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Team knowledge management within an outsourced business systems software maintenance environment: a case study using grounded theory methods

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The effective management of knowledge is increasingly seen as an essential contributor to the success of a knowledge-based organisation. There is a wealth of methodologies and approaches providing guidelines or frameworks for managing knowledge in a wide range of domains such as software development, IS service delivery and project management but few are dedicated to software maintenance. This paper presents the case study research of an outsourced software maintenance operation in the e-commerce business unit of a large UK retailer, using grounded theory to investigate a framework for assessing and improving the knowledge management capability of the software maintenance teams. The framework assesses the operation in five areas: leadership, communication, tools, processes and cultures. The results offer an insight into the strengths and areas for improvement in the knowledge management arrangements.

Keywords | *outsourcing; systems software maintenance; knowledge management; grounded theory; e-commerce business*

Introduction

In today's commercial environment businesses restructure the way they operate in order to focus organisational resources on the delivery of their core business competencies. By recognising and targeting those core competencies an organisation seeks to define a strategy that will improve its competiveness in the market place and increase profitability. This strategy, referred to as a knowledge-based strategy, has led organisations to engage in outsourcing relationships with external companies who are able to deliver those non-core functions, commonly the development and support of software and infrastructure (Hu, Gebelt, and Saunders, 1997). Outsourcing is defined as '…*the organizational decision to turn over part or all of an organisation's (IS) functions to external service provider(s) in order for an organization to be able to achieve its goals*' (Chen et al., 1995; Chaudhury, 1995; Fitzgerald and Willcocks, 1994; Lacity and Willcocks, 2001). In theory it can benefit both the client organisation and the service provider but there are a number of factors which affect how well the relationship works in practice. From the outset the organisations involved must have a clear understanding of what needs to be delivered, how it will be managed and what management roles the organisations will assume. These points are often built into the outsourcing contract as well as a description of the nature of the relationship (partners or simply customer and provider). Equally important is the compatibility between the organisations, whether their size, structure, organisation cultures and management styles can successfully work alongside each other (Fitzgerald and Willcocks, 1994) and the degree to which the service provider comes to understand and master the client's IT and IS infrastructure and business domain.

A service provider will establish processes that will enable it to develop over time a high degree of knowledge of and about the client organisation in order to successfully design, build or support that service; it is necessary to identify, elicit, transfer and capture tacit knowledge about the client organisation, its business and systems for the contractual obligations to be met.

Approaches to knowledge management: Garcia-Perez and Ayres (2009), proposed the Collaborative Transfer Approach as a means of extracting and transferring knowledge from an expert source to interested parties making use of a Knowledge Transfer Facilitator. The approach attempts to overcome some of the general difficulties associated with knowledge management such as extracting knowledge from knowledge experts and providing an environment where knowledge can be extracted and shared in a guided, structured and reusable a way. The approach tries to facilitate the transfer of knowledge by bringing together the experts and knowledge recipients to discuss, agree and represent the main concepts in a domain. The process of collectively representing the domain according to Garcia-Perez and Ayres (2009) not only ensured the vital participation of the subject matter experts but also establishes a common vocabulary and reduced disparity in understanding due to language differences or domain understanding.

Existing research: framework for team knowledge management: The study done by Eppler and Sukowski (2009) (as a direct result of their research into teams involved in product development in the truck division of Daimler Chrysler) encountered many of the same issues as Garcia-Perez and Ayres (2009). They found that poor communication of teams skills, individual or shared experiences, poor domain knowledge, limited awareness of stakeholder goals and objectives had a negative impact on the effectiveness and cohesion within the teams. They also discovered that the lack of structure around the management of team knowledge meant that opportunities for resolving existing problems, discovering new solutions or overall process improvements were regularly missed. Like Garcia-Perez and Ayres (2009), Eppler and Sukowski state that governance of the knowledge management framework was an important part of the solution. However, in their approach Eppler and Sukowski took a more holistic view of the team knowledge management problem and considered the working environment, available technology and culture, both organisational and human, in conjunction with the people components and the prevalent knowledge management strategy. This encompassing philosophy as an industry independent approach made it reasonable believe the framework for Team Knowledge Management could be utilized to as a tool for assessing the knowledge management capability in a different domain.

