 2004, Stoop 2004, Chi, Chang and Ting 2005, Woodcock *et al.* 2005) or recording the methodology of experts as they solve a given problem, coding and transposing their conversational thought process to present expert modelling (Farinha *et al.* 2005). 'Expert' systems in safety

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management have included the use the use of Neural Network (NN), Petri nets (James F. Peters 1999) and Case Base Reasoning (Arditi and Tokdemir 1999, Gouriveau and Noyes 2004, Sung-Sik, Taeksoo and Ingoo 2004). Research has recognised the importance of behavioural and cultural issues on construction safety (Feyer, Williamson and Cairns 1997, Cooper Ph.D 2000, Humphrey *et al.* 2004, Fynes and De Burca 2005)

Increasingly, such applications have been distributed via network and internet connections (Wilkins and Barrett 2000, Cheung, Cheung and Suen 2004) with some allowing free download of software (Diviacco 2005). The proliferation of safety management research in academia, industry, and collaborative partnerships begs the question why the use of such academic 'tools' have not easily transcended the gap to become widespread in the Construction Industry.

Within this context this paper presents a review of the current literature. Various forms of collaborative partnerships, frameworks and performance measurement methods are discussed and a new framework for academic collaboration and strategies (FACS) is presented along with key parameters based on this literature

LITERATURE REVIEW

Many tools and systems have proved to be unsustainable for 'real world' scenarios; enjoying only short-lived success or being so unyielding as to make progression between research and industry poor value for money (Kaneko, Yonamine and Jung 2006, Sousa, Aspinwall and Rodrigues 2006). Creating a sustainable collaborative cycle between those involved in research and development (R&D) and those at 'the sharp end' of construction practice is important to both the industrial and research partners (Drongelen, Nixon and Pearson 2000). Research has also suggested that productivity of researchers who collaborate with industry is greater than collaborative partnerships with peers and other institutions (Landry, Traore and Godin 1996). Other reasons for a collaborative venture between industry and academic research include resource and information sharing, securing future research funding and collaborations, and lastly, prestige of being associated with a successful venture.

This literature review will focus on two aspects of research aimed to identify key parameters applicable to safety management tools: survey questionnaires and measurement performance tools. The review is then used to identify 3 key parameters, which will be referred to as as the 3R's: Resources, Results & Relationships.

Survey Questionaire

Historically, research has been limited to the investigation of perceived key factors by questionnaire (Landry, Traore and Godin 1996) and / or case studies (Nixon 1998) in order to identify key parameters. Parameters can also be taken from literature searches and current best practice guides and ISO standards (Rao Tummala *et al.* 1997, Varonen and Mattila 2000, Vredenburgh 2002, Gervais 2003). Brief summations of such research are given below where it can be seen that selection of parameters is by no means universal.

1. Six parameters were identified during a survey of senior personnel in consultancy, client, contractor and supplier roles in Hong Kong (Ugwu *et al.* 2006). This work identified key sustainability indicators from the perceptions of these various stakeholders toward infrastructure projects

2. Similarly, 21 'best value contributing factors' (or BVCFs) were gained from questionnaire survey aimed to establish international expert opinion on various issues relating to Public-Private Partnership (PPP) projects relating to build-operate-transfer type contracts (Zhang 2006). Results from 29 industrial and 17 academic respondents spanning 12 different countries indicated small differences in the top ten parameters.
3. A questionnaire sent to a mixed group of 300 contractor, clients and consultancies in China used 13 performance metrics grouped into 4 categories: cost, time, quality and relationship performance (Jin and Ling 2006). Although there was no indication of the response rate or type mentioned in the study, regression analysis of the result showed 4 key variables, 5 relational building tools and 3 relational risks.

Modelling of management strategies has also been researched. Neural networks (NN) have been used to model and evaluate the effect of different levels of project management efforts or strategies on the budget performance of a project (Chua *et al.* 1997). Chua's NN model was trained using data from a previous questionnaire survey (Jaselskis 1988) relating to 75 construction projects, 48 from contractor organizations and 27 from owner organizations. This research identified eight key project management factors from 27 input parameters.

Past questionnaires have been used to develop a quality performance evaluation model to better evaluate bidders during the contractor selection process (Yasamis, Arditi and Mohammadi 2002). Ten 'Corporate Quality Performance indicators' were used in this research, as derived and adopted from previous questionnaire surveys of 200 managers (Black and Porter 1996).

Questionnaire can also be used to highlight important management issues. A postal survey of Singapore contractors showed site accidents were more likely to happen when there are inadequate company policies, unsafe practices, poor attitudes of construction personnel, poor management commitment and insufficient safety knowledge and training of workers (Teo, Ling and Chong 2005).

