

The Impact of Information and Communication Technology (ICT) on Project Team Dynamics and Work Design

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Abstract

Numerous reports worldwide have highlighted degrees of client dissatisfaction with the services they receive from the construction industry putting forward issues such as: consultants' performance, speedy and reliable service and value for money. Change in the industry has been significantly driven by large client organisations demanding a better service from project team participants. A key factor in achieving successful project outcomes is the nature of the relationship between members of the project teams, including clients, which needs to be established as early as possible in a project's life cycle. This paper discusses the impact of the growth of ICT usage on construction project teams, specifically in terms of how its implementation affects such teams, and the individuals within them, taking into account process changes, work design and skills development relevant to project teams working in virtual environments. It then reports some of the outcomes of a research pilot study which investigated project team dynamics from the standpoint of "people and process" issues; concentrating on project team members' experiences and their reflections on how changes and improvements to their work situation could be facilitated in the future. The paper concludes that the key factor in achieving successful outcomes was the need for a project team strategy to implement ICT, supported by appropriate knowledge, understanding and skills to ensure that the technology was utilized to its full potential.

Keywords

Information and Communication Technology, Work Design, Project Team Dynamics.

1. Introduction

A research report conducted by the United States Construction Industry Institute (CII), which studied the implementation and management of virtual teams, examined practices and developed recommendations (Construction Industry Institute, 2001). The report concluded with a belief of the majority of CII members who participated in the research, that virtual teams will be a primary mode of project execution by 2006. Furthermore, the report stated that technological and organizational issues, in particular, needed to be considered. Therefore with the likelihood of project teams having to perform, to differing degrees, in virtual environments, careful consideration needs to be given to people and process issues. Van Der Spiegel (1995) suggests that it is difficult to ignore the impact of Information Technology (IT) given that

it's effect on the work environment is significant. The objective of this paper is to provide an overview of certain aspects of a research pilot study. It provides some background information, from a review of recent project management and Virtual Team (VT) literature, relating to project team dynamics and work design, specifically in relation to project teams working in virtual environments. Findings of a single case study project are presented which discuss project team participants' 'reflections' on how their experiences of working in a team utilizing ICT could lead to improvements in performance of such teams in the future. More detailed outcomes of the research can be found reported elsewhere (e.g. Gameson and Sher, 2002)

2. Project Teams and ICT Implementation

2.1 Project Teams and Virtual Teams

There are now many alternatives from which clients of the construction industry can choose to procure facilities, **with a growing trend, particularly with major clients in both the private and public sectors, towards more long-term relationships with construction organizations such as, partnering and alliancing and public-private partnerships, including Build-Operate-Transfer (BOT) and other derivatives (McCarthy and Tiong, 1991), a number of which involve international consortia (Flyvbjerg *et al.* 2003), and therefore lead to situations where project team participants may find themselves working together 'virtually' from geographically distant locations (Duarte and Tennant-Snyder, 2000).** The importance of good planning has been identified as being crucial to project success. Walker and Shen (2002) contend that there needs to be a clear understanding of mechanisms to adopt which allow for flexible problem solving. With regard to the 'people' dimension of project team dynamics Sotirou and Wittmer (2001) report that project team members stated, when surveyed, that "...*challenging projects...*" influenced their behaviour, as did the project culture (Wang, 2001). Respect for people (Movement for Innovation, 2000) and team members experiencing progress and a sense of "...*well being...*" were also identified as important factors (Veil and Turner, 2002).

McDonough *et al.* (2001) define virtual teams as being, "...*comprised of individuals who have a moderate level of physical proximity and are culturally similar.*" It is suggested, by Kayworth and Leidner (2000) that virtual teams are an attractive management strategy in that, "...*they allow dispersed organizations to maximize their expertise without having to physically relocate individuals.*" This can lead to cost and time benefits as well as improved decision making and problem solving. However, there are also significant challenges to address to ensure that virtual teams work efficiently and effectively with regard to issues such as trust, cooperation and information sharing (Kasper-Fuehrer and Askanasy, 2001). In addition there needs to be a structure to the work performed with explicit objectives (Lurey and Raisinghani, 2001). Finally the need for a mix of appropriate skills has been identified to ensure good communication between team members (Tullar and Kaiser, 2000).