The research problem: Organisations that provide outsourcing services use a range of knowledge management approaches to demonstrate their capability in their field and signal their compatibility to the procuring organisation. In software development methodologies, like Extreme Programming or Agile, the methodology indicates a philosophical approach to dealing with uncertain requirements and the need to develop a 'fit for purpose' product quickly, making efficient use of people and resources in the achievement of that goal. The Capability Maturity Model Integration in Software Development and Service Delivery and ITIL versions 1 to 3, suggest that an organisation is aware of its core skills and has embarked on an organisational strategy to continually improve its ability to deliver cost effective technology skills to a client. Equally, project management methodologies such as SCRUM and Prince2 show that there is an understanding that managing people, technology and process simultaneously increases the likelihood of successful project delivery.

Organisations dedicate time, effort and resources to the instigation, review and measurement of knowledge management procedures in areas such as software development, project management and organisational structuring. However, although the challenges of identifying, recruiting and retaining staff with the right blend of technical, industry and domain experience are common, the options for assessing knowledge management within the software maintenance field are limited.

This leads on to defining two core research questions:

- How can knowledge management strategies, tools and processes succeed in an outsourced software maintenance operation?

- How can the knowledge management strategies, tools and processes in place be assessed?

Literature review

Knowledge: Knowledge is '*information with direction*' (Nonaka and Takeuchi, 1995). Knowledge is '*...information with decision-making and action-directed utility and purpose*' (Becerra-Fernandez et al., 2004). Definitions which suggest that knowledge when applied to a situation is an element that stimulates change and underpins evolution, that knowledge is a catalyst for ideas, invention, problem solutions, improvement and progress are widely held.

Where does knowledge come from? Nonaka and Takeuchi (1995) envisage knowledge as the pinnacle of a three layered hierarchy with information in the middle and data at the base. The ascent of the hierarchy is triggered by the application of meaning to transform data, the discrete facts in the form of numbers, records, transactions or observations, into information. In other words data within the context of its environment, importance and function. The transition from information to knowledge takes place as a result of human contribution, in that it is people who define the context that ascribes knowledge its meaning, function and value through their interaction and experience of their environment. The Nonaka and Takeuchi (1995) perspective explains this as '*a justified belief about relationships among concepts relevant to that particular area.*' This concept is shared by Davenport and Prusak, (1998) who view knowledge as a '*fluid mix of framed experience, values, contextual information and insight*'. Samiotis et al., (2003) expand on the intentions behind the human contribution in the creation and interpretation of knowledge. The emphasis on context is alluded to in the statement that knowledge is '*as much about the perception arising from information… refracted through the individual's personal lens*' (Fowler and Pryke, 2003). Whilst Blackler's (1995) definition, by incorporating the concepts of tacit, explicit, individual and organisational knowledge, recognises the multifarious nature of knowledge as '*multifaceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded.*'

Within academic literature, there are distinctions made between '*tacit*' and '*explicit*' knowledge (Polyani, 1966). Explicit knowledge can be encapsulated and shared with or without the use of technology. It is

'documented and public; structured, fixed-content, externalised, and conscious' (Duffy, 2000). Tacit knowledge evolves from human relationships and requires skill and practice as it 'resides in the human mind, behaviour, and perception' (Duffy, 2000). Tacit refers to hunches, intuitions and insights (Guth, 1996), it is personal, undocumented, context-sensitive, dynamically created and derived, internalised and experience-based (Duffy, 2000).

Nonaka and Takeuchi in 1995 also explored the idea that as knowledge is dynamic, tacit knowledge, which originates in individuals via personal experiences and which is inherently difficult to express, evolves into explicit knowledge which can be captured, codified and shared, as a result of four knowledge management processes: socialization, combination, internalization and externalization. These processes contribute to the creation of organizational knowledge which they defined as '…the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems' (Nonaka and Takeuchi, 1995). This same premise contends that because knowledge is created by people and used by organisations, knowledge exists on two levels: epistemological and ontological. Tacit and explicit knowledge at an epistemological level progresses ontologically from person to team, group to organisation and further.

Knowledge management: 'Performing the activities involved in discovering, capturing, sharing, and applying knowledge so as to enhance, in a cost-effective fashion, the impact of knowledge on the unit's goal achievement.' (Becerra-Fernandez et al., 2004).