Performance Measuring

Although a substantial body of research work exists on methods of performance measuring within the general business setting, very little has made the leap to safety management.

There is substantial amount of research recognising the development and implementation of performance measures can improve business performance (Neely 1998, Schiemann and Lingle 1999). Historically, performance measuring within construction has been restricted to financial terms such as comparison between forecast and actual costs. Negative issues arising from reporting focussed solely on a financial snapshot were outlined during a critical appraisal of Key Performance Indicators (KPIs) for the construction industry (Beatham *et al.* 2004). Performance measuring can be viewed as only a small part of an improvement process as without subsequent action based on continuous improvement, measurement values are utterly meaningless (Beatham *et al.* 2004). To this aim, benchmarking can act a performance 'snap shot' whereby the current performance measures are recorded for comparative analysis against other timeframes, thus corroborating important decision choices and assessing whether these choices were in fact correct.

The European Foundation for Quality Management Excellence model (EFQM 2006) is a tool to aid business managers in continually assessing eight non-financial performance criteria. Performance prowess using such models can lead to awards by accredited bodies. 'Quality awards' are no new occurrence in business and are descended from the 'Deming Prize' introduced in 1951 marking the work of Dr W. Edwards Deming and Dr Joseph Juran towards aiding the post-war recovery of Japanese Industries (Beatham *et al.* 2004).

Within an 'non-business' setting, key features of academic performance have been recognised as basic research, applied research and instructional development (Martz, Mckenna and Siegall 2001). This research work established an IC (intellectual contribution) model aimed at continually improving the contributions within a medium sized USA university. The IC process model contained 5 principles and presented 6 milestones assessing 'relative value' of academic performance measured as point against

Finally, other key measuring parameters included perceived importance of the relationship, information exchange, conflict resolution procedures and expected rewards (Bonaccorsi and Piccaluga 1994) and the importance of traditional and peer mentoring within individual and group setting (Level and Mach 2005).

THE 3RS

The 3Rs three key topics of 'resources', 'results' and 'relationships' as identified during a mapping exercise to collate general key parameters from the literature. Table 1 shows the mapping of key parameters discussed in the literature review under these 3topics.

The topic of 'resources', the first of the 3Rs, must include communication between those involved in the research venture, provide a platform for scoping team roles for both strategic and operational members and methods to facilitate the general administration of the project.

'Results' must focus on the project goals including their scoping, measurement and evaluation methods along with contingency strategies for changes and unavoidable lapses in performance expectations. Links between these team defined goals are likely to relate to the established performance of 'actual versus anticipated' cost, time and quality indicators but must also incorporate the collaborative needs of the team

The last of the 3Rs, 'relationships' must deal with two remaining, but never-the-less important issues: satisfaction perception and education. Discussion and understanding of each others expectations for the project and the level at which they are satisfied with the outcome are crucial in determining the overall outcome of the project. Transparency and feedback is equally important in recognising academic and business needs, whether this is in the form of accredited courses, peer and/ or traditional mentoring schemes

Table 1: The 3Rs and mapped parameters from literature review

Resources	Results	Relationships	Author
Resource Utilisation, Project Administration	Health and Safety	Societal, Economy, Environment	(Ugwu *et al.* 2006)
Optimized resource utilisation	Low project lifecycle cost, early completion (service delivery)	Reduce disputes, long life project span	(Zhang 2006)
No of organizational levels (project manager and workers), level of detail design at preliminary stages, No of 'control' meetings & budget updates.		Team Turnover, project managers experience	(Chua *et al.* 1997)
People and customer management, supplier partnership	Strategic quality management, operational quality planning, quality improvement measurement systems, corporate quality culture	Communication of improvement information, customer satisfaction orientation, teamwork structures form improvement	(Yasamis, Arditi and Mohammadi 2002)
Empower staff with authority, early involvement between all project parties	Adhere to mutual goals, solving problem jointly	Maintaining sufficient/efficient communication, relationship building workshops, Cultivating a learning climate	(Jin and Ling 2006)
Leadership and constancy of purpose, management by process and facts	Results orientation customer Focus, public responsibility	People involvement and development, continuous learning/innovation and improvement, Partnership development	(EFQM 2006) (Beatham *et al.* 2004)
Conflict resolution procedures	Scoping of expected rewards	perceived importance of the relationship, information exchange	(Bonaccorsi and Piccaluga 1994)

A FRAMEWORK FOR ACADEMIC COLLABORATIONS AND STRATEGIES (FACS)

