AN INVESTIGATION INTO PROJECT TEAM DYNAMICS AND THE UTILISATION OF VIRTUAL ENVIRONMENTS

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The construction industry offers its services to customers. Change in the industry has been significantly driven by large client organisations demanding a better service from construction industry participants. A key factor in the achievement of successful project outcomes is the nature of the relationship between members of project teams, including clients, which need to be established as early as possible in a project's life cycle. This paper focuses on the initial phase of a research scoping study which aims to investigate, by reviewing and analysing relevant literature, project team dynamics from the standpoint of "people and process" issues. The impact on the growth of Information and Communication Technology (ICT) on teams is discussed, specifically in terms of how its implementation affects project teams, and the individuals within them. The research method involves a literature review which identifies key factors relevant to project and virtual team environments. The outcome of the literature review is the identification of a model of work design to be tested in the next stage of the scoping study. The paper concludes that although, not unexpectedly, project management and virtual team literature share many common themes, a greater understanding of how new, and different, knowledge and skills are required by teams to work in virtual environments is critical.

Keywords: construction client, construction professional, project team dynamics, virtual environment.

INTRODUCTION

The relationship between participants in a project process is the source of unpredictable behaviour that impacts on project performance. Project processes involve many independent agents interacting with each other in many different ways, creating situations of great complexity. The behaviour of each agent, while directed at the project objectives, is also influenced by their own agenda, determined by a, *"...web of incentives, constraints and connections."* (Groak, 1992). Effective relationships within the project team has been demonstrated to be directly related to improved performance (Walker, 1995; 1996). The relationships and 'formal' behaviour of project participants can to some extent be moderated by 'contractual rules' and the management of this can be facilitated using Information and Communication Technology (ICT) mediated processes.

The impact of Information Technology (IT) cannot be ignored as it has had a significant influence on the work environment (Van der Spiegel 1995). Parker *et al.* (2001) suggest that factors such as the low cost and portability of computers and internet access have led to employees being able to, *"...work away from a designated*

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office (geographic virtuality) and to work a 'waking' week rather than a 'working' week (temporal virtuality) ". This has led to the growth of employees working in virtual teams (Duarte and Tennant-Snyder, 2000).

The focus of this paper is to investigate project team dynamics from the standpoint of "people and process" issues rather than a detailed investigation on ICT issues. The impact on the growth of IT usage on teams will be discussed, specifically in terms of how its implementation affects project teams, and the individuals within them, taking into account process changes and skills development; ie. current skills and any new skills required to work efficiently and effectively in an ICT environment.

FACTORS INFLUENCING PROJECT TEAM PERFORMANCE

Systems have been developed to measure the performance of individuals (eg. consultants, contractors) (NSW: CPSC 1999; 2000), and projects (using key performance indicators (KPIs)) (DETR 2000), but research into project team dynamics, relating to the construction industry, is limited. Much has been written on relationships between project participants initially prompted by issues such as alternative procurement systems but of late this has developed into areas relating to partnering, strategic alliances (Bresnen and Marshall 2000a; 2000b) and supply chain management (London and Kenley 2001; Love *et al.* 2002). Although the same parties are involved in any construction project (eg. client, professional advisors, contractors, sub-contractors, suppliers) the relationships between them can differ depending upon procurement and contractual systems adopted. Such changes have, in part been influenced by increasing demands from the industry's clients for better, and more efficient, products and services (Davis 1995; Latham, 1994; DETR, 1998; New South Wales Government, 1998). A consequence of this has been that the boundaries between organisations are blurring; with a growth in 'network organisations' (eg. joint ventures, strategic partnerships).

Walker and Shen (2002: p31) state the importance of organizations understanding the mechanisms that help to achieve better planning through adopting flexible approaches to overcoming unexpected problems. They also put forward the proposition that, *".....the degree of ability of construction management teams to exercise flexibility options during construction to obviate unexpected problems is influenced by two key factors, the ability to be flexible and the commitment to do so."* This relates to project complexity and the ability of the team and individuals to understand it, and be flexible when overcoming unexpected problems. In turn these are influenced by individual / team enabling goals which can be internalized through the development of 'mental models' (Senge, 1992; Schon, 1983).

A report from the "Movement for Innovation" working group in the United Kingdom (UK) (Movement for Innovation, 2000) has highlighted the importance of people issues in the construction industry. It puts forward a 'business case' for such improvement hinging on the '3 **R**'s' contending that, *" – firms who fail to improve their attitude and performance towards **Respecting** people will fail to **Recruit** and **Retain** the best talent and business partners."* The report states that this should apply to all organisations, large or small, in the supply chain. The use of Key Performance Inticators has shown, on demonstration projects, better performance in terms of client satisfaction, productivity and motivation of teams and individuals (M2 Presswire 2001).