Knowledge, both in academic and commercial communities, is recognised as an essential tool for driving competitive advantage, differentiation within the market place, reducing costs, promoting innovation and achieving organisational objectives. Becerra-Fernandez et al. (2004) support this view, suggesting that by effectively creating, collecting, disseminating and applying knowledge organisational objectives are achieved, defining the ability to recognise and manage essential knowledge as knowledge management. Knowledge management therefore is concerned with creating, identifying, recording and disseminating knowledge. Knowledge is complex territory

as it is has to be viewed as 'both a thing and a flow or a process' (Snowden, 2002). Knowledge exists where people need, create and use it. Although it is important to 'organise and make important knowledge available whenever and wherever it is needed' (Becerra-Fernandez et al., 2004), knowledge is difficult to manage as outlined in Snowdon's heuristics: 'Knowledge can only be volunteered; it cannot be conscripted', 'We can always know more than we can tell, and we will always tell more than we can write down' and 'We only know what we know when we need to know it' Snowdon (2002). In other words, if you ask the right question, at the right time, an answer can be found or uncovered. Becerra-Fernandez et al. (2004) recognize four knowledge management processes: discovery, capture, sharing and application. Discovery, they define as 'the development of new tacit or explicit knowledge from data and information or from the synthesis of prior knowledge'. Discovery according to published literature can be dissected into two sub-processes, combination and socialization. Combination refers to the idea that individuals, in the course of an activity, by examining data, information or available explicit knowledge, will uncover new facets of a field and is so doing create an opportunity to either build upon their own or develop new tacit understanding. Socialization describes a situation where new tacit and explicit knowledge comes about where individuals collectively, whether formally or informally, develop knowledge within a common space.

Capture, defined by Becerra-Fernandez et al. (2004) as 'the process of retrieving either explicit or tacit knowledge that resides within people, artifacts, or organizational entities' is concerned with the methods that can be employed to access knowledge so that it can be recorded. Sharing is 'the process through which explicit or tacit knowledge is communicated to other individuals'. Application is the means of utilizing knowledge without the actual transfer or exchange of knowledge.

Knowledge is strategic (Williams, 2001), and is embedded in relationships and context. It operates within a context, and is implemented or used by particular people in particular positions and contexts. To paraphrase, knowledge is a synthesis of the how and the why things get done (Williams, 2003). This is the crux of the issue when dealing with knowledge management within a

geographically extended team. In all likelihood there are people within a sphere of influence who have the required knowledge but who are they and how can the knowledge be accessed?

Forces influencing knowledge management: The trend towards market globalisation is providing a new impetus for knowledge-sharing between organisations, teams and team members. The reasons for IT outsourcing are well-documented in academic and commercial literature, include reducing cost, improving performance, and accessing to wider labour markets (Barthélemy, 2001; Di Romualdo and Gurbaxani, 1998). Traditional ways of localised working now share a landscape with the new concept of 'global virtual teams' requiring innovative communication and learning capabilities for different team members to effectively work together across cultural, organizational and geographical boundaries (Zakaria, Amelinckx and Wilemon, 2004). As a strategy outsourcing offers many economic and performance advantages but it can also be problematic when two or more organisations come together. Differences in ways of working and communicating, management styles, hierarchical structure and culture necessitate the need to acknowledge and adapt to the challenges presented. Academic literature suggests that communities of practice within organizations are not only a source of competitive advantage by encouraging the sharing and discovery of knowledge but that they can also overcome the differences between organisations by assuming the role of organizational learning facilitators (Brown and Duguid (1998) cited in Davenport and Prusak, 1998) leading to greater synergies within a multifarious partner environment.

Culture determines ways of doing business, negotiation and attitudes towards authority. Even management styles for example, can tend to the autocratic, patriarchal or meritocratic through long term cultural programming. Organisations with divergent cultures may have difficulty understanding the styles, attitudes and methods of the opposing culture causing friction in working relationships. Nicholson et al. (2000) suggested that cultural training of at least one of the cultures involved is a way to identify differences in culture and work practices affording an awareness that could facilitate harmonisation between the cultures. Geert Hofstede, the renowned Dutch social psychologist and anthropologist and one of the foremost exponents on the study of

cultural differences, has said that *'Culture is the collective programming of the human mind that distinguishes the members of one human group from those of another'* (Hofstede, 1981).

The ability to create and share knowledge is seen as a key factor contributing towards organisational competitiveness (Holsapple and Joshi (2002) cited in Garcia-Perez and Ayres, 2009) in an increasingly competitive global market place and dynamic labour market. An example of this organisational approach to knowledge and resource management is ITIL, the public framework that describes best practice in IT service management for the governance of IT, the 'service wrap', and focuses on the continual measurement and improvement of the quality of IT service delivered from both a business and a customer perspective. Another example in software development the Capability Maturity Model, (CMM), which, after consolidating a number of CMM models evolved into Capability Maturity Model Integration (CMMI), is a model used by organisations to harness and exploit their intellectual capital. The model, devised by the Software Engineering Institute (SEI) at Carnegie Mellon University originated from the US government need to address projects that were late, over budget and which failed to meet project objectives (Glazer et al., 2008). With process management as the core ideology, CMMI provides a five level process maturity continuum for defining and assessing the predictability, effectiveness and control of organisational processes, outlining the process objectives which, if followed will allow an organisation to progress to the higher continuum levels. These process areas contain a set of paradigms common to many software development and project management methodologies: clearly defined goals, measurement, validation and verification. However, unlike those other methodologies CMMI takes a holistic, long term strategic view drawing on learning from all aspects of organisational activity to inform and drive improvements for both people and processes but there is a balance to be struck between ascending the continuum and remaining sufficiently grounded in business and project objectives as well as flexible enough to benefit and motivate projects, individuals and teams or to recognise and take advantage of opportunities to improved product quality and productivity over the long term (Glazer et al.,

In the age of outsourcing and globalisation, reliable and obtainable technology plays an important role whether as a tool or as a means of communication and can be integrated anywhere (Mårtensson, 2000). Zakaria, Amelinckx and Wilemon (2004) argue that technology alone is not enough to promote effective knowledge management and sharing. They argue that global virtual teams require trust and positive team dynamics in order to create an environment conducive to knowledge sharing. Huber (2001), King et al. (2002) and Davis (1981) expand and develop this idea further in their belief that motivation is also a key factor in determining whether individuals are willing to share what they know. Davis (1981) suggests that communication problems and psychological limitations such as human bias in selecting and using data, or human behaviour in problem-solving situations also impede knowledge management. Another impediment observed by Ostro (1997) is that individuals do not believe they have anything of value to share.

Language and cultural differences create obstacles too (Koudsi, 2000), particularly where the cultural, often corporate, tendency is to view retaining knowledge as preferable to sharing (Warren, 1999; Anthes, 1998; Cole-Gomolski, 1997).

The management and use of tacit knowledge is a focal tenet of Agile methodologies and is at the core knowledge management processes: discovery, sharing, capture and application. Within an Agile activity tacit knowledge is accessed in the close relationships that exist between developers, team members and customers calling for a high level of trust that comes from working closely on an activity to which all parties have a vested interest in the outcome. A project can benefit in the immediacy of the exchange between team members who are all stakeholders, however, the sharing of tacit knowledge and discovery of new knowledge can be lost if not consciously captured. Hillier et al. (2008) counter this argument stating that Agile mitigates against the loss of knowledge by virtue of the typically short project duration, circulating current knowledge within the project team. They also argue that if following Agile principles software development projects will provide documentation in the actual developed code itself, that it is written to be self explanatory, saving time normally spent on producing documents associated with