2.2 Key Issues and Work Design Model

The discussion in the previous two sub-section highlights some key issues relating to project and virtual teams. Table 1 below provides a full list of key issues that emerged from the literature review conducted for the research pilot study.

Having reviewed relevant literature above, and also identified key factors, the next stage of the research was to develop a 'test' to compare 'theory' with 'practice'. An overriding theme, emerging from this investigation, is that of work design to enable people to work in project teams, utilizing virtual environments, efficiently and effectively.

Table 1: Key Issues Emerging from the Literature Review

Key issues	
<ul style="list-style-type: none"> • Relationships between team members • Team incentives, constraints and connections • Individuals' performance monitoring and feedback • Project performance monitoring and feedback • Skills development • Good communication • Organizational design and structure • Individuals' commitment / involvement • Problem solving: flexibility and commitment • Project complexity • Individual and team goals • Challenging projects • Positive project environments 	<ul style="list-style-type: none"> • Team building • Team integration • Project success criteria • Project leadership • Customer demands • VTs need effective project management • Traditional communication strategies inappropriate to VTs • Cultural issues may impinge on VTs • Geographic proximity of team members important to successful communication • Importance of clarity of roles of members within VTs • Recognition of need to employ different skills

Parker *et al.* (2001) propose a work design model, summarized in Table 2, containing 5 categories of variable. This model is the result of a comprehensive review of literature based upon Parker *et al.*'s (2001) premise that, “developments in work design theory have not kept pace with changes in the organizational landscape.” This includes consideration of changes to project teams and the growing influences of new technology upon the work of such teams. The model below was adopted as the framework for data collection.

Table 2: Model of Work Design (from Parker *et al.* 2001)

Categories of Variable	Main Factors Relating to Variable
1. Antecedents	<ul style="list-style-type: none"> a. <i>external organizational factors</i> (environmental, political, labour market, technology) b. <i>internal organizational factors</i> (management style, technology/tasks, organizational design) c. <i>individual factors</i> (personality, beliefs, trust)
2. Work characteristics	<ul style="list-style-type: none"> a. <i>individual level</i> (e.g. job control, skill variety, performance monitoring, role conflict, social contact) b. <i>group level</i> (e.g. autonomy, feedback, skill variety, task interdependence) c. <i>interaction between individual and group level factors</i>
3. Outcomes	<ul style="list-style-type: none"> a. <i>individual / group outcomes</i> (e.g. performance, safety, creativity) b. <i>organizational outcomes</i> (e.g. productivity, customer satisfaction, accidents, innovation)
4. Mechanisms linking work characteristics to outcomes	<ul style="list-style-type: none"> a. <i>motivation, quick response, learning and development, interaction processes</i>
5. Contingencies affecting the link between work characteristics and outcomes	<ul style="list-style-type: none"> a. <i>organizational</i> (e.g. interdependence, uncertainty, information / technological systems) b. <i>group</i> (e.g. norms, knowledge structures, size, skill composition, goal clarity, information support) c. <i>individual</i> (e.g. growth, ability, context satisfaction, trust)

3. Data Collection and Analysis

3.1 Background on the Case Study Project

The project studied was a large Government facility with a contract value of \$A95 million and a construction duration of approximately two years. The client was an Australian State Government. The professional design team were all employed by the client organization, but had to tender competitively to

work on the project. The project was procured using a traditional contract with contractors tendering on a full design. This was a departure from previous practice, on similar projects, where a design and construct form of procurement had been used. Once the contractor was appointed a partnering relationship was established between all of the project participants. One of the contractual requirements was that the main contractor established a 'web portal' to be used by all parties working on the project.

3.2 Data Collection, Processing and Analysis

Data were collected by conducting semi-structured interviews with eight members of the project team, involved in the case study project. They were: senior project coordinator / project architect, client representative, project manager, senior mechanical engineer, principal electronics engineer, senior quantity surveyor, main contractor and a trade subcontractor. Interview questions were presented using the variables in Parker *et al's* (2001) work design model as a framework. All interviews were tape recorded and then verbatim transcripts were word processed. To expedite the analysis of the interview data a specialized computer software package was used. The 'Ethnograph' software is, "...a collection of procedures designed to enhance and facilitate the process of qualitative data analysis....the process of noticing, collecting and thinking about interesting things." (Seidel, 1998: p3). Each interview question response was assigned a unique code word. The 'Ethnograph' software allows for all answers, in this case eight, from interviewees to be retrieved so that the answers can be compared and analyzed by identifying differences and similarities in the interviewees' responses.