Project management literature suggests a number of important factors to be considered when discussing project teams and their dynamics. Sotirouu and Wittmer (2001: p12)

conducted a study which found that the creation of professionally challenging projects was the single most important factor influencing the behaviour of project team members. Jiang *et al.* (2001: p49) investigated issues confronting project organisations and posed the question as to where responsibility for creating a positive project environment lies; with the project manager or the organization itself. They concluded that it was important for senior management to foster environments that allow project managers to adopt needed methods effectively. Veil and Turner (2002: p137) state that, *"Experiencing progress and well-being within a project group is of the utmost importance both to the project managers and the project team members."* They also contend that although working in a project group may bring insecurity and stress, caused by new colleagues and contexts, it is more exciting than any other business situation; in that it is meaningful, a continuous process of learning and adapting and of overcoming problems. Wang (2001: 2-8) suggests that, *"Professional culture is important to guide members of a profession to think and behave as the profession requires."* He puts forward, based upon the survey and analysis of data collect by questionnaire, a model of Project Management (PM) culture consisting of four key dimensions, each with sub-dimensions, as shown in Table 1.

Table 1: Project management (PM) culture model (Wang 2001: 2-8)

Key dimensions	Sub-dimensions
1. Professional commitment	PM career pursuit
	PM reference group
	Leisure time for PM
2. Project team integration	Consciousness of team identity
	Knowledge-based influence
	Informal process
3. Work flexibility	Job decodification
	Work autonomy
4. Viewing others in terms of work performance	Positive aspects
	Negative aspects

White and Fortune (2002: 6-9) conducted a survey of 'real world' experiences of people active in project management. Two aspects of the survey instrument design involved the identification of common criteria used for defining project success and the establishment of a list of 'critical success' factors. Criteria used for judging project success, and the top ten factors critical for successful project outcomes are summarised (in rank order highest to lowest) in Table 2.

Table 2: Project success and outcome factors (White and Fortune 2002: 6-9)

Criteria used for judging project success	Factors critical to successful project outcomes
1. meets client's requirements	1. clear goals / objectives
2. completed within schedule	2. realistic schedules
3. completed within budget	3. support from senior management
4. meet organizational objectives	4. adequate funds / resources
5. yields business and other benefits	5. end user commitment
6. causes minimal business disruption	6. clear communication channels
7. meets quality / safety standards	7. effective leadership / conflict resolution
8. other criteria	8. effective monitoring and feedback
	9. flexible approach to change
	10. taking account of past experience

Many of the criteria and factors in the above table are often cited in literature related to the management of projects (eg. Bennett 1991; Morris 1994; Walker 1996). Key issues relating to the literature presented in this section will be summarised in the subsequent 'Discussion' section of this paper.

FACTORS INFLUENCING THE PERFORMANCE OF TEAMS WORKING IN VIRTUAL ENVIRONMENTS

The United States Construction Industry Institute (CII) has initiated a study of the implementation and management of virtual teams to examine practices and develop recommendations (Construction Industry Institute 2001). The majority of CII members believe that virtual teams will be a primary mode of project execution within 5 years and that consideration needs to be given to organizational and technological issues. The subsequent sub-sections discuss issues relating to virtual teams.

What is a 'Virtual Team' (VT)?

A succinct summary is provided by McDonough *et al.* (2001: p111) who distinguish between various teams:

- **Colocated teams** are comprised of individuals who work together in the same physical location and are culturally similar.
- **Virtual teams** are comprised of individuals who have a moderate level of physical proximity and are culturally similar. One example of a virtual team is where team members are located in different parts of the same country. Another example is where team members are in the same building but on different floors.
- **Global teams** are comprised of individuals who work and live in different countries and are culturally diverse.

The need for Virtual Teams (VTs)

VTs are viewed by Kayworth and Leidner (2000: p183) as vehicles by which cycle times are improved, travel costs reduced, and redundancies across organizational units reduced. In a global business context, Kayworth and Leidner (2000: p183) identify the deployment of VTs as an attractive management strategy because. *"... it allows dispersed organizations to maximize their expertise without having to physically relocate individuals. The required expertise for a given task or project may be dispersed at multiple locations throughout the organization, however, a virtual team may facilitate the 'pooling' of this talent to provide focused attention to a particular problem without having to physically relocate individuals. In addition, virtual teams may allow organizations to unify the varying perspectives of different cultures and business customs to avoid counterproductive ethno-centric biases."* Kayworth and Leidner (2000: p184) also identify further benefits of cost reduction, cycle-time reduction, integration of distant members, and improved decision-making and problem solving skills.