project management or generated during the software or product delivery life cycle. These arguments may be true but it can equally be argued that the tacit knowledge built over the course of a project remains in the minds of the project team and provides little in the way of explicit knowledge for anyone making use of or maintaining the product once the project ends.
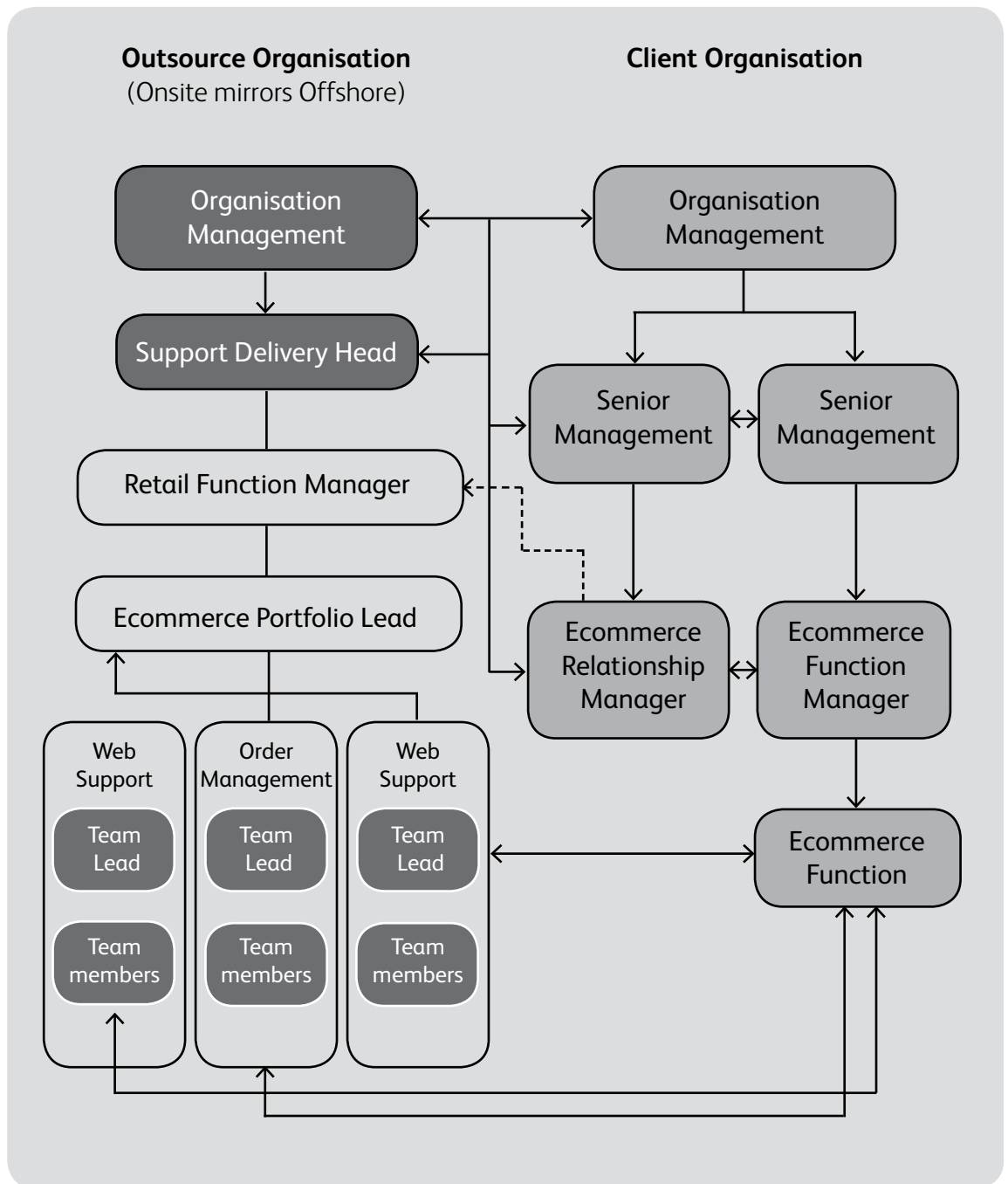
Research methodology

Case study - the Application Maintenance Support Team in context: The research subject for the study was the knowledge management infrastructure within an e-commerce systems maintenance IT support unit for a large UK retailer. The retailer is a very experienced consumer of outsourced IS services having begun the process of outsourcing development and maintenance of their business systems over ten years ago. The current service provider took over the e-commerce systems maintenance contract nearly three years ago and is a large, well known Indian outsource services provider with a large number of clients based all over the world in a wide range of industries. The services provider is accredited to CMMI level 5 in software development and service delivery and according to published literature has a complex structure based on two strategic concepts: industry and technology. It can combine those concepts to provide a support service specific to each client, by aligning to both the industry, business function, and the technology, business application.

For management purposes the retail organisation is divided into separate organisation functions: core business, business support and IT, which in turn consist of a number of core and peripheral business units which may be present in other functions. IT is responsible and accountable for providing IS services, the IT infrastructure and all IT systems used by the different business functions who are also referred to as customers. As well as providing overarching service to the retail business as a whole, the IT function is subdivided into smaller units that are aligned to individual business units.

Figure 1 shows the functional relationships within the retail organisation and those between the IT function and the service provider.

Figure 1. Client and Service Provider Organisational Structure

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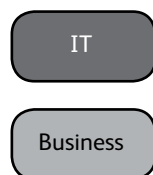
The applications include a website, website content applications and customer order, customer delivery, customer services and customer order delivery management systems. There is a high level of dependency between the teams as the applications together cover the start, middle and end of the e-commerce business processes and are connected by system interfaces. The applications are operated on a number of technical platforms from mainframe to distributed systems hosted by hardware service providers. The support teams vary in size according to either the complexity of the application or the level of demand for an application's business functions.

The flow of data through the applications can be broadly categorised into three types. The first is common to the client organisation as a whole and is known as reference data. The second type is specific to the e-commerce business unit and is used to some extent by all of the e-commerce applications. The third type is data specifically created and stored in an application which may or may not be derived from the other data types. The data is the system representation of an intricate set of business rules that define the client organisation, the e-commerce business, UK tax and distance selling regulations and the service offered to customers. Because of this the support teams are simultaneously independent and interdependent using the same core business rules to operate. The team feature that made it of special interest to the study was the fact the teams are split across geographic locations: half of a team in India and other half in the UK.

Research method: A case study approach (using semi-structured interviews) was used as a research strategy to generate empirical, qualitative data to examine the environment. The resulting data was analysed from an interpretivist viewpoint looking for psychological understanding rather than explanation. These methods and paradigms are fairly typical in European IT outsourcing research (Dwivedi and Kuljis, 2008) and in keeping with their practice only one client and service provider organisation was included in the study with six participants sampled.

The study looks at the importance and behaviour of people in team knowledge management and attempts to find a balance between the interpretation of measured data (considered by some qualitative advocates to

be less significant) and the direct interpretation of events.

Use of grounded theory: The idea behind the grounded theory approach as introduced by Glaser and Strauss (1967) cited in Moghaddam (2006) was the appeal of studying available phenomena to arrive at a theory rather than starting with a theory and using study data to prove or disprove the theory. Academic literature already possesses a wealth of information about knowledge management in differing circumstances but few if any examine it from the social aspect in the way proposed by this study. In keeping with grounded theory practice outlined by Strauss and Corbin (1990) cited in Moghaddam (2006) the constant comparative analysis is used as a discovery process to interpret data and derive the key themes or concepts.

Research theoretical sensitivity in grounded theory: The research was carried out by a female researcher educated in the UK, France and Canada, with a background in retail and finance business systems, software development and maintenance and management experience of mainframe and distributed maintenance teams. In terms of organisation experience, the researcher has worked for a small privately owned UK based software consultancy, an Australian insurance conglomerate and the Indian service provider in the study. This career history affords an understanding of the IT industry and both the personal and professional relationships within the sample group and indicates a level of trust between the researcher and the sample group as evidenced by the group's willingness to participate in the study and to share personal opinions. The researcher's closeness to the setting has meant that potential issues with language comprehension (none of the group are native English speakers) could be mitigated as the group felt comfortable asking for clarification during the interviews or when completing the questionnaire thereby reducing but not necessarily misinterpreting questions or adversely affecting the richness of the data.

Grounded theory recommends collection and analysis simultaneously but for practical and time considerations the interviews were done before the analysis phase started.

Approach: Framework for Team Knowledge Management: The Framework For Team Knowledge Management (Eppler and Sukowski, 2000), following an '*interaction*' approach

(Håkansson (1982) cited in Kern and Willcocks, 2002) was taken as the mechanism through which the knowledge management resources, support teams and their environment could be observed. The approach provides a format for the analysis of the structure of and functions within the organisation, the partnerships and relationships between organisations and their knowledge areas.

The framework for team Knowledge Management is shown in figure 2

Figure 2. Eppler and Sukowsk's Conceptual Framework For Team Knowledge Management
(Source: Eppler and Sukowski, 2000, p.335).
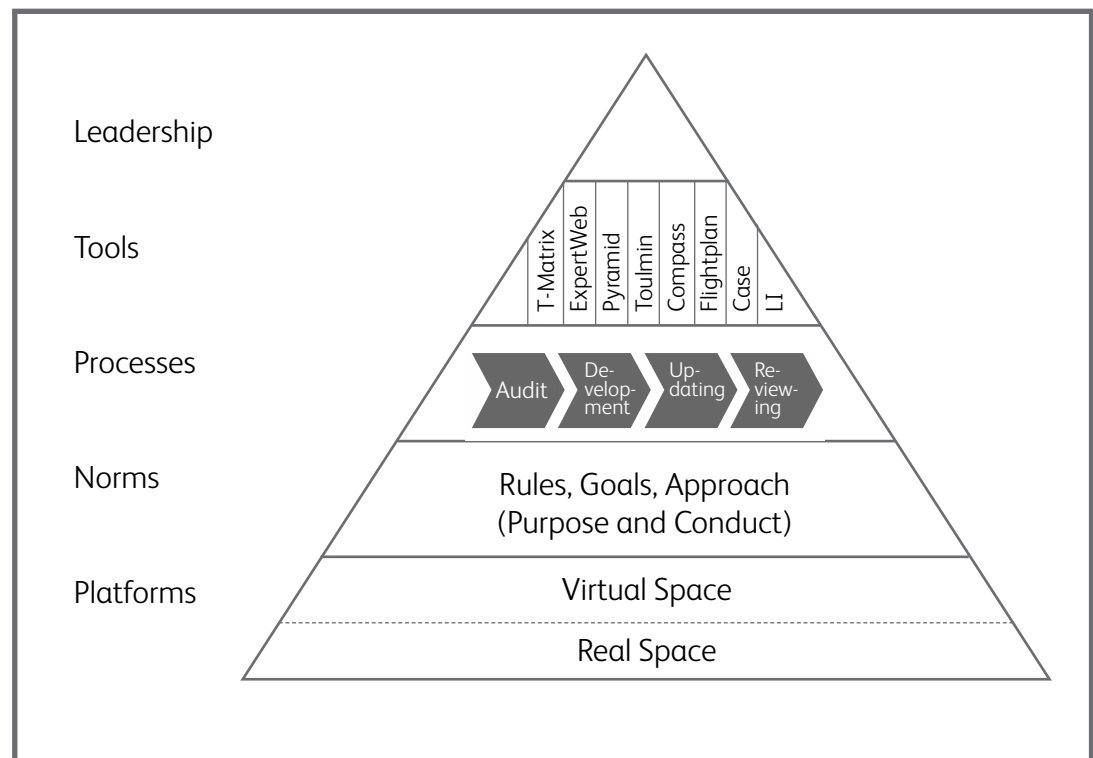
Research data: The primary, empirical and qualitative data used in the study came from a variety of sources: semi-structured interviews, semi-structured questionnaires, company documentation and reports available within the organisations and from the public domain. To assure consistency and validity of the process and data collected a journal was kept throughout the investigation and all data captured and stored electronically. All interviews were transcribed and catalogued. Interviews were directed towards the technical and managerial functional elements in the e-commerce maintenance unit and were carried out in two phases: pilot and main study.

Questionnaire design: Before constructing the questionnaire the two organisations in the study were examined by way of the Framework for Team Knowledge Management. Information was sourced directly from the company databases, information repositories and information sources in the public domain, such as news outlets and company websites. With this background information it was decided to structure the questionnaire around the framework layers and in so doing provide a basis of comparison between the information uncovered in the background research with the information gathered from the interviewees.

The questions were constructed in an attempt to open up an avenue of conversation around the aspects of the research so the questionnaire was used as a compass rather than a rigid checklist covering the important topics. The early versions of the questionnaire included both questions and an assessment scale so that the respondents could add emphasis to their replies. The questionnaire included a section for obtaining limited personal and professional information about the participant called the participant profile data capture sheet and questionnaire.

Data validity: pilot interview : To ensure the validity of the research methodology the questionnaire was trialled before introducing it to the sample group. The purpose of the pilot phase was to test the appropriateness of the targeted topics and interview questions. Due to the inexperience of the researcher a pilot trial was used as a technique for validating the research approach, following the example set by Kern and Willcocks (2002) in their study of outsource relationships. This was not entirely necessary as there are examples of research that do not include trials but it gave

an opportunity to identify and correct flaws in the approach early in the study. As researcher tools, a voice recorder, laptop, notepad and pen were brought into the pilot interview session to experiment with methods of capturing the interview. For expediency it was later decided to digitally record the sessions.

The pilot interview used both the questionnaire to frame the key areas of interest and the assessment scale. After the control it was decided to exclude the assessment scale as it interrupted the conversational flow of the interview and was too cumbersome. The pilot prompted the addition and expansion of two areas of interest: software maintenance and culture as these were of particular importance to the pilot interviewee.

Data collection: The inclusion of the offshore and onsite team members was necessary for a reasonable representation of team perspectives and richness of data, however the offshore team could not be interviewed directly in the manner of the onsite participants. Gaining access to the participants based in India presented challenges in terms of the time difference and the options for recording the interviews. Conducting interviews via the office telephony system meant high quality recordings were not possible so it was decided to email the participant profile data capture sheet and questionnaire to the participants to fill out and return. There was a risk that participants might not complete the questionnaires independently but the risk was considered acceptable.

The semi-structured nature of the questionnaire allowed a degree of topic latitude in the face to face interviews so that interviewee responses and ideas could be explored more deeply, responses clearly understood by the interviewer and to potentially develop new areas for consideration in future research. This latitude was not possible with the questionnaires completed by the participants in India. All interviews were digitally recorded and transcribed to capture the conversational interaction as only a broad transcription was necessary. Overall recording quality was high, due to the isolation of the interview location. However, there was some difficulty accurately transcribing some conversations due to interviewee accents and level of oral language sophistication.

Research sample group: The unit of analysis was the technical support teams responsible for the operational support and maintenance of key e-commerce business applications for a large UK based retailer with global and UK domestic commercial interests. The e-commerce support teams vary in size with between 2 and 15 team members based in two locations: India and the UK. The sample group was made up of six team members, ages ranging from early twenties to late thirties, selected from teams supporting four of the six applications in the e-commerce maintenance unit. All of the participants are university graduates, five hold bachelors' degrees in IT related subjects and one has a masters degree in IT. All participants have received technical training but none have pursued recognised professional technical certification.

Data analysis process

Open coding of transcripts and questionnaires for general themes: The transcriptions and completed questionnaires were read and reviewed several times in preparation for the three stage grounded theory coding steps. The identification of key threads from the participants' responses was the first stage of the iterative analysis process. The responses were reviewed separately to identify phrases or words that encapsulated separate units of meaning (Goulding (1999) cited in Moghaddam, 2006) and were recorded alongside key words or statements. Notes made either during the interviews or upon reviewing transcripts were also referred to at this stage. To make the data manageable the threads were initially organised by sections according to the original question area but new sections were added following another review to identify observable facts (Spiggle (1994) cited in Moghaddam, 2006).

The next stage was to pool and compare the responses, identify labels that allowed discrete categories to emerge (Babchuk (1997), Brown, Stevenson, Troiano and Schneider(2002) cited in Moghaddam, 2006), whilst maintaining a connection to the actual participant responses (Babchuk, 1997). By then comparing the categories (Creswell, 2002; Glaser and Strauss,1967) new categories and sub categories emerged totalling eleven categories in all. This was deemed sufficient and the study diverged from standard grounded

theory practice of continuing to the point of theoretical saturation.

Axial coding: finding relationships between the themes: The second coding phase, axial coding, sought to establish relationships between concepts to which a 'gestaltian' hierarchical system of categories and subcategories could be introduced (Goulding, 1999) where the categories represent the core topics and the subcategories the observed variances or attributes within that topic (Strauss and Corbin, 1990).

Selective/hierarchical coding: This final coding phase dealt with the theories alluded to in the axial coding results, taking the core or central categories as the foundation and using the subcategories to explore the emerging and often divergent theories. These theories were reinforced with participant responses.

The central categories were chosen according to the criteria defined by Strauss and Corbin (1998):

- It must be central; that is, all other major categories can be related to it
- It must appear frequently in the data. This means that within all or almost all cases, there are indicators pointing to that concept
- The explanation that evolves by relating the categories is logical and consistent. There is no forcing of data
- The name or phrase used to describe the central category should be sufficiently abstract that it can be used to do research in other substantive areas, leading to the development of a more general theory
- As the concept is refined analytically through the integration with other concepts, the theory grows in depth and explanatory power
- The concept is able to explain variation as well as the main point made by the data; that is, when conditions vary, the explanations still hold, although the way in which a phenomenon is expressed might look somewhat different. One also should be able to explain contradictory or alternative cases in terms of that central idea (p.147).

Results and discussion

In order to manage the data through the coding phase the data was entered into a spreadsheet with the column headings used to describe the source and level of abstraction. Through the analysis it was clear that some responses pointed in a different direction to the specific framework topic whereas others veered completely off topic and were not actually related to the original topic. These responses were recorded against the originating section but were tagged for later review. The information contained in the responses was valuable and so new themes or categories were added to the structure as appropriate. However, processing the data threw up many questions such as did a subcategory become a category if it appeared multiple times? The answer to this question depended on whether the interview responses that generated the subcategory reflected opposing views in which case both subcategories were retained and distinguished with a new marker indicating a positive or negative perspective using the symbols '+' and '-' respectively. If the responses reinