Driving Innovation: Lessons from Understanding Sticky Knowledge and Innovation Diffusion

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Abstract
The aim of this paper is to explain how sticky-knowledge theory (Szulanski, 1996;2003) is applicable to both knowledge transfer as well as innovation diffusion when applied to promoting innovation. Knowledge about how innovation drivers and inhibitors can assist project-based organisations to be more competitive is important in improving processes of applying innovation that can enhance project management (PM) practice and performance. Thus, a model of reducing stickiness of knowledge transfer will be offered using results from two recently completed PhDs on organisational learning and innovation diffusion. That highly practical research work focussed upon three large construction organisations that are representative of the top tier of less than 10 global contracting organisations based in Australia that each has an annual turnover of about £200 million. We combine those results with findings from another part of that research work relating to developing capability maturity models (CMMs). This paper presents lessons learned from research upon highly competitive and commercially successful organisations that routinely practice project management in their core business.

The paper concludes that sticky knowledge provides a useful way of understanding the forces of inertia that often undermine effective knowledge transfer. A key finding is that closer attention to people, process and technology interaction could be used to reduce knowledge stickiness. Also measurement of the impact of stickiness on innovation can be measured using a CMM approach.

Key words: Innovation, Project Management, Sticky Knowledge

Introduction
Translating theoretical examples of how innovation best practice may be driven to produce practical outcomes can be far more difficult to achieve than is promoted in much of the literature. Best practice models for driving innovation tend to aspire to enabling successful innovation to take place rather than explain exactly how this is achieved. Problems, associated with organisations achieving replicable transfer of superior practices from one situation to another or to encourage innovation across business units, arise. This is because the context and cause-effect relationships that govern the dynamics of innovation and its translation into enacted best practices may not be clear (Szulanski and Winter, 2002). While aspiring to replicate best practice is laudable it may be not be achieved if it is obsessively pursued without thinking through the dependencies involved in transferring knowledge from one situation to apply to another (Christensen, 2007). This requires a deeper understanding of the drivers of knowledge ‘stickiness’—
that is about how best practices may be difficult to transfer. This stickiness challenges the diffusion of innovation. It also inhibits the ability of project organisations to learn from the interaction of their employees with supply chain partners as well as learning from interactions with their environment.

The paper is structured as follows. First we establish the context and value of the best kind of organisational knowledge management processes that we observed being shared and transferred within these organisations as well as between their project supply chain members. Second we explain the problem of knowledge stickiness for this kind of knowledge. We then discuss how two recently completed PhDs that investigated this problem suggest how this problem may be obviated. We also discuss a tool that was developed by the authors and tested by a practicing project manager as part of another doctoral thesis. This tool was used to explore the extent of knowledge sharing practices that impact upon knowledge stickiness. With this understanding of how to measure a project’s knowledge transfer practices, stickiness can be better dealt with to enable important knowledge to flow more easily. The solutions that emerge from analysis of these studies are then discussed and a practical tool to enhance essential knowledge transfer is presented.

**Best Practice Knowledge Processes – Context and Value**

The importance and value of innovation in both product and project management service delivery is well recognised and understood. We will first discuss the context of best practices in transferring knowledge about how to drive innovation and then discuss how this can be of value.

The aim of innovation in product, service or process is an attempt to achieve a sustainable competitive advantage. Porter (1985) was one of the first thought leaders to alert us to three types of competitive advantage—cost competitiveness (providing the same goods for lower price), differentiation competitive advantage (offering goods/services that are unique or at least very difficult to replicate) and focus (developing narrowly targeted and specialised competencies to satisfy a customer’s want or need). This is the quest for the Holy Grail of competitive advantage. However, the challenges to achieving this are wrapped up in a race by competitors to outpace each other in cost reduction, specialisation or deepening their ability to match their offerings with what their customers most highly value.

This battleground has tended to form around quality management as it is expected that superb quality in process delivers cost advantages through efficiencies and differentiation and focus through superior management of knowledge about how to become more effective or how to know exactly what a customer’s value proposition may be and how to satisfy that need.

Figure 1 illustrates the journey beginning with a focus on quality assurance on specific demonstration projects moving through a trajectory of quality management and adoption of a range of best business practices that can be
applied to all projects across the organisation with the ultimate goal as being achieving competitive advantage that can be sustained.

Figure 1 From Quality Assurance to Sustainable Competitive Advantage

The problem is that while we can clearly design a fluid process improvement program of projects, we find that at each stage there is a stickiness of knowledge transfer about how to effect this change that bedevils most if not all organisations.