Problems / challenges with virtual teams

VTs are beset with a range of challenges inherent to their dispersed, and often impersonal, nature. Indeed, McDonough *et al.* (2001: p11) argue that *"...if team members cannot be colocated they may as well be miles apart, since even a small degree of dispersion among team members will negatively affect the degree of trust and degree of cooperation between them."* While all teamwork involves challenges to be managed, the tools at the disposal of VTs limit the options they have for addressing the difficulties of coordination (Kayworth and Leidner 2000: p183). Furthermore, maintaining VTs can be very challenging due to the complex set of variables they involve. This, as well as an appreciation of the difficulties in achieving business objectives and turning value from these relationships, has been noted by Lurey and Raisinghani (2001: p524).

Kasper-Fuehrer and Askanasy (2001) argue that, when dealing with establishing trust in virtual organizations, appropriate ICT is needed, as is the establishment of a common business understanding and maintenance of ethical standards. They identify the importance of "information sharing" which contributes to a virtual organization's flexibility and responsiveness. In addition, as virtual organisations are temporary by nature, the communication of shared values and visions, leading to a sense of organizational identity (Gioia *et al.* 2000) is an area which has not been researched in any detail.

The need for working differently

The literature suggests that VTs require the application of management strategies which are different to those applied for traditional practices. According to McDonough *et al.* (2001: p117), "...*firms need to recognize the different problems that may be associated with managing colocated, virtual, and global... teams. This also suggests that companies may need to prepare their managers and team members for working in different types of teams and in teams whose members speak several different languages and come from a variety of cultures*". This view was echoed by May and Carter (2001) who identify the possible tensions that may occur when new work practices are implemented in the automotive industry. They note the view held by engineers using their VT environment that their responsibilities and authorities may need to be redefined as they did not necessarily possess the skills and authority to make decisions using them. They sum up by stating that, "...*management of changes in roles within companies must be achieved, with devolution of responsibility and authority as appropriate*". (May and Carter 2001: p182). Similar findings are articulated by McDonough *et al.* (2001: p117) who found VTs pose greater behavioral and project management challenges than colocated teams.

A key finding of the literature is the need for management of the processes inherent in managing VTs. Lurey and Raisinghani (2001: p532) observe that, "...*formal processes must be developed. Due to the physical barriers involved with virtual work... these teams require more structure to perform their work. In addition, the individual team members' roles and the teams' primary objectives must be explicit, not simply assumed.*"

The benefits and advantages of working in virtual teams

VTs should result in many and varied benefits and advantages over traditional practices. These include better quality, reduced costs and a reduction in the time-to-market (May and Carter 2001: p172). These benefits extend to the supply chain where greater integration is possible (May and Carter 2001: p182). May and Carter's studies note that, "...*the various stakeholders (users, managers and implementers) suggested that the widespread adoption of technologies... would enable a more effective use of company resources, a greater degree of simultaneous engineering and a more flexible approach to engineering liaison and problem resolution by distributed engineers throughout the supply chain.*" (May and Carter 2001: p183).

Challenges of working in virtual teams
Effective use of VTs present various challenges. Kayworth and Leidner (2000) categorise these into the following four areas:

Table 3: Challenges of working in virtual teams (Kayworth and Leidner 2000: 186-190)

Areas	Challenges
Communication	VTs potentially face a much greater strain on communications
	VTs must use a variety of means to transmit information, meaning, and symbols over time and space
Culture	Cultural differences among VT members may intensify some communications problems
	Culture may also act in a positive manner to bring diversity on VT behavior
Technology	Problems likely to be experienced include:
	Maintaining any type of structure or theme throughout meetings
	Variability among individual's level of skill or familiarity with information technology
	The level of technical expertise of individual team members
Project Management	The quality of project management is a vital issue
	Distributed working requires more of a group management and co-ordination overhead than standard face-to-face meetings
	The solutions at the disposal of team leaders to address the problems of teamwork are quite different in the VT from the face-to-face. In face-to-face environments, increased monitoring can be employed as can frequent one-on-one discussions with various members. In the virtual environment, much of the control and reward capabilities of the leader are reduced so that the leader must create inventive solutions to address team problems.

Changes in skills requirements

It is clear that VT members require a different mix of skills to those of traditional teams. These include project management and skills in liaison/negotiation (May and Carter 2001: p116), skills to deal with cultural and language complexities (McDonough *et al.* 2001: p116) and skills in developing a shared vision or goal, developing a sense of team identity, getting a state of mutual trust, communicating effectively, enjoying the group process and successful interpersonal processes (Tullar and Kaiser 2000).