The uses of frameworks to provide management strategies for safety, health and risk management in projects have been developed by a number of authors both in industry and academia. For example:

- the multiple attribute decision-making (MADM) framework to assist decision makers in selecting the winning design/procurement proposal based on cost, safety, and technical performance (Sii and Wang 2003)
- prescriptive industry-university collaborations (Landry, Traore and Godin 1996), and the difficulty in capturing informal or quasi formal informative

channels. Landry also notes that where formal communicative structures exist, little information is often given as to the intensity of the collaboration or number and/or importance of joint decision and reliance on such a formal and structured communicative channel may bypass collaborative activities between individuals

However, there is little evidence of any framework widely used in UK Universities who undertake such academic/industrial projects. This paper introduces a Framework for Academic Collaborations and Strategies (FACS), which aims to counter this problem by providing an easy to follow format to improve management of such projects. Within this paper and the work of these authors, it is focussed towards safety oriented research, though its application is also intended to be generic.

FACS

The proposed Framework for Academic Collaborations and Strategies (FACS) is aimed towards guiding academic, industrial and other funding bodies as they collaboratively manage projects. The example of a FACS structure is given as Figure 1 for a FACS team of 3, namely the 'academic', 'industrial' and 'active worker' (i.e. perhaps a PhD student or researcher undertaking the work).

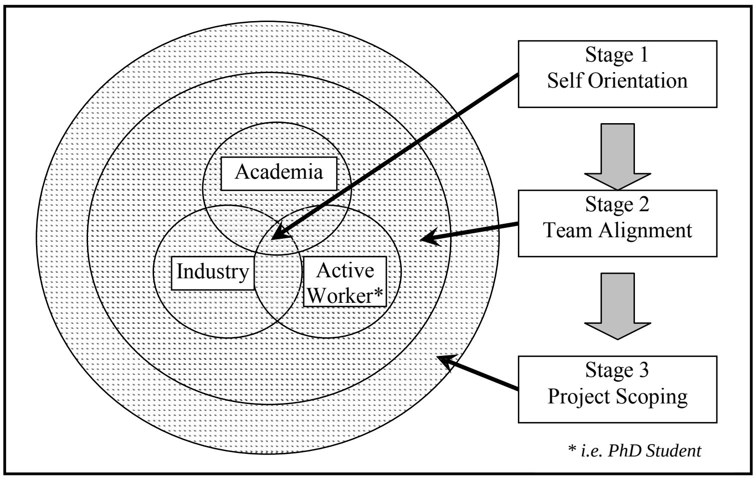

Figure 1: FACS Structure

The first stage of FACS is a 'self orientation' process whereby each partner must assess their individual view the importance of the project towards the needs of society, the economy or specific industry, the industrial partner's competitive 'edge', academic and personal career prospects. Overall these topics act merely as an aid to generate individual focus within each group and it is suggested that this be done at some form of facilitated 'start up' workshop where all those concerned may have an input. Ranking these (and other important) topics in order of individual importance will demonstrate the individual agendas and a further exercise will show how they initially perceive the agenda of other members of the FACS team.

In the Second stage of the FACS process, results from the both ranking exercises can be pulled together and pre-workshop assumptions and differing opinions discussed between the FACS team in order to create an agreed set of topics, ranked in importance. Thus the FACS Team has undergone 'team alignment' and have all contributed towards a united agenda.

The third and final stage of the FACS process is to agree the structure of the project in a scoping exercise using the 3Rs; resources, results and relationships. This scoping exercise should be held as a facilitated brainstorming workshop whereby each member of the FACS team can contribute their thoughts under the 3Rs. Consequent sub-topics can then be prioritised and scoped with designated responsibility and accountability between the FACS team. Scheduled ‘follow-on’ workshops and/ or meetings will then exhibit a collaborative management structure based on these discussions, and may provide further strategic direction in project.

CONCLUSIONS AND FURTHER STUDY

This research has reviewed key parameters gained from previous research involving questionnaire surveys and performance measurement methods in order to develop three key topics towards the improved management of academic-industrial collaborative work in safety research. These 3Rs - resources, results and relationships – can further be used as an integral part of a ‘Framework for Academic Collaborations and Strategies’ (FACS). The introduction of FACS and an example structure has highlighted how the management of academic/industrial projects can be facilitate by providing a three phase system of self orientation, team alignment and project scoping.

Further research on brainstorming techniques and practices is necessary in order to provide case studies using FACS and the 3Rs, as are willing academic/industrial candidates to become FACS teams.

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