Barriers and Facilitators to Knowledge Capture and Transfer in Project-Based Firms

Dr. Jeremy Hall*
Faculty of Management
University of Calgary
2500 University Drive N.W.
Calgary, Alberta, Canada T2N 1N4
Tel: (403) 220-2694
Fax: (403) 282-0095
Jhall@mgmt.ucalgary.ca

Dr. Jonathan Sapsed
Centre for Research in Innovation Management (CENTRIM)
University of Brighton,
Room F214, Friston House
Falmer, Brighton BN1 9PH
Tel: (0)1273 642504
Fax: (0)1273 685896
J.D.Sapsed@bton.ac.uk

Kelly Williams
Faculty of Management
University of Calgary
2500 University Drive N.W.
Calgary, Alberta, Canada T2N 1N4
Tel: (403) 256-8790
Fax: (403) 282-0095
Kellyrae@telusplanet.net

*Corresponding Author

Abstract

The objective of this paper is to increase our understanding of knowledge management policies in project-based organisations from a human resource management perspective, a neglected dimension in the knowledge management discourse (Scarbrough & Swan, 1999). We hypothesise that incentive structures play a major role in the operational success or failure of knowledge capture and transfer policies. More specifically, conflicts and inconsistencies in incentives lead to variances in whether or not these policies are successful. The paper analyses three empirically grounded models of knowledge management in project-based firms, and works towards a framework drawn from three literatures: knowledge management, the resource-based view of the firm and agency theory.

Drawing from the ‘resource-based view’ theories of the firm (Barney, 1991, Teece at al, 1997, Collis & Montgomery, 1995), we argue that knowledge capture and transfer can be regarded as strategic issues, in that they benefit the organisation as a whole. However, the process of accumulating and documenting (i.e. capturing) ‘lessons learned’, is more tactical in nature, as it involves costs attributable to a specific project (for example employee time to document and compile reports). Furthermore, these costs may be in conflict with the pressures of a specific project, such as completion on time and within budget. If there are inappropriate or non-existing incentive structures to address this inherent conflict, knowledge management policies will be inadequate.

This fundamental tension is analysed through the agency theory perspective, which attempts to address the problems that result from agency relationships where there is goal incongruence between the principal and the agent. In this case, the conflict is between the strategic benefits accruing to the organisation as a whole from the knowledge transfer, and the tactical costs associated with knowledge capture that are borne by the individual projects.

The paper begins with a review and integration of the relevant knowledge management, resource-based view and agency theory literature. We continue with a discussion of the methodology for our empirical research, followed by the results: 3 company case studies of approaches to knowledge capture and transfer. These firms are all international, project-based and leaders in their sectors, yet approach knowledge management in very different ways. We conclude by analysing the cases with reference to the earlier theories, and propose the beginnings of a new knowledge management typology that integrates the human resource implications of agency theory.
1. Overview

The loss of corporate knowledge from project-to-project has far reaching implications for performance, productivity and competitiveness. Research conducted by the CoPS Centre at the Universities of Brighton and Sussex shows that it is extremely difficult for project-based firms to learn systematically, yet there is still insufficient understanding of how these processes can be improved. This research hypothesises that incentive structures play a major role in the operational success or failure of knowledge capture and transfer policies. More specifically, conflicts and inconsistencies in incentives lead to variances in whether or not these programs are successful.

Derived from the ‘resource based view’ (RBV) theories of the firm (Barney, 1991, Teece et al, 1997, Collis & Montgomery, 1995), knowledge capture and transfer can be regarded as strategic issues, in that they benefit the organisation as a whole. Moreover, access to the accumulated knowledge from projects completed over the years may be a competitive advantage that is difficult to imitate due to time compression diseconomies as well as asset mass efficiencies (Dierickx and Cool, 1989). However, the process of accumulating and documenting (i.e. capturing) ‘lessons learned’, is more tactical in nature, as it involves costs attributable to a specific project (for example employee time to document and compile reports). Furthermore, these costs may be in conflict with the pressures of a specific project, such as completion on time and within budget. If there are inappropriate or non-existing incentive structures to address this inherent conflict, knowledge management policies will be inadequate.

This fundamental conflict can be viewed from the agency theory perspective, which attempts to address the problems that result from agency relationships where there is goal incongruence between the principal and the agent. In this case, the conflict is between the strategic benefits accruing to the organisation as a whole from the knowledge transfer, and the tactical costs associated with knowledge capture that are borne by the individual projects. Agency theory specifically looks at the principal/agent contract and how the agent is compensated and monitored to ensure compliance with the objectives of the principal. The underlying assumption is that learning can be managed within an organisation and that control systems can affect the success of these knowledge management systems.

The objectives of this paper are firstly to document and evaluate different approaches to knowledge capture and transfer, but more broadly to also increase our understanding of knowledge management policies in project-based organisations from a human resource management perspective. This dimension has thus far been absent from the knowledge management discourse (Scarborough, & Swan, 1999). The paper begins with a review and integration of the relevant knowledge management literature and agency theory. We continue with a discussion of the methodology, followed by our empirical findings. We conclude by applying the basic tenets of agency and knowledge management theories to the results of our empirical research, and propose the beginnings of a knowledge management typology.

2. Knowledge Management

Knowledge management has received widespread attention in recent years. Companies and academics have highlighted the importance of knowledge as the basis for competitive advantage (c.f. Teece, 1998; Boisot, 1998; Zack, 1999), while a vast body of literature has been generated around the creation and exploitation of knowledge in organisations. We begin this section with an overview of the knowledge management literature as it relates to incentive structures, followed by a discussion of capturing and transferring knowledge in project-based firms.

For the purpose of clarity, we follow Zack’s (1999) distinction between knowledge versus data and information. Data represent observations or facts out of context that are, therefore, not directly meaningful. Information results from placing data within some meaningful context, often in the form of a message. In contrast, knowledge is more complex in that it can be both tacit and explicit. Tacit knowledge is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, storytelling, and shared experiences. Taking the concepts of data, information and knowledge one step further, we come to the concept of organisational learning. Drawing from the cognitive, social network view, Fisher and White (2000) define organisational learning as:

1 Fisher and White also note that the literature and research on organisational learning are so fragmented that there is no widely accepted model or theory
“... a reflective process, played out by members at all levels of the organization, that involves the collection of information from both the external and internal environments. This information is filtered through a collective sense-making process, which results in shared interpretations that can be used to instigate actions resulting in enduring changes to the organization's behavior and theories-in-use” (p. 246).

According to Crossan et al. (1999), organisational learning involves a tension between assimilating new learning (exploration) and using what has been learned (exploitation). This includes individual, group and organisational levels of learning, which are linked by the social and psychological processes of intuiting, interpreting, integrating, and institutionalising (4I’s). Of interest to this paper are the latter two. Integration is necessary for coherence to evolve where shared understanding by members of the group is required. It is through the continuing conversation among ‘communities of practice’ that shared understanding, or collective mind, develops and mutual adjustment and negotiated action takes place. The process of institutionalising sets organisational learning apart from individual or ad hoc group learning. The underlying assumption is that organisations are more than simply a collection of individuals and thus organisational learning is different from the simple sum of the learning of its members. Some learning is embedded in the systems structures, strategy, routines, prescribed practices of the organisation, and investments in information systems and infrastructure.

Many companies have adopted knowledge management strategies to foster organisational learning. According to Sarvary (1999), a knowledge management system is “... the infrastructure necessary for the organisation to implement the Knowledge Management process”. This includes both IT and organisational infrastructure, of which organisational culture, internal governance mechanisms and appropriate incentive schemes are necessary. Zack (1999) argues that the success of these strategies is contingent upon the fit between organisational roles and structure (both formal and informal) with socio-cultural factors affecting knowledge management such as culture, power relations, norms, management philosophy, and of relevance to this research, reward systems:

“... effective knowledge creation, sharing, and leveraging requires an organizational climate and reward system that values and encourages cooperation, trust, learning, and innovation and provides incentives for engaging in those knowledge-based roles, activities, and processes. I have consistently observed this aspect to be a major obstacle to effective knowledge management. (p. 55)

Hansen et al. (1999) also argue that incentives play a key role in the knowledge sharing process. Drawing from management consultancy cases, they argue that there are two knowledge management strategies – ‘codification’ versus ‘personalization’. The former is a policy of codification, stowage and reuse of knowledge, “... a ‘people-to-documents’ approach” (p 107) used by such firms as Andersen Consulting and Ernst & Young. The personalization strategy used by more specialised consulting firms such as Bain, Boston Consulting Group, and McKinsey emphasise networks of people and dialogue between individuals rather than via databases. They argue that incentive structures for these two strategies should be very different. For the codification approach, consideration for codification activities should be part of the performance review. In contrast, they argue that the personification approach needs to reward people for sharing knowledge directly with other people. For example, at Bain up to 25% of a partner’s annual compensation is evaluated on such issues as how much direct help they have given colleagues.

It should be noted that Hanson et al. (1999) found that all firms used both the codification and personalization approaches, although each focused on one strategy and used the other in a supporting role. In one of Hansen et al’s cases, electronic document systems were developed, where consultants scan documents to get up to speed in a particular area then find the consultant that has worked on the topic. However, this article did not explore why consultants would compile the electronic documents in the first place. We will later show that this is part of a built-in process of being recognised within the firm, which in turn facilitated career opportunities.

As can be expected, there are considerable difficulties associated with effective organisational learning. Of relevance to this research, March (1991) argues that exploration and exploitation of knowledge often compete for scarce resources. Fisher and White (2000) argue that industrial shifts such as downsizing may seriously damage the learning capacity of organisations. Brown and Skarkey (2000) recognise the role of individual egos and the divisions that may arise in the process of organisational learning. Cross and Baird (2000) recognise that employee turnover endangers organisational memory, since people take what they know with them. Consistent with our research, they also recognise the importance of teamwork; the difficulties of dealing with conflicts between daily versus future pressures; and that personal recognition can be used to motivate personnel. As will be shown below, we also recognise the importance of having compensation systems that support knowledge transfer and do not create conflict or multiple objectives.
3. Knowledge Capture and Transfer

Although the preceding section is a small part of the vast literature on knowledge management, there remain areas that warrant further research. Knowledge capture and transfer mechanisms in project-based organisations have been identified as areas of neglect. Most work has concentrated on high-flow production businesses, and there has been little attention to the specific problems of discontinuous project-based organisations (Gann & Salter, 2000; Shapiro, 1998). More specifically project-based organisations that are involved in the production of Complex Products and Systems (CoPS) have particular knowledge management needs. The production of CoPS - large, capital goods that are typically produced as one-offs or in small batches - involves a multiplicity of different knowledge bases, which are not generally amenable to codification and standardisation, as is the case for mass production and process industries (Hobday, 1998).

Nevertheless practitioners in project-based organisations have tried with limited success to implement KM solutions that focus to a large degree on disembodied knowledge (Marshall & Sapsed, 2000). The objective in such cases is to take knowledge that is tacit, embodied in people’s minds and work routines, and convert it into explicit, codified knowledge that may be written down, categorised and made available through a digital network. This is the process of knowledge management stressed by Nonaka & Takeuchi (1995) and the aspect of their work, which has attracted greatest interest. However, companies have found that the codification of good practice and lessons learned is incomplete (Blackler, 1995; Dutta, 1997; McDermott, 1998).

The challenge of applying knowledge and insights gained in one project to others is an ongoing problem, and appears to have more to do with the knowing embodied in people, rather than disembodied knowledge in Intranets or expert systems (Cook & Brown, 1999). It certainly appears to be easier when the same project teams are reassembled for subsequent projects, but with change in personnel ‘lessons learned’ appear to be forgotten (Bartezzaghi et al., 1997). This suggests that the embodied knowledge may be more important and difficult to capture than is presented in some of the literature and in the brochures of KM ‘solution providers’.

It should perhaps come as no surprise that transfer from project to project and team to team is difficult. Psychological research has shown that cognitive transfer - the application of knowledge acquired in one situation to other situations - is deeply problematic even within the same individual (Singley & Anderson, 1989). People are poor at recognising similarities between situations and drawing on analogous solutions, even when these solutions reside in their own experience. Furthermore, there is little evidence of general transfer, the abstraction of knowledge gained in specific contexts into generalisable lessons or rules. Where this does occur is where there is significant shared or overlapping content between situations of acquisition and application (Ibid.). Moving from the individual level to the firm, Arora et al. (1999) and Bartezzaghi et al. (1997) have made the same points with regard to knowledge bases of firms. They are, however, more sanguine about the prospects for context-dependent knowledge to be transferred to other domains, through abstracting and generalising the knowledge.

Transfer may in fact be an over-simplification of the process by which knowledge is acquired. The fact that one individual or team has learned something does not mean that another individual or team may leapfrog the process of learning through some simple interaction between them. Knowledge acquisition is not a matter of ‘copy and paste’ between individuals or teams with the knowledge to those without it (Sapsed et al., 2000). The process is more one of new generation in the recipient rather than transfer of knowledge (Cook & Brown, 1999).

Szulanski’s (1995, 1996) work on ‘stickiness’ in the transfer of best practice within firms has shown the importance of several factors: firstly preparedness and prior knowledge in the recipient of knowledge transfer, in other words, does the recipient have the absorptive capacity (Cohen & Levinthal, 1990) to successfully receive the knowledge. Secondly, an intimate relationship between source and recipient removes barriers to transfer. Although Szulanski argues that these knowledge-related issues dominate over factors such as motivation and incentives, we suggest that they are not so easily separable. In particular, we stress structural barriers such as organisational designs that promote ‘silo’ behaviour within departments and functions; cultures of expertise and the ‘not invented here’ syndrome, as well as absence of reward systems to provide incentives for knowledge sharing, (O’Dell & Grayson, 1998). These are all factors that prevent development of absorptive capacity and the intimate relationships between source and recipient that Szulanski identifies. Reward systems are particularly germane, as too often approaches to knowledge management have an almost extramural quality, rather than being built into the everyday work process. It is with this in mind that we attempt to integrate agency theory—which explicitly addresses incentives- with knowledge management issues.
4. Agency Theory

Of the various theories of the firm, agency theory has emerged as the principal theory guiding organisational research on the pay-performance relationship (Bloom and Milkovich, 1998). An agency relationship arises between two or more parties when one, designated as the agent, acts for the other, designated the principal, in a particular domain of decision problems (Eisenhardt, 1985). Agency theory in its pure economic form assumes that agents and principals are motivated to act in their own self-interest with the principal attempting to minimise costs while the agent attempts to minimise effort. Jensen and Meckling (1976) define agency costs as the sum of (1) the monitoring expenditures by the principal, (2) the bonding expenditures by the agent, and (3) the residual loss. Divergence from the interests of the principal is minimised by establishing appropriate incentives for the agent and by monitoring agent activity. In some situations the agent expends resources (bonding costs) to guarantee that the principal will be compensated if inappropriate actions are taken. Finally, there will inevitably be a degree of divergence between the agent's decisions and those decisions which would maximise the welfare of the principal. This divergence is also a cost of the agency relationship, and is referred to as 'residual loss'.

The theory suggests that when the behaviour of the agent can be easily observed (i.e. complete information), a behaviour-oriented contract is optimal. In the case where information is incomplete, and the principal is not aware of the agent's actions, the principal has two options. First, information about the agent's behaviour can be purchased (monitoring mechanisms), or the principal can reward the agent based on outcomes. Outcome-oriented reward systems, however, have the disadvantage of transferring risk to the agent. The cost of transferring that risk becomes higher as the agent becomes increasingly risk averse. The fundamental problem for agency theorists therefore is to define the optimal balance for a given information setting, between the costs of monitoring behaviour, the costs of measuring outcomes and the cost of transferring risk to the agent.

Eisenhardt (1985) advanced agency theory by incorporating the organisation approach to control. Based primarily on Ouchi’s (1979) rational control model, the organisation approach argues that a collection of people can be moved towards co-operative action through one of three devices: a market mechanism, a bureaucratic mechanism or a clan mechanism. The control strategies overlap, occurring in various combinations, and task characteristics (Thompson, 1967) determine which mechanisms are appropriate in a given environment. If a task is easily programmable, then behaviours can be defined and measured, and behaviour-oriented control mechanisms are suitable. As a task becomes less programmable, different control strategies must be considered. If goals can be explicitly stated and outcomes measured, then outcome-oriented mechanisms are appropriate. In a situation where there is neither task programmability nor outcome measurability minimising the interest divergence, or clan control, becomes the preferred device. Clan control, which focuses on selection, training and socialisation, appears to be a precursor to the concepts articulated in the organisational culture literature, defined by Schein (1985) as:

“... a pattern of basic assumptions - invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration - that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems” (p 433).

Eisenhardt (1985) points out the obvious similarities between the economic view and the organisational view, which includes the objective of determining optimal (efficient) control mechanisms, the concern with information availability (task programmability or outcome measurability) and the distinction between behaviour-oriented and outcome-oriented mechanisms. Agency theory places greater emphasis on reward systems, risk and the costs of purchasing information and control mechanisms. Organisation theory brings recognition of the potential of a social strategy for control in situations where tasks are ambiguous and the cost of obtaining information is high. The organisation literature also relaxes (to a degree) the assumption of purely self-interested behaviour, and the effects of organisational culture on a rational decision process are taken into consideration.

Agency theory has been criticised for being excessively narrow in its implications (Perrow, 1986, Nilikant and Rao 1994), and that although offering some valid insight, ignores much of the complexity of organisations. We would add to this criticism - the theory as it currently exists is overly internally focused, and does little to incorporate either control mechanisms or agency relationships that exist outside the confines of the firm that

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2 For an overview of the organisational culture literature, see Shafritz and Ott (1996).
significantly affect agency costs. In addition, although relaxed in more recent work, the fundamental assumption of self-interested behaviour has remained unchallenged in the agency theory literature. Incorporating knowledge management research with agency theory begins to address some of these critiques by recognising the added complexity of external influences on principal/agent motivation and the potential effects of this motivation on agency costs.

5. Integrating Agency Theory and Knowledge Management

Eisenhardt (1989) suggests that additional research into agency theory should include situations in which there is: (a) substantial goal conflict between principals and agents, such that agent opportunism is likely; (b) sufficient outcome uncertainty to trigger the risk implications of the theory, and (c) unprogrammed or team-oriented jobs in which evaluation of behaviours is difficult. Following from these suggestions and the above literature reviews, we postulate that there are areas of substantial overlap between agency theory and knowledge management research, which could be integrated. This includes the central role of conflict, the information setting, and the nature of the task. Each body of work also brings unique perspectives - for agency theory, the risk aversion factor and for knowledge management, the influence of external control mechanisms. While we do not claim agency theory is a global theory it does provide a useful lens through which to examine knowledge transfer (a low programmability task) in a project-based (team oriented) setting.

Conflict as an inherent feature of the organisation. In agency theory the conflict is narrowly defined as occurring between the principal and agent. The knowledge management literature also acknowledges the principal/agent dichotomy in the employment relationship and suggests it fosters both co-operation and conflict. The co-operation exists in the work process, while potential conflict exists between the respective goals and interests of the parties (Scarborough, 1999). In addition, the knowledge management literature also identifies a source of discord between the social conditions that promote the formation of knowledge and the economic conditions that allow the appropriation of its value, which is the exploration/exploitation tension described by Crossan et al. (1999). This tension is specifically illustrated in the three project based case studies in this research, where project pressures conflict with strategically valuable demands for knowledge accumulation. If the objective of agency theory is to determine the most efficient contract governing the principal/agent relationship, then potential sources of conflict affecting that contract should be understood.

The role of information. A second similarity between agency theory and knowledge management is in the role of information. Agency theory sees information as a commodity that can be purchased and thus a cost to the organisation. Like the KM literature, agency theory recognises the distinction between implicit and explicit information, suggesting that:

"...the explicit system is far less complete in its ability to convey information and it has often been noted that there is no ...measurement which fully captures the underlying performance of a department or corporation, since many of the dimensions of performance defy measurement. Typically an explicit information system must be created and maintained intentionally and at some cost, while an implicit information system often "grows up" as a natural by-product of social interaction." (Ouchi, 1979)

The knowledge management literature specifically addresses the problem of converting the implicit to the explicit, while agency theory directs our attention to the costs of doing so. Those that advocate the Resource-based View of the firm would recognise the underlying assumption that converting information into knowledge is a strategically important effort, which in turn can lead to competitive advantage, as it is difficult to imitate ‘lessons learned’. This is especially the case for CoPS projects, which often generate unique learning opportunities.

The nature of the task. Agency theory suggests that the extent to which a task is programmable affects the choice of control mechanism. As noted by Ouchi, (1979):

"Under conditions of ambiguity, of loose coupling, and of uncertainty, measurement with reliability and with precision is not possible. A control system based on such measurements is likely to systematically reward a narrow range of maladaptive behavior, leading ultimately to organizational

3 Though it is not the purpose of this paper to delve into disciplines of psychology and sociology, agency theory would be well served by an incorporation of the existing body of work in human cognition and motivation.
Knowledge management as a task, particularly in project-based organisations, is an evolution of cognitive processes and social interaction. As knowledge formulation moves through the stages of intuiting, interpreting, integrating, and institutionalising (Crossan et al., 1999) the tasks become less ambiguous and more concrete. This suggests that a blend of control mechanisms is necessary to effectively manage knowledge capture and transfer within the organisation.

**Risk Aversion.** Risk is recognised only peripherally in the knowledge management literature, as a potential competitive disadvantage. However, agency theory brings a direct consideration of risk aversion at both the strategic and project level (albeit there remains contention as to its effectiveness\(^4\)). The degree of perceived risk and the degree of risk aversion of both principal and agent will affect resource allocation decisions. As risk aversion increases in the principal, it becomes increasingly attractive to pass risk to the agent. At the same time, as the agent becomes more risk averse, it becomes increasingly expensive to pass risk to the agent (Eisenhardt, 1989). Thus, if the risks associated with immediate projects are perceived as greater than the risks associated with loss of organisational knowledge, we would expect to see outcome-oriented contracts used for short term projects while behaviour or clan control methods would be more likely in the knowledge management tasks. The problem, as will be shown below, is also contingent upon the conflict between the perceived value of strategic knowledge versus tactical project constraints.

**External Control Mechanisms.** Finally, the knowledge management literature allows us to take agency theory beyond the boundaries of the firm. Control mechanisms in classic agency theory as well as the more recent approaches, which incorporate organisational culture considerations, remain firmly focused on what occurs inside of the firm. Minor consideration is given to the external labour market's role in determining management wages (Fama, 1976), however the effects of external social structures are subdued. The particularly relevant contribution in the knowledge management literature is the existence of 'communities of practice'. These external bodies act as control mechanisms in both the formal regulation and cultural indoctrination of their members. Professional associations for knowledge workers such as accountants, lawyers and engineers are an important mechanism for reducing agency costs. From a knowledge capture and transfer perspective, external affiliations would play a role in decreasing the 'stickiness' of the transfer process and minimising the 'silo effect'. Professional associations offer training and development which increases the absorptive capacity of the individual, and encourage knowledge sharing, albeit within a discipline, but across organisational boundaries. They are not competitive threats to the firm therefore present little risk to the firm, and also define codes of conduct by which members govern their decision-making. External mechanisms such as this are especially important in CoPS organisations, where monitoring and inter-project learning are particularly challenging.

Drawing from the above discussion, we will now introduce three models of knowledge management, which are based on three case studies from different industrial settings. They illustrate how the role of personnel incentives, environmental circumstances and structural factors promote or hinder knowledge capture and transfer.

6. **Methodology**

Following the case-study approach as suggested by Yin (1994), interviews were completed with three project-based organisations. The first is a British subsidiary of a multi-national aerospace firm and a leading manufacturer of simulators for the international aerospace, defence and entertainment industries. The second case is an American owned, Calgary-based supplier of technical expertise and specialised products & services for the oil and gas industry. The last company is a large, prominent management consultancy firm with offices in most major business centres. Although all three companies are project-based organisations, operate internationally and are considered leaders in their respective fields, the incongruous industry categories illustrate a broad range of knowledge management techniques. The fact that each organisation operates under completely different circumstances allows for a useful contrast in how knowledge management is conducted.

Semi-structured interviews were conducted with senior and middle-level managers from each company. Questions specifically addressed knowledge management policies, practices and tools, as well as incentive structures, if any, that were designed to foster these types of investments. The industrial contexts leading to the

\(^4\) Wiseman and Gomez-Mejia (1998) argue that agency theory's formulation of risk has been too restrictive, naive and insufficiently developed. However,
development of knowledge management techniques were also investigated, as well as the major innovation drivers within the industry, and significant cultural influences within the firm.

7. Firm A: Aerospace Systems Integrator:

The end of the Cold War brought about a major downsizing of the aerospace industry. This in turn led to considerable industrial and organisational change, such as increased sub-contracting, an increased demand on systems integration capabilities, more cost effective quality assurance measures, industry consolidation and greater emphasis on reducing costs. The industry is no longer characterised by lucrative mega-projects and 'cost-plus' pricing policies, while R&D and production costs continue to rise (Hayward, 1994). These pressures forced firms to adopt flexible manufacturing practices (Velocci, June 3, 1996, p 59), as well as lean production, cost concessions from lower-tiered suppliers and out-sourcing as practised in the automotive industry (Chinworth and Mowery, 1995). Another key characteristic that traditionally distinguished the aerospace industry from others is the significant role played by government - as a major customer, industry promoter and regulator. According to Hayward (1994), governments were interested in promoting and developing the aerospace industry for national security reasons, to build up technological capabilities, for economic benefits and for prestige. However, the collapse of the Soviet Union ended this strategically lucrative relationship.

It is under this industrial turbulence that we investigated knowledge management in Firm A, one of the world’s largest suppliers of simulators for civil and military aviation and related training services. 5 Smaller markets include simulators for land armaments, naval applications, energy, road driving and entertainment. Like most aerospace companies, they pride themselves on having a strong technical orientation. Their expertise is derived first from the fields of software engineering, and then mechanical and aeronautical engineering. Another major technical competency is their ability to integrate these capabilities both within the company, as well as across the boundaries separating them from their suppliers and customers. Co-ordinating these activities through a project-based structure, while meeting budgetary and time constraints, has become an increasingly important issue for maintaining competitiveness. Management believes that capturing and transferring 'lessons learned' from project to project is one technique that will allow them to meet these constraints.

The nature of the business dictates a co-operative approach with airframe manufacturers, suppliers and other simulation manufacturers. For example, they need to liaise with the aircraft manufacturers to ensure that their products replicate the aircraft feel and performance. Indeed, the inside of a simulator has identical parts as a real craft. Meeting these criteria is particularly difficult when a new aircraft is being introduced, as airlines need to have trained, certified pilots to operate the new aircraft. Firm A must therefore develop a simulator before the aircraft are in operation. However, it is the software that offers the greatest opportunities for competitive advantage. Software not only drives the simulator, but also plays a major role in training and distinguishes their products from the competition. Managing knowledge and data is therefore very important, especially since the commercial environment is "extraordinarily tough, and you cannot afford to have a lot of non recurring costs for every design..." (interview, Senior Manager, Firm A). At the same time there are considerable barriers, such as commercial sensitivity and security issues that must be honoured, as well as financial considerations, discussed below.

To address this issue, Firm A operates a 'Lessons Learned' programme, where at certain breakpoints in the programme a 'Lessons Learned' review is conducted. Documentation from these reviews is compiled by a process facilitator, and is available to project managers. It is a completely open process, and full disclosure (both positive and negative events) is encouraged. However, it is not linked to the appraisal process, with the only motivation being the desire to improve overall business efficiency. One Project Manager interviewed believed that they are not commonly accessed. In some respects it is only an academic exercise – often the project managers request a previous 'Lessons Learned' document simply to use as a guideline for formatting. The problem is therefore more concerned with transfer than capture:

"The actual gathering of the knowledge is good... it was an open forum for everyone... But from then on, I'm not sure that the information then is spread out correctly... its almost, 'we've done the lessons learned, that goes to your engineering manager and he makes sure its signed and then puts it in the bookcase because then its been done'. And although it's available, it's not actually used by other programmes... I think the lessons learned are only carried into other programmes by the people who then move into those programmes” (interview, Project Manager, Firm A).

5 To illustrate just how turbulent this industry has been, ownership of this company has changed hands five times over the last 25 years.
While there is no doubt that Firm A possesses a high degree of technical proficiency, it is apparent that the company is not run by the technicians, but rather by the accountants. The structure of the company is designed to facilitate financial control. From an engineering perspective, “…we tend to be locked into our own little rooms and at the moment there does not seem to be this crossways connection. I think they are trying to get that way but we haven’t got anywhere near it yet” (Interview, Project Manager). Given the narrow financial constraints imposed upon the industry, project accountability is very tight, with minimal overhead costing. For example, employees are sometimes discouraged from asking other people for information, where a manager may question how this use of time will be accounted. For example, one employee stated the following scenario:

“I hope you are going to pay in some hours for this…. We are very much structured with how much it costs for me to sit down with somebody for an hour... my programme manager’s paying for that and if someone is coming over to talk to me about a subject, they had better bring across an hour’s worth of pay that they can pay me for [sic].

If unexpected specialised expertise is needed, it has to be costed into the project, as an additional ‘consultancy’ expense, even if it comes from within the firm. They offer a reward scheme called ‘Solutions’, where employees receive a monetary award for proposing improvements to the overall business. However, the Project Manager said that it was concerned with specific improvements and not knowledge capturing and transferring activities. The Senior Manager further stated that knowledge management and learning issues are not included in project performance measurements, stating: “You need a mature organisation to do that, and at the time of this research it was challenging enough to deliver it to schedule and within budget”. The company’s appraisal process is only concerned with the individual’s ability to meet specified objectives, and has little consideration for knowledge capturing or transferring activities beyond financial accountability. Indeed, according to one Project Manager, the capturing of information is actually cost based:

“...the finance people have got all the information they want and they gather it and they know what’s going on. But the whole company is set up to do that. Its not really set up to exchange any new information…. I think maybe that is the whole problem of communication within the company is the fact that everybody has got their little purse that they have to control…”

As discussed above, we proposed that capturing knowledge is a strategic benefit (and thus is justifiably an overhead expense), but in this case it is a tactical cost, as each individual project is expected to absorb it. Given that project managers are under demanding pressures to deliver on time and within budget, it is not surprising that knowledge transferring activities are cast aside.

8. Firm B: Oil and Gas Service Organization

Over the years the oil and gas industry has had to deal with high capital investments in a fluctuating commodity market. Health & safety risks, environmental degradation, human rights issues and other stakeholder concerns have played a key role in the patterns of innovation. The prevention of spills, leaks and explosions are of major concern in this heavy industry, particularly following such highly publicised disasters as the Exxon Valdez oil spill. Accumulating expertise to reduce such risks, along (with the standard economic benefits) therefore makes knowledge management a strategically important issue within the industry.

The selected case study firm is a leading supplier of physically and technically complex products and services such as cement that provides wellbore integrity and casing support, specialised coil tubing, as well as nitrogen purging drying, displacement and pressure testing, helium leak testing, accelerated cool-downs, mine inerting, and foam inerting. They operate globally, but their primary market is in North America. They were recently acquired by a Houston-based oil & gas company that employs 7000 people.

The company is geographically and functionally segmented with cross-functional teams structured to deliver the required services to their oil and gas exploration clients. Despite the appearance of the formal organisation chart, Firm B is culturally divided into two distinct camps, the engineering group and the field operations group. Engineering is responsible for the design and application of well treatments and equipment fabrication. This group is highly cohesive - annual turnover is consistently low at 5% and much of their post-graduate professional training is conducted by the organisation. Indoctrination to the engineering culture begins with a four year university degree program and is perpetuated through professional associations and communities of practice in the corporate setting. A Senior Manager interviewed describes the engineers as “a tight-knit group, much like a family, which doesn't appeal to everyone, and they take great pride in their work.” The field
operations group, in contrast, begins with a less formal introduction. As one manager stated: “recruiting is based on the Wrigley's concept, if you can chew gum and walk, you have a job”. Once they are hired, they receive technical training by the company and are sent to remote project sites where they continue to learn from their supervisors and gain experience. Although well compensated, the work is physically challenging and isolated. The field hand population is typically transient and turnover is as high as 40% in the first six months. The rate drops to 10% after the six-month zone and becomes less than 4% once they have been with the organisation for more than a year. The turnover rates are not considered unusual for this group due to exceptionally competitive compensation packages offered by the oil & gas service firms during busy seasons.

While this is a highly technical business, R&D often starts out “on the back of a cigarette package” in the field. The process is non-linear, and there is no formal R&D department. Knowledge is carried by the individuals on a given project team, and is transferred from the team to the organisation by both formal and informal mechanisms. Knowledge capture is encouraged through specific policies and reward systems that clearly signal expectations.

Formal mechanisms primarily include the annual business plan process (which incorporates regional recommendations and objectives), frequent and intense technical/safety training (provided internally), and Firm B’s proprietary software system. The software system incorporates over seven thousand databases using conventional platforms such as Excel, Lotus Notes, SAP and a special treatment report system (TPRSS). Everyone with a workstation has access to the information (other than confidential files), and employees are encouraged to use it regularly to reference safety manuals, training materials, job opportunities, critical incident reports, fleet data etc. Many of the essential tools required by employees to perform their jobs are on the system, and it is widely recognised as the most timely and accurate source of information in the organisation. This comprehensive electronic system was developed in response to ISO 9000 certification requirements, where document control standards are significantly more rigorous than industry standards. The large set of databases, however, is admittedly cumbersome and navigating the system can be difficult - employees are not always directed quickly to the specific information they require.

The TPRSS reports are Firm B’s most overt mechanism for capturing and transferring knowledge gained, and are a policy requirement for all of the 100 projects running on a given day. The reports ideally trickle back to engineering who use them for ‘historical matching’, examining the requirements of new jobs and comparing them with solutions that worked in similar situations. The TPRSS system also houses standard templates for some of Firm B’s more common offerings. In addition to the regular TPRSS reports, employees are encouraged to use the system to document mistakes (they are required to by law if there is a lost time accident or significant safety violations). However, it was admitted that disciplinary procedures are inconsistent and an employee may in fact be discouraged from documenting undiscovered errors or those that might but significant but pose no safety hazard, thereby defeating opportunities to learn from the process.

In order to encourage complete and accurate filing of reports, Firm B budgets 3.7% of overhead into every project to be distributed as discretionary bonuses for overtime and filling out paperwork appropriately. In contrast, regional managers who are not working directly on project teams are compensated based on ‘value added profit’ (VAP) which is strictly tied to regional and overall corporate financial performance. Bonuses can be a substantial proportion of an employee’s compensation package.

Firm B also fosters a mentoring program that vacillates between a formal and an informal knowledge transfer mechanism. In order to encourage mentoring behavior, the company offers bonuses for mentoring activities. This was a recent development that was partly attributed to the growth of the organisation. Its significance in terms of cultural impact on control mechanisms was exemplified in the statement of one long-time senior manager who felt that the culture had ‘degraded’ to a point where it had become necessary to ‘legislate caring’ for fellow workers. Informal knowledge capture and transfer mechanisms included project debriefings which transpire only if a substantial problem occurred, and may or may not be documented for wider distribution depending on the sensitivity of the issues involved. Mitigating loss of organisational intelligence was also cited as a primary objective behind policies such as internal promotion and interdepartmental transfers that facilitate knowledge pollination between cost centres.

9. Firm C: Management Consulting Firm

Firm C is a major international management consultancy, with 6000 consultants and practices dedicated to numerous business sectors and several corporate functions. The company distinguishes itself from its competitors through a bespoke, rather than standardised approach to client studies. Greater knowledge and
thought are claimed to be the basis for Firm C’s competitive advantage, which are also used to explain the substantial fees charged to their clients.

All Firm C’s work is project-based, and targeted at the specific needs of particular clients. There is an imperative therefore to capture knowledge gained on projects and to make this accessible to subsequent client studies. As such Firm C promotes the sharing of knowledge through various mechanisms. Firstly, there are incentives and pressures to make knowledge explicit initially in the form of project review reports; these document ‘lessons learned’ as well as articulating new insights gleaned from projects. Given sufficient interest these reports may then be developed into Practice Documents. These may then be made available through a worldwide database to all Firm C employees after references to clients are removed. Approximately 4,800 copies of these documents are requested from the various consulting teams each week.

The pressure to write these reports is described as “a culture of codification of knowledge” (Interview with European Manager, Firm C). About 70% of the firm’s consultants have authored Practice Documents of this type. The pressure to codify knowledge enforces a discipline on post-project discussions. “People do not want to discuss anything that is not in the pack” (Ibid.) While the importance of tacit knowledge is acknowledged in the firm, it is also considered as slightly ephemeral and of limited use until it is codified, and made available to colleagues. This supports a ‘one firm’ ethos which is central to the company’s internal and external cultural message. As well as other electronic tools and databases, Firm C also promotes articulation of knowledge through traditional publishing media of books, articles in popular quasi-academic management journals such as Harvard Business Review, as well as publishing its own journal containing articles by its consultants.

Some client studies and subsequent practice documents generate such interest that the company allocates funding for a research initiative. This will typically cut across the interests of many different industry practices. A recent example was an initiative on how to attract and retain talent in an organisation. The initiatives can vary in duration from one to six months and can be very large scale, involving 10s of companies in the research and thousands of Firm C consultants. These research initiatives serve two purposes: firstly, they renew, extend and consolidate the company’s knowledge in an area that is identified as increasingly important across the firms’ activities of interest. Second, the leadership and management of these initiatives is considered an important career-step at the top end of the promotion ladder. “To become a Director you need a major initiative with your imprimatur” (interview, North America Manager, Firm C). Only 20% of the company’s consultants achieve this level within the firm.

Knowledge development is therefore a key competence - it forms an explicit part of the personnel review and appraisal process. There are four levels to staff development in connection with knowledge development. The first is through transferring tacit knowledge to the immediate team; the second is through codifying it in the form of practice documents; the third level is developing a more general development project, perhaps with a greater sample size; and the fourth level is the leadership of large initiatives. Consultants build their reputations and demonstrate their expertise through moving up this hierarchy of knowledge development. As well as publications and reports other mechanisms include the dissemination of work and ideas through organising breakfast seminars and presenting at conferences.

This personal expertise is exploited through the firm’s system of office transfers in the execution of client studies. Firm C has an organisation of industry-specific practices, and several functional practices that are horizontal and whose resources may be brought to bear across different sectors. The authors interviewed managers and consultants in the Organisational Practice. This is a core competence for all industry practices, and interests other functional practices such as strategy, operations, marketing and so on. The Organisational practice takes in ideas and research from academic fields, such as organisational behaviour and industrial organisation, and draw upon quite theoretical academic frameworks to inform client studies. For example, transactions costs economics may be applied to real-world client problems such as the role of the corporate centre in the organisation.

Other practices will draw upon the expertise of the Organisational Practice to strengthen the organisational aspects of their client work. Individuals with specific areas of expertise may be identified through an electronic yellow-pages system, which documents the firm’s world-wide expertise. Consultants are encouraged to use this resource, internal evaluations look for evidence that attempts have been made to bring in the company’s experts outside the local office.

On the supply side, the firm’s experts are expected to respond to a colleague’s request within 24 hours. Interviews with a consultant attached to a North American office revealed that he receives enquiries from
colleagues throughout the world on a daily basis. Furthermore, he estimates that 50% of these queries are from people with which he has had no prior contact. This shows a rare extension beyond the interpersonal networking that tends to limit the ‘reach’ of knowledge sharing to informal groups in organisations. Firm C consultants are not limited only to ‘know-who’.

The depth of support provided varies from a 10 minutes telephone call to a greater involvement in a project in framing a problem, breaking it into smaller parts, demonstrating practices from other cases or explaining the latest thinking in the area. Practices may commission a full study if their needs demand it. The greater levels of involvement necessitate office transfers, which are very much promoted in the firm. Even Partners find 30% of their time is spent working on studies for offices other than their own. The company tries to avoid accounting practices that may discourage these office transfers, for example, making the practices profit centres. This would work against the ‘one-firm’ ethos that the company is presenting as its competitive advantage.

This model of knowledge management appears to rely to a large extent on incentives. Firm C presents itself as a knowledge and intellect business, developing its own research initiatives in new areas. The company’s interests are aligned with its consultants to promote knowledge sharing. The more that a consultant’s new knowledge and expertise is codified and disseminated, the more likely that the consultant’s reputation will be enhanced and be rewarded with favourable appraisals and promotions. There are therefore disincentives to hoard knowledge, and powerful motivating factors to make knowledge accessible and available to the firm.

Other structural factors such as mechanisms for office transfers, accounting practices and IT systems all are designed to support the sharing of knowledge across the Firm’s world-wide operations. This is shown by the high degree of enquiries and interaction between colleagues who are not yet acquainted. The corporate culture reflects a propensity for knowledge sharing and receiving, which goes beyond the need for an intimate relationship between source and recipient as stressed by Szulanski (1995).

10. Discussion and Conclusions

We have argued that knowledge management is a strategic objective that, given inappropriate incentive/reward structures can be in conflict with the tactical requirements of a specific project. This complicates the principal/agent contract, and may increase the opportunity for self-interested behaviour. Because the benefits of knowledge management efforts are clearly uncertain, there is a dual risk to the organisation - failure to meet short-term project goals, and potential failure to support accumulated knowledge as a source of competitive advantage. Our research has shown three approaches to knowledge management that attempt to mitigate these risks; a ‘social’ control model, a ‘bureaucratic’ control model and a ‘financial’ control model. No single system is employed exclusively by any organisation, while environmental and cultural contexts significantly influence the emergence of the dominant mechanism.

Firm C primarily utilises the social control mechanism, capitalising on career ambitions and a quasi peer review process to motivate employees to codify knowledge. A sloppy report would be detrimental to career prospects, and therefore acts to control the behaviour of the agent. This social control model offers the strategic benefits associated with knowledge management while minimising agency costs and actually supporting the tactical aspects of project completion. There is a practised system in place that decreases the need to reinvent solutions on every project. Their incentive structures therefore appear to be an efficient model of knowledge management. This may perhaps be expected in a firm that specialises in organisation structuring, but may be difficult to replicate in a different cultural setting. The consultants recruited by Firm C are considered the best and the brightest of the Business Schools MBA output, and increasingly have Ph.D.’s as well as years of business experience. They are highly educated and intensively trained by the company in using the latest tools and technologies. In this regard, the Firm C case confirms Szulanski’s views on the capabilities of recipients. In addition, both MBA’s and PhD’s are indoctrinated by an academic community of practice that emphasises the importance of research and publication. As receivers of knowledge they are of a very high calibre. We would also argue that the social nature of the organisation’s incentives to codify, develop and disseminate personal knowledge is vital to the perpetuation of Firm C’s model. This is consistent with O’Dell and Grayson (1998), who state that reward for sharing knowledge is required to sustain such a culture.

As suggested earlier, while this model of knowledge management may work for the consultancy, it is questionable whether it could be applied within the industry or across others. Indeed, it can be argued that this management system is a valuable, non-replicable resource consistent with the Resource-Based View of the firm (Barney, Teece at al, 1997, Collis & Montgomery, 1995, Dierickx and Cool, 1989). Regardless, the lesson from this case is that, similar to Brown and Starkey (2000), highly motivated individuals can efficiently codify
knowledge if appropriate incentives are in place. Organisations that operate with similarly educated employees in ‘fast track’ management positions could potentially benefit from similarly efficient social control structures.

Firm B, the oil and gas service organisation, attempts to overcome the strategic goals versus tactical pressures dichotomy through a more structured ‘bureaucratic’ system of knowledge management. They explicitly reward codification of knowledge through a bonus system that is controlled hierarchically (i.e. supervisors review and approve bonus allocations). Their policies also include explicit incentives to encourage knowledge transfer through the mentoring program, and the organisation requires substantial training and development that contributes to a degree of indoctrination. The fact that Firm B’s employees are less culturally homogenous than Firm C’s, seems to demand that they rely less heavily on social control mechanisms. While the management and engineering groups may be motivated to pursue knowledge capture and transfer activities through a social control system, the organisation has chosen an outcome-oriented approach where bonuses are allocated based on corporate and regional success. A more behaviour-oriented approach is in place to manage the contracts with the predominantly transient field operators, who are rewarded specifically for completing knowledge capture documentation. Agency theory suggests that both the outcome-oriented and the behaviour-oriented mechanisms are more expensive, but given the diverse population in Firm B, may be what is required.

To this point, while acknowledging agency cost differences, we have been careful to avoid claiming that any model is more successful at knowledge management than the others, as this would require some measurement of knowledge accumulation performance which is beyond the scope of this paper. However, our third case indicates a control mechanism that acts as a barrier to achieving many of the strategic knowledge management objectives of the firm. Firm A, the aerospace company, adopted a rigid ‘financial’ control system to compete in an industry that had undergone significant restructuring. To a greater degree than the other two companies, the difficulty was not just in winning the project, but also completing it without cost-overruns. There was therefore little room for organisational slack. Every hour of the employee’s time was accounted for within the project and no allowances for knowledge capture and transfer activities were made. This project-based costing system (the ‘financial’ model) incorporates no clear reward system for KM and consequently acts as a barrier to knowledge transfer, even though management fully realises the benefits of not repeating mistakes. Of course we recognise the difficult industrial context faced by the Aerospace firm. They are in an industry suffering from many restrictive features such as downsizing (as discussed by Fisher and White, 2000) and high employee turnover (Cross and Baird, 2000), which generates conflicts between short term and long term pressures, (Cross and Baird, 2000) and competition for scarce resources (March, 1991). Thus, we would suggest that the financial control model used by Firm A, rather than inappropriate is incomplete. There are insufficient incentives in place that indicate to employees the appropriate balance between strategic and tactical objectives. The organisational control system, including reward and recognition, acts as a transfer mechanism, shunting risks to the project managers, who are then charged with allocating the organisation’s limited resources. Managers will be concerned with the mechanics by which their performance is judged, and will seek information about the responsiveness of the system in rewarding performance (Fama, 1976). If knowledge capture and transfer activities are rewarded in an appropriate and meaningful way, agency costs are reduced to ‘residual losses’. Agency theory would suggest that where financial constraints are significant, and outcome or behaviour oriented approaches are too costly, a social control model is more appropriate. However, for social control to be effective it must be culturally ingrained, and given the RBV approach to asset stock accumulation, a question remains as to the plausibility and effectiveness of attempting to design such a system.

Rapid technological advancement and the increasingly complex organisational structures of project-based firms will continue to affect many industries at a global level, and those industries, like aerospace, will be faced with accommodating that change. We have presented two knowledge transfer models that are currently contributing to the competitive positions of successful companies in very different industries. Organisational culture and motivational assumptions are clearly important factors in designing a knowledge transfer system, and ultimately, decisions have to be made whether intangibles derived from better knowledge management practices outweigh their associated costs. Given this situation, we propose that further research is needed to develop a typology/taxonomy of knowledge management practices based on industry and firm-specific cultural characteristics.

References