DISCUSSION

Having reviewed literature relevant to both project team dynamics and virtual teams in this paper, this section briefly summarises the key issues, and puts forward a model which will be used to gather data, utilising a methodology which is also outlined.

Key issues emerging from the literature review

The project team performance literature has within it a number of common 'themes' and 'issues'. The need to create 'positive' environments which are challenging to project teams is a central theme. Other themes relate to 'people issues' (eg. respect, excitement, trust, relationships, communication) and 'environmental / process issues' (eg. customer / client demands, team integration, culture, complexity, flexibility, leadership). The review of literature, in the project team and virtual team areas, supports the contention that both people and process issues are important when considering project team dynamics. It also links into a growing trend in the construction industry towards partnerships and alliances which, if taken to an extreme, can encompass the entire supply chain. Love *et al.* (2002: p7) present a model for construction alliances which emphasises a, "...*collective learning environment.*" as a key element. The model includes references to issues such as: knowledge, communication, teams, culture and relationships, linking to factors identified by Wang (2000) and White and Fortune (2002). The literature relating to virtual teams also strongly emphasises these issues (McDonough *et al.* 2001). It also supports the importance of considering integrated supply chains (May and Carter 2001), as well as

stressing the need for good project management (Keyworth and Leidner 2000). Therefore many key issues emerging from both areas of literature reviewed are common. The overriding theme, emerging from this research investigation, is that of work design to enable people to work in project teams, utilising virtual environments, efficiently and effectively. Parker *et al.* (2001) propose a work design model, summarised in Table 4, containing 5 categories of variable. This model is the result of a comprehensive review of literature based upon a premise that, *"developments in work design theory have not kept pace with changes in the organizational landscape."* The model, outlined in Table 4, will be used for this research pilot study to elicit views from participants in the construction process to obtain views and opinions on key factors influencing team dynamics and working in virtual teams. The model contains all of the key factors identified from the literature in this investigation.

Proposed research methodology for a pilot study
It is intended to collect qualitative data, via interviews, from representatives of different participants in a typical construction supply chain: clients, architects, quantity surveyors, consulting engineers, project managers, construction managers, sub-contractors and suppliers. The objective of this approach is to gain an insight into different views of all parties involved in virtual and traditional projects. The outcome of the data collection and analysis will be a critical review of the original model to produce, if appropriate, a 'refined' model for further, and more rigorous testing beyond this pilot phase.

Table 4: Model of work design (Parker *et al.* 2002: 419-432)

Categories of variable	Main factors relating to variable
1. Antecedents	*external organisational factors* (environmental, political, labour market, technology) *internal organisational factors* (management style, technology/tasks, organizational design) *individual factors* (personality, beliefs, trust)
2. Work characteristics	*individual level* (eg. job control, skill variety, performance monitoring, role conflict, social contact) *group level* (eg. autonomy, feedback, skill variety, task interdependence) *interaction between individual and group level factors*
3. Outcomes	*individual / group outcomes* (eg. performance, safety, creativity) *organizational outcomes* (eg. productivity, customer satisfaction, accidents, innovation)
4. Mechanisms linking work characteristics to outcomes	*motivation, quick response, learning and development, interaction processes*
5. Contingencies affecting the link between work characteristics and outcomes	*organizational* (eg. interdependence, uncertainty, information / technological systems) *group* (eg. norms, knowledge structures, size, skill composition, goal clarity, information support *individual* (eg. growth, ability, context satisfaction, trust)

CONCLUSIONS

It is clear that an understanding of how project teams function is a critical issue, particularly in relation to the growing utilisation of ICT within and between participants in such teams. This is well summarised by Lurey and Raisinghani (2001:

p532) who state that, *"...team leaders need to establish positive team processes, develop supportive team member relations, create team-based reward systems, and select only those team members who are qualified to do the work... These factors, then, clearly constitute the beginnings of a comprehensive set of best practices to be used when designing and supporting effective teams, regardless of whether they are co-located or virtual."*

Perhaps the use of ICT could be seen as something which could improve the nature of project team performance by reducing more mundane tasks (such as record-keeping, improving communication, etc) to allow team members to concentrate energies on being more creative and innovative. However, a contrary view could be that the use of ICT, without a strategy to ensure that project team members have the necessary knowledge, understanding and skills to utilise the technology to its potential, could be counterproductive. This research, having identified key issues from the literature, seeks to investigate this potential dilemma further.

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