Moving to Best Business Practices

A major trigger for change directed towards sustainable competitive advantage was the emergence of the quality management movement. This initially tended to relate to general product or service quality improvement metrics as these were, to a certain extent, codified in standards such the ISO 9000 series. Kumaraswamy and Dissanayaka (2000) report that this innovation was fervently introduced into the construction industry. The literature was dominated during the 1980-1990 period by examples of how this standard enabled construction contractors to better formalise their metrics and information about quality and codify practices that should lead to improved quality management. During the 1990s the focus moved from isolated quality management standards to integrate environmental quality and health and safety quality standards (Aboulnaga, 1998; Karapetrovic and Willborn, 1998; Wilkinson and Dale, 1998;1999; Walker, 2000).

Also during the mid-late 1990s the focus on total quality management (TQM) moved further towards a more holistic approach of best business practices. This institutionalised within an organisation the move from a quality of product/service culture towards a business excellence model through the widespread adoption of ‘best practices’ (CIDA, 1993). The Malcolm Baldridge award and other industry excellence awards (that encouraged firms to share organisational knowledge within their business units) experienced increased popularity as it encouraged the firm as a whole to improve it competitiveness in reducing waste and rework (Love, Mandal, Smith and Li, 2000) which in turn provides a qualitative competitive advantage. It is clear from the analyse of nine international awards covering
North America, Europe, Australasia, Brasil, India and Singapore, by Puay, Tan, Xie and Goh (1998), that at this time the quality movement was global with the criteria of awards shifted from demonstrating single loop learning characterised by quality assurance to total quality management and business excellence to demonstrating double loop learning. Argyris and Schön (1978; 1996) describe double loop learning as a system fixing rather than problem fixing single loop learning.

Moving to Organisational Learning

The trajectory that we describe in Figure 1 is intended to illustrate a move towards innovation that delivers a sustainable competitive advantage. The next burst of business improvement literature indicated a concern to encourage improvements through doing things more smartly by introducing innovative new processes and products. In terms of adopting product innovation tools, this was advancing along the business process re-engineering (BPR) route (Hammer and Champy, 1983; Hammer, 1990; Hammer, 1996; Hill and Collins, 1999;2000). Concurrently, interest in organisational learning as an extension of QM was gaining momentum with a realisation that double-loop learning was being valued as an organisational response to changing the system through developing new ways of integrating management and business processes (Love, Li, Irani and Faniran, 2000).

However, with each advance up this best practice adoption food-chain, the amount of codified information and process improvement knowledge becomes more complex and difficult to fully comprehend. The current global climate seeks rapid 24/7 innovation adaptation, reflexivity and movement from innovation (which can be copied or replicated) to competitive advantage derived from being creative and producing products, processes and approaches that are entirely novel and therefore extremely difficult to mimic. The focus is now on how to use knowledge from within an organisation, between supply chain partners and even working with competitors (Sweetman, 1997; Kim and Mauborgne, 1999; Kaufmann, 2003) to provide creative solutions to the challenge of a 24/7 expectation of customer delight (Johnston, 2004). The problem facing most organisations as they pass along this trajectory is that they must rely less on explicit knowledge and more on tacit and intuitive transformational knowledge (Scharmer, 2001). Further, as organisations move towards the innovation and creativity end of the continuum of knowledge they find themselves increasingly forced to confront how they manage the process of knowledge creation, use and maintenance. This requires organisational learning (OL) and unfortunately OL can not be achieved by decree, assertion or pretence—it is a cultural change and in fact addresses the difficult issue of ‘thinning out’ the viscosity or ‘stickiness’ of knowledge transfer. Figure 1 indicates that OL is an important step towards sustainable competitive advantage. This is because any organisation that can learn from its experiences and find an effective way to create, share and manage its knowledge resources, can reduce knowledge stickiness.
Explicit knowledge is codified while tacit knowledge is hidden and embedded (Nonaka, 1991; Nonaka and Takeuchi, 1995). Davenport and Prusak (2000) discuss a hierarchy of knowledge value from a systems perspective. This considers data as having the lowest value, being considered to be raw while information has an element of classification and therefore meaning imbued. Knowledge embodies innate individual and group perception so this bestows deep meaning with which to be used to make sense out of situations.

Tuomi (1999) by contrast, sees the value of the knowledge hierarchy from a reverse perspective. He presents the conventional view of knowledge in terms of potential yield or dividends paid from intellectual effort expended. This conventional view considers that unfiltered data has little potential yield. Information yields patterns and knowledge yields predictability so these have more value. Additionally, intelligence is added to this typology as providing choices with wisdom yielding compassion or what von Krough (1998) terms ‘care-why’ knowledge. Tuomi (1999) also argues that through reflection, an observer may choose or care enough to study a situation such that refined data emerges from the process. Intelligence is required to view a complex situation and through applying intelligence and knowledge—taking tacit knowledge and making it explicit through contextualising it. The result is refined data about that particular situation. He uses the Nonaka (1991) knowledge model of knowledge transfer and exchange (SECI) whereby individuals share of tacit knowledge through socialisation and as this tacit knowledge is explained it become externalised into explicit knowledge that through being combined with existing explicit knowledge becomes internalised by the individual and re-framed again as person tacit knowledge. This way of looking at knowledge generation and use sees both data and knowledge as being both inert and being actively refined.

Others have advanced that view of the knowledge generation and use process from both the group and individual perspective. Crossan, Lane and White (1999), for example, offer a model described as the ‘4 Is’ – intuiting, interpreting, integrating and institutionalising. This can be seen as being similar to the SECI model. Intuition is tacit knowledge, this is made explicit through interpreting it relative to its context, the knowledge becomes combined and integrated with the pool of knowledge and this becomes internalised by the organisation as a whole. Lawrence, Mauws, Dyck and Kleyesen (2005) add to this model’s notions by considering the role of power in the process to better explain how the dynamics of the process operates. They argue that individuals influence groups and the group forces the organisation to internalise knowledge and once that happens this view of the knowledge becomes institutionalised through culture and governance and this disciplines groups and individuals.

Knowledge, information and data about best practices—what they are, how they may be applied, and how this resource should be stored, accessed and used are very important issues to be addressed if an organisation wishes to remain competitive. Creating an environment where knowledge assets are valued and taking the care to properly value and manage organisational
routines such as best practices, innovation and creativity can be argued as vital in today’s knowledge-based economy. OL requires groups of people to interact and one useful way of facilitating that is to encourage people with a shared passion about how to improve various aspects of a business to form what is called a community of practice (COP) (Wenger, 1999; Wenger, McDermott and Snyder, 2002). Discussing how to best shape and encourage a COP to develop is beyond the scope of this paper but readers could refer to Wenger et al (2002) to learn more about this and those for a practical example of COPs in a project management environment could refer to Jewell and Walker (2005) and Peansupap and Walker (2005a).

**Capability Maturity Models (CMMs)**

Figure 1 indicates that a capability maturity model (CMM) is a tool that helps move an organisation from a quality assurance (QA) focus to a quality management (QM) focus that is broad in terms of encompassing business excellence. CMMs have been a more recently applied measurement tool that can be used to identify the stage of business practice adoption as well as a tool for identifying how improvement and innovation can be more effectively diffused from the project level to across the whole organisation. We focus on innovation from the perspective of how process improvement tools such as best practices can enhance organisational competitiveness.

The CMM literature had its genesis with finding ways to measure process improvement in software engineering at the Software Engineering Institute Carnegie Mellon University, Pittsburgh (Paulk, Curtis, Chrisses and Weber, 1993). Its utility lies with in its capacity to measure the ‘as-is’ state of process improvement as well as indicate a ‘could-be’ situation that can be aspired to. With these points defined, a gap analysis can be undertaken to appreciate what needs to be done to scale from the ‘as-is’ to ‘could-be’ states. Strategies can then be developed to move to the ‘could be’ state.

A CMM approach has been used to measure and improve PM (Ibbs and Reginato, 2002; PMI, 2003) and has been used to measure the maturity levels of knowledge management and OL within organisations (Walker, Wilson and Srikanathan, 2004; Walker, Maqsood and Finegan, 2005). Manu and Walker (2006) also illustrated how a CMM was used by to measure knowledge sharing on a Pacific Island construction project.

A CMM generally defines process development in five stages ranging from an initial level, usually being unaware or barely aware of the characteristics, aims and advantage of a process. For example being unaware of the need to be innovative or being aware of innovation but being ambivalent about its value. The levels progressively describe the level of commitment to, and proficiency in the use of, the described process. The Paul et al (1993) approach uses level 2 as a repeatable process, level 3 as a defined process, level 4 as managed and level 5 as optimised where the process is embedded and continually challenged for relevant improvement and refinement. The management (Walker et al., 2004; Walker et al., 2005; Manu and Walker, 2006) approach use five levels. These range from inactive (awareness only),
pre-active (initiation), active (adoption), pro-active (acceptance and adaptation) to embedded (routinisation and infusion). In the context of driving best practice innovation, the key processes for achieving the aim need to be defined and operationalised through describing their characteristics in a way that can be recognised as meeting the criteria defined for each maturity level.

The approach adopted by Manu and Walker (2006) required designing a relevant question about the issue to be addressed by the CMM, in this case knowledge sharing and transfer. The question was then answered by reference to defined dimensions of the performance characteristics of that process from the literature. In this case, the work of Nahapiet and Ghoshal (1998) on developing social capital was used. Dimensions to be measured that were deemed fundamental to the organisation’s OL were: development of network ties; anticipated value; desire to share knowledge; and a capacity to share knowledge. The processes presented as answers to that question provide practical ways of achieving the objectives posed by the question. Evidence was gathered from observation, interviews and developed quantitative metrics that support the level 5 rating for that dimension. In this way, the process (knowledge transfer) can be assessed and more importantly maturity levels can be visualised and the scope of what needs to be done to aspire to the improved level can be understood.