4. Discussion of Results

4.1 Managing teams

Interviewees noted that a clear definition of the requirements of a project contributed to effective team leadership. Suggestions for improving management style included reverting to 'design and construct', understanding management methods at the start of a project, facilitating consultation between teams, improving selection of personnel, providing clearer definitions whereby the success of a project might be assessed, and promoting commitment to a project and its deadlines. It was noted that improved autonomy within teams could be as a result of team leadership and a clear definition of requirements. Partnering was also seen to provide positive input. It was suggested that the balance between the demands of work and an individual's personal control over this could be improved by adopting a team approach when setting project milestones. Ways of improving project performance monitoring and feedback included formalizing feedback, conducting post-project evaluations, and providing balanced and constructive feedback. In this context Key Performance Indicators (KPI's) were identified for incorporation in post project completion evaluations. Feedback to individuals was seen as important because it acted as a catalyst for staff development. Interviewees noted that KPI's would also impact at this level as individual performance could be linked to project performance.

4.2 Teamwork

With regard to team incentives, getting teams to set project goals was identified as an aspect that could improve team performance. In addition, interviewees identified the creation of the 'right balance' between staff, resourcing and interaction as another factor that would impact positively on team performance. No specific 'team building' improvements were identified but this might be due to the fact that most interviewees had positive experiences in their working environment (A common observation was that the case study project was well managed). Developments in IT infrastructure were seen as key drivers supporting electronic communications and teamwork. More training in the use of IT tools was identified as desirable, as were promoting a 'partnering' environment, and coordination of team members. Interviewees also felt that improvements to teamwork could be made by understanding decision-making

at a higher level, securing the support of management and having a 'good' team attitude. In a team environment, planning was seen as an aspect that could be improved. Also, interviewees saw the retention of project specific expertise as advantageous, as it would maintain the 'quality' of a team.

4.3 Continuing professional development (CPD)

Continuing professional development (CPD) was seen as a necessity in the current and future industrial environment. Those interviewed argued that focused CPD in discrete areas would benefit individuals as well as organizations. In this context, skills that interviewees wished to improve included 'people' and 'technical' skills. Furthermore, interviewees appreciated the need to engage in CPD activities so that they could keep up to date. Many noted the evolutionary nature of skills development and the danger that skills might be lost unless used on future projects. CPD was also seen to play a role in shaping / expanding the nature of work and personal education, changes in technology, and expanding markets were seen as ways in which this might occur. Ways to improve project environments included having opportunities to learn new systems before they go 'live', and increased integration between systems. Also influencing this were the type of contract entered into, having clients as active participants, and integrated design systems.

4.4 Communication

Electronic communication was seen as a positive development and likely to continue. Interviewees forecast that faxes were likely to become redundant and be replaced by new, innovative electronic tools. Training staff to use such new technologies was seen as an essential precursor to the introduction of new systems. However, electronic methods of communicating were not without their problems. Those identified included: clarity of communication, lack of familiarity of staff with systems, and personal preferences. Interviewees noted a need to improve site-to-office communication. Ways to achieve this included the provision of images (both stills and video). Furthermore, management needed to be aware of the training needs and costs associated with implementing electronic communication aids. These are significant, and need to be budgeted for. IT was seen as a vehicle that could improve communication and overcome geographic barriers. Some of those interviewed saw additional opportunities for improving the quality of their work by having wider access to data from other professions.

5. Conclusions

This research has concluded that it is crucial to understand how project teams function, considering, in particular, the effect of the increasing use of ICT within and between the members of such teams, leading to teams working more in 'virtual' environments. The key factor in achieving successful outcomes was the need for a project team strategy to implement ICT, supported by appropriate knowledge, understanding and skills to ensure that the technology was utilized to its full potential.

The literature review identified 24 key issues relating to project teams and the work of such teams in virtual environments, as shown in Table 1. These factors were also present, in differing degrees, in the model of work design (Parker *et al.* 2001) that was utilized to formulate and structure the interview questions used to collect the case study data. Analysis of the data collected suggested that, although the project was perceived as being successful, there appeared to be no formalized monitoring and feedback systems relating to project, team and individual performance. Areas for future improvement, identified during the interviews, focused on managing teams, teamwork processes, a need for engaging in continuing professional development and communication.

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