The practical use of this technique lies in taking steps that comprise the hard work of designing a process improvement initiative that drives attainment of the desired maturity level for that dimension. The CMM assists indirectly in driving innovation through identifying processes and best practices to undertake those processes. The relevance of CMMs to this paper is that a CMM can help the effective promotion of processes in taking an organisation along its innovation journey. Additionally a CMM such as that developed by Walker (2006) can be modified to more closely address issues of sticky knowledge.

The ‘Sticky Knowledge’ Barrier to Knowledge Transfer

Figure 1 indicates that, while in theory organisations can move smoothly along a journey from isolated project based QA to support competitive advantage through to the applications of the tools and techniques that improve the capability of an organisation, knowledge used to transfer is inhibited by stickiness of knowledge and difficulty in transferring best practices. The concept of ‘sticky knowledge’ as developed by Szulanski (1996; 2003) forms a valuable and useful support and testing mechanism for the two research projects that will be described in more detail in a following section of this paper.

Gabriel Szulanski (1995; 1996; 2003) undertook a PhD on the stickiness of knowledge and identified seven sources of knowledge stickiness:
1. Source Lacks Motivation (unwillingness to share knowledge);
2. Source lacks credibility (the source lacks authority, expertise or is perceived as unreliable or untrustworthy);
3. Recipient lacks motivation (doesn’t care);
4. Recipient lacks absorptive capacity (has not the background to perceive cause and effect links, lacks underpinning knowledge or experience in experimentation to know how to use the knowledge);
5. Recipient lacks retentive capacity (forgets vital details);
6. Barren organisational context (the culture or governance structure inhibits knowledge sharing); and
7. Arduous relationship between source and recipient (lack of empathy, trust or commitment to collaborate in the task of sharing knowledge).

He concluded from testing his model (using canonical correlation analysis of a data set consisting of 271 observations of 122 best-practice transfers in 8 companies) that contrary to conventional wisdom that blames primarily motivational factors, his findings show major barriers to internal knowledge transfer are:

- knowledge-related factors such as the recipient’s lack of absorptive capacity (source 4);
- casual ambiguity (source 4); and
- an arduous relationship between the source and the recipient (source 6) (Szulanski, 1996).

These factors relate to individuals and organisation’s ability to build and sustain innovation capacity that could be designed into a procurement system for clients to choose only innovative contractors to undertake their projects. As indicated in Figure 1, stickiness can occur at each stage of the illustrated journey towards sustainable competitive advantage.

These findings about how knowledge is sticky provide a useful framework to make sense of why innovation may be easily diffused in one organisation but not in another. This framework also helps us to better understand the antecedents of knowledge transfer, innovation diffusion, and variability in organisational adaptability and competitiveness. Finally, through understanding knowledge stickiness, we can find more effective ways to obviate the problem.

**Value of Innovation through Applying Knowledge of Best Practices**

Evidence from the construction industry indicates that clients demand innovation and also that having an innovative culture enhances a construction management organisation’s competitive advantage (Manly, forthcoming-b; forthcoming-a). A case in point is the National Museum of Australia project where one procurement selection criterion was ‘a demonstrated ability to add value and bring innovation to the project’ (Walker and Hampson, 2003: p91). The winning alliance team demonstrated to the project team selection panel how its integrated information and communication technology (ICT) portal could enhance its capacity to deliver the project in an innovative way (when compared to current construction management practices at that time). UK studies also indicate a role for discerning project providers (clients) and the professions in promoting innovation (Winch, 1998; Winch, 2005) and US studies indicate a similar
pressure that arises from construction clients who demand cleverer solutions to their project problems and professionals who wish to deliver more value (Tatum, 1984; Slaughter, 1998).

Added to this active interventionism is the influence that some of the US literature suggests is exerted by lead users of innovations who undertake beta testing or forms of alliance can influence development of products and processes (Von Hippel, Thomke and Sonnack, 1999). Organisations working with lead users develop what is termed ‘empathic design’—that is solutions developed in the field through trial and error experimentation and observation of the way that lead users adapt and improve innovative solutions to the development of products, services and processes (Leonard-Barton, 1992;1995; Leonard and Rayport, 1997; Leonard and Straus, 1997). Empathic design capitalises upon lead user creativity in extending the application and usefulness of innovations. These examples, from across many continents and disciplines, share the central idea that innovation is unleashed from the creative and curious interface between clients/users who wish to explore new and more useful ways to do their job (Leonard-Barton, 1992;1995; Leonard and Rayport, 1997; Leonard and Straus, 1997). Lipshitz, Popper and Friedman (2002: p81) adds to this the policy facet of ‘tolerance for error’, that is allowing people to learn from mistakes and experience in a positive way.

This supports the inference that if clients choose to include a requirement to demonstrate innovative capacity in delivering projects, that serendipitous value may be generated as an outcome, providing that the client side of the team has the capacity, motivation and open mind to engage in experimentation.

If we accept the above inference as a valid trend that reinforces the need for organisations to be innovative then it becomes important to understand what organisational cultural features support or hinder innovation. Given this imperative, we need to identify a theoretical framework that we can use to guide us. We argue that the concept of ‘sticky knowledge’ (Szulanski, 1996;2003) offers this framework. We test the framework against two parts of a research study that we were recently involved in. We present a model of innovation that helps us better understand how an innovation culture can be developed within organisations.

**Empirical Findings from Two Recent Studies**

The studies that we test against the knowledge-stickability framework are drawn from a four-year funded research project that involved 2 full time researchers, 2 PhD candidates and 2 part time research chief investigators. The study involved investigating the way that information communication technology (ICT) diffusion with major Australian construction organisations took place and how these organisations managed their knowledge resources. This study provided data from three targeted ICT experienced organisations to unearth ICT diffusion factors from quantitative data gathered that was analysed using factor analysis, ANOVA statistical tools to gain broad insights
as well in-depth case studies with four leading ICT-savvy construction contractors that provided deep insights through case study work. We also draw upon a set of highly intensive soft systems methodology (SSM) studies of one of these major leading Australian global-reach construction contractors. SSM is a useful approach where the situation under study is ill defined and messy, it provides for a 7 stage process (Checkland, 1999) where the problem is investigated and knowledge gained captured in the form of what are called ‘rich pictures’ that are cartoon-like representations that caption emotions as well as explicit knowledge and data. This knowledge/data is then analysed and an idealised system to solve the problem developed. The ideal model can be compared to the observed situation and a series of improvement processes can be prioritised and those that can gain support for action can be implemented.

This provides us with qualitative data and deep insights with which to test the Szulanski model of knowledge transfer stickiness. Results from the two PhDs and the research project that generated numerous book chapters, refereed journal and conference papers are used to test this sticky-knowledge transfer model.

**Study 1 Information Communication Technology (ICT) Diffusion**

A quantitative study was undertaken using a survey instrument of 46 questions responses were answered either on-line together or via a hard copy version. The total number of respondents was 117 from three large construction organisations. Each organisation was requested to select approximately 50 regular ICT users to fill an online questionnaire. Respondents were drawn from a representative pool of users in their organisation. Thus, the types of user responding to the questionnaire were generally matched from the pool of users representative of their organisation’s ICT use. There were 35 respondents from the public client organisation (group A), 39 respondents from the construction contractor (group B), and 43 respondents from the engineering consultant (group C). Data was analysed using a principal component and varimax rotation for factor extractions. A pairwise rather than listwise selection method of cases was used because this questionnaire allowed respondents to select a ‘non-applicable’ response as well as the 1 to 5 value. As a result, the number of cases in variables ranged from 102 to 117. The result of factor analysis shows 11 factors with an Eigenvalue exceeding 1, explaining cumulative 70.45 % of variance. In addition, varimax rotation was used in explain these factors. The result of this rotation shows that forty-six variables were grouped into eleven factors. Cronbach’s Alpha ($\alpha$) analysis was conducted to examine the reliability of variables in each factor (Hedderson, 1991; Pallant, 2001). Further details of the research approach can be found elsewhere (Peansupap, 2004; Peansupap and Walker, 2005c; Peansupap and Walker, 2005b;2005d).

A summary of the model resulting from identifying the eleven factors that were found to impact ICT diffusion in the three organisations are presented
in Figure 2 and were categorised into management, individual, technology and environment factors.

![ICT Diffusion Model](image)

**Figure 2 ICT Innovation Diffusion Model**

This work was followed up with intensive semi-structured interview qualitative work using one of the contractors from the quantitative survey plus two other large construction competitors within the top 10 by annual turnover in Australia. The focus was an investigation of how a new groupware ICT tool had been implemented throughout each organisation. This part of the study provided deeper insights from rich data gathered from a cross section of ICT users in those organisations. Interviewees were grouped into five levels as illustrated in Table 1: IT strategists (senior level management champion and initiative driver) implementers (given the task of encouraging diffusion of the ICT groupware initiative), project managers (responsible for construction teams on projects using this technology), site engineers, and site foremen (both direct users of the technology in coordinating on-site physical and administrative work).

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Case study A, B and C</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>CSA</td>
</tr>
<tr>
<td><strong>IT STRATEGIST</strong></td>
<td></td>
</tr>
<tr>
<td>Implementer (L1)</td>
<td>1</td>
</tr>
<tr>
<td>Project/Engineering manager (L2)</td>
<td>4</td>
</tr>
<tr>
<td>Site engineer (L3)</td>
<td>1</td>
</tr>
<tr>
<td>Foreman (L4)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
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</tbody>
</table>

Details of this work can be found elsewhere (Peansupap and Walker, 2006b; Peansupap and Walker, 2006a).
Study 2 Knowledge Management Supporting Innovation

The second study was undertaken with one of the three construction contractor organisations from the above study 1. The research approach was qualitative using soft systems methodology (SSM) approach through semi-structured interviews to investigate the ‘messy situation’ encountered in managing learning and knowledge associated with a small team of professionals engaged in pre-tender work for large construction projects. The two studies were linked, along with the research work that involved developing the CMM discussed earlier, as part of a $400,000 three year research project funded by the Collaborative Research Centre in Construction Innovation (CRC CI) in Australia from 2002 to 2005. Study 2 was intended to explore how knowledge management (KM) may be applied in the construction industry to improve the diffusion of innovation and its adaptation by construction organisations.

SSM was chosen as a research approach as it was best used for what may be described as messy or poorly defined problems (Checkland, 1999; Green and Simister, 1999) in which tacit knowledge is mainly used but is often poorly transferred within the organisations. The situation studied revolved around the organisation’s decision-making about investigating the scope, scale and risks involved in tendering in addition to potential impacts of winning these projects. There were also elements to the study that surfaced about managing knowledge about lessons learned from previous decisions made, tenders undertaken and feedback from completed projects.

Five SSM studies were undertaken. The first for example involved six participants using six face-to-face interviews (one business manager, estimating manager, engineering manager and three design managers). These interviews resulted in the development of rich pictures that were subsequently validated through feedback comments and these were used to produce the SSM models. Rich pictures are diagrammatical representations of narratives in a form not unlike cartoons or storyboards. The models proposed from these generated a set of recommendations for KM that were validated with participants.

The timing of projects, the limitations of a PhD and the dynamic nature of these resulted in recommendations not being able to be tested using an action learning approach which would have been a preferable approach to continue the study. However, the SSM studies fulfilled a useful purpose in investigating several KM strategies that could be adopted. For further details of these studies, interested readers should refer to (Maqsood, Finegan and Walker, 2005; Maqsood, 2006; Maqsood, Finegan and Walker, 2006; Maqsood, Walker and Finegan, 2007).

The whole study of five SSM rounds was also valuable in enabling a meta-model to be conceived about the nature of such organisations’ in-practice management of knowledge and the development of an ideal model. This is illustrated in Figure 3.
The model describes how organisations can become learning organisations through improving their knowledge management (KM) processes. The key element relates to the organisational culture that facilitates knowledge sharing through integration of people, supporting processes and supporting technology. The model indicates that at the initial stage these three elements are generally poorly integrated and that the organisational culture throws up a barrier to knowledge entering the organisation from external knowledge bank sources such as academia, professional associations, and competitors or supply chain partners. Further, little knowledge of information is validated, tested or refined through exposure to scrutiny from external sources. With improved KM the organisation more closely integrates its people, processes and technology as well as reduces the cultural barriers so that it becomes less rigid and allows some two way flow of knowledge. The third stage (usually ideal and rarely attained), the culture allows the organisation to be permeable so that knowledge freely flows both in and out of the organisation with people, processes and technology are closely integrated.

The trajectory traces the degree to which:
1. absorptive capacity is developed and increases;
2. a two-way knowledge flow emerges that links people and reduces their causal ambiguity through better understanding cause-and-effect loops; and
3. the organisational culture reduces the arduousness of the relationship between parties involved in knowledge transfer about innovations and their impact.

The relevance of Study 2 to this paper is that the data gathered and the methodology used provides an alternative approach to investigating this kind of problem. We were able to achieve significant triangulation in research approaches by combining Study 2 findings with the findings using quantitative and qualitative approaches for Study 1 together with the work undertaken on CMMs as part of that broader study and then its further field testing by Manu and Walker (2006) using a case study approach. Thus, triangulation was achieved from a research method perspective as well as from several different cases and that was combined with insights from the literature.

**Discussions and Analysis**

Specific results from the research studies that are applied to the Szulanski model include:

1. A quantitative study of the factors contributing to ICT diffusion at the implementation stage based upon three leading ICT literate and experienced construction organisations (study 1);
2. A qualitative study of the drivers and inhibitors of ICT diffusion of four of the leading Australian construction contractors (study 1); and
3. A SSM study of how one of these leading Australian construction contractors actually manages knowledge in one of its most strategic business units (Study 2).

<table>
<thead>
<tr>
<th>Szulanski Factors</th>
<th>Study 1 - Comments</th>
<th>Study 2 - Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (knowledge deliverer) lacks motivation - unwillingness to share knowledge</td>
<td>F6 - Supporting open discussion environment F8 - Supportive colleagues help F5 - Supervisor and organisational support</td>
<td>Stage 1 state (see Figure 3) process, people and technology PPT) disjointed with lack of organisational effort to integrate.</td>
</tr>
<tr>
<td>Source lacks credibility - the source lacks authority, expertise or is perceived as unreliable or untrustworthy</td>
<td>F1 - professional development &amp; technical support F4 - supportive technology characteristics F11 - Frustration with ICT</td>
<td>Stage 1 state PPT lack/or demonstration of commitment to move from Stage 1 through to Stage 3. Not invented here syndrome.</td>
</tr>
<tr>
<td>Recipient lacks motivation - doesn’t care</td>
<td>F2 - clear benefit of use F9 - Positive feelings towards ICT use F10 - Negative emotions towards ICT</td>
<td>Focus on present + single loop learning rather than double loop learning. Poor encouragement to interact with external knowledge sources.</td>
</tr>
<tr>
<td>*Recipient lacks absorptive capacity has not the background to perceive cause and effect links</td>
<td>F1 - professional development &amp; technical support F3 - supporting individual characterises</td>
<td>Stage 1 state lack of experience with KM initiatives, Stage 2 improvement to Stage 3.</td>
</tr>
<tr>
<td>*Recipient lacks underpinning knowledge or experience in</td>
<td>F1 - professional development &amp; technical support F3 - supporting individual</td>
<td>see Figure 3 for degree of changed pull-pushed of knowledge across</td>
</tr>
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experimentation to know how to use the knowledge characterises F10 - Negative emotions towards ICT F11 - Frustration with ICT

organisational boundaries.

*Recipient lacks retentive capacity-forgets vital details F1 - professional development & technical support F3 - supporting individual characteristics See Figure 3 for states of integration of knowledge about PPT and its implied effects on innovation.

Barren organisational context-the culture or governance structure inhibits knowledge sharing F4 - supportive technology characteristics F5 - Supervisor and organisational support F7 - Supporting tangible and intangible rewards The extent to which Stage 1 can move to stage 2 and 3 by organisational commitment and design of processes to enable it to become a LO.

*Arduous relationship between source and recipient (lack of empathy, trust or commitment to collaborate in the task of sharing knowledge) F5 - Supervisor and organisational support F7 - Supporting tangible and intangible rewards F9 - Positive feelings towards ICT use Organisational internal cognitive, people-skills and people motivational, process and technology infrastructure support integration to drive towards Stage 3.

* Shaded cells indicate most significant key factors affecting knowledge stickiness

Table 2 illustrates some of the issues and influences that impact upon how sticky knowledge can affect innovation being diffused throughout an organisation to position itself to achieve a sustainable competitive advantage.

Study 1 was focused how knowledge transferred in ICT applications. Its findings generally support the Szulanski (1996; 2003) model. Without delving into details available in the published literature reporting on Study 1, it is difficult to fully illustrate conceptual synergies other than re-state where factor 1 to 11 fit into the Szulanski (1996; 2003) model. What can be gained from close study of the cited references to this study in matching the findings to the Szulanski model relating to the recipient’s absorptive capacity is that this is affected by:

1. The recipients personal ICT knowledge brought with them to the workplace from previous professional and academic development;
2. The degree to which organisations offer ICT learning opportunities;
3. The level of ICT technical support offered by designated staff as well as ad hoc help from colleagues in problem solving; and
4. The attitudinal and behavioural aspect that in this case, related to negative frustrations associated with use of poorly supported ICT that does not provide benefits or worse still becomes an encumbrance.

This absorptive capacity focus for ICT suggests that it can be generalised for other type of knowledge transfer. If we substitute knowledge about another business process with for example ICT, then the same concept may apply.

Study 1 also related Factors F1 and F3 to the recipient’s retentive capacity with professional development and the individual’s learning and retention characteristics. Study 1 did not specifically ask any questions about retaining ICT knowledge about the groupware applications but the questions
about support and technical assistance related to access to help where ICT groupware users experienced problems with access or use.

Study 1 results support ICT as an effective potential enabler of knowledge transfer. Its findings particularly highlighted the importance of a supportive environment and proactive measures taken by the organisation to open communication channels, to encourage and resource training and professional development, and to select people who can more easily transfer knowledge. These characteristics are entirely in tune with the Szulanski (1996; 2003) model.

Again Table 2 suggests arduous relationship factors for Case 1 that can be generalised across knowledge transfer of other business processes.

1. The general (real as opposed to espoused) support through the organisational culture for ICT knowledge sharing;
2. ICT Knowledge sharing behaviours being integrated into reward systems that encourage experimentation;
3. Not punish errors in using ICT as long as these are acknowledged, analysed and used as true lessons learned. This later aspect is also supported by Lipshitz and his colleagues (Lipshitz et al., 2002; Lipshitz, Friedman and Popper, 2007).

Study 2 gathered rich case study data at the ‘messy problem’ level and its synthesis as illustrated in Figure 3 conveys the trajectory of reducing knowledge stickiness through better interaction and alignment of people, processes and technology. This model with its staged (1 to 3) increase in the degree of organisational ‘pull’ of knowledge from external sources and increased ‘push’ of knowledge outside for testing and re-framing also is highly congruent with the Szulanski (1996; 2003) findings. This study indicates how absorptive capacity can be increased and how the environment for OL can become more fertile through strategic and tactical planning of initiatives that draw the PPT elements together. The 5 SSM studies reported by Maqsood (2006) describe in detail, particularly through the rich pictures and SSM models, that socialisation of knowledge and the importance of capturing tacit knowledge and sharing it is a vital aspect of knowledge transfer facilitation. The 5 cases investigated also highlighted the importance of personal knowledge exchange through the ‘pull’ and ‘push’ forces and the value in linking people, processes and technology.

When this evidence is assimilated and combined it strongly suggests and supports the proposition that stickiness of knowledge transfer is a barrier that can be overcome only with great determination, organisational senior management focus and effective PM implementation. This assertion has been supported by the literature discussed earlier. The determination aspect has implications for senior management because Szulanski’s 7 sources of stickiness of which the 3 bullet points earlier highlighted, relate to empowering individuals to question the status quo and to be free to experiment with improvement strategies and tactics. People need to be liberated to gain experience in experimentation and opening up their minds. They need to tinker and play (experiment) to visualise and understand
cause-and-effect loops that lie at the heart of causal ambiguity, and the relationship needs to be not arduous but welcoming between knowledge source and recipient to promote OL. The idealised Stage 3 in Figure 3 is shown to have impervious boundaries (dotted rather than thick lines) and well integrated PPT elements with strong knowledge ‘pull’ from outside the organisation as well as a confidence to push knowledge back to external sources for testing, re-framing, and re-cycling.

Conclusions

This paper is unfortunately limited in its scope by the needs of the conference review committee. However, the paper has presented a narrative of how knowledge transfer aimed at moving an organisation towards a sustained competitive advantage, has been inhibited by forces of inertia. The concept of ‘sticky knowledge’ describes this force of inertia and the utility of this concept was tested against two case studies in knowledge transfer. We can conclude that sticky knowledge is a significant factor to consider in the design or organisational interaction and culture as well as how process, people and technology can be better integrated to systematically reduce the viscosity of the forces of inertia.

The two studies provide both a high level of quantitative and qualitative data that can be analysed against the sticky-knowledge model. We argue that this will provide deep insights into how project organisations of this nature can better prepare themselves to be competitive and attractive partners of clients who wish to encourage and benefit from innovative PM processes. We also suggest that while the examples are confined to a construction environment (and also use data gathered from a representative sample of the most innovative and advanced construction management organisations in Australia) lessons learned may be more broadly applicable to other PM organisations. Further we indicated how a CMM approach may be applicable to visualising knowledge stickiness as well as developing strategies to overcome that stickiness.

The Szulanski (1996; 2003) model, together with the two models offered from Study 1 and Study 2 help us understand how sticky knowledge may be transferred more effectively. The thrust of the paper is based on overcoming knowledge ‘stickiness’ and aligning knowledge management in people, processes and technologies. And how this can be better integrated and lead from a low level innovation-effective organisation to a very high level one. The presented models summarise supporting evidence to show how innovation, knowledge sharing and knowledge stickiness are related.

The Szulanski (1996; 2003) model, however, is silent on the role of linking people, processes and technology either through COPs or through individuals interacting in dyads. Study 1 was weak on pin pointing the role of recipient knowledge retention and so its findings provide indicative evidence only. Study 2 raw data and findings (Maqsood, 2006) provide many insights into how Szulanski’s work can be useful to better understand the dynamics of
knowledge transfer, but scope limitations of this paper prevented us from elaborating upon that.

The CMM work (Walker et al., 2004; Manu and Walker, 2006) that was referred to earlier in this chapter shared similarities with much of Szulanski’s work and could be refined further to better target measurement of absorptive capacity include gaps and recipient retentive capacity that was identified from Szulanski’s work but not specifically considered in the CMM developed by Walker (Walker et al., 2004) or tested by Manu and Walker (2006) and referred to earlier.

The practical implications of this upon an organisation’s competitive advantage when seeking to win project management work and implication for improved PM practices can be summarised as follows. Figure 1 illustrates a trajectory that can lead organisations to sustainable competitive advantage. This model is not revolutionary and upon closer scrutiny can be described as obvious or banal; however, it recognises the factor that many practitioners seem to be blind to—the pervasive negative influence of knowledge stickiness. Overcoming stickiness is the key but to do so it requires a series of organisational cultural settings that are very difficult for many organisations to accept and deliver. The ability to manage these organisational and technology support changes (perhaps as a series of projects in a cultural change program) lies at the heart of sustainable competitive advantage for organisations.

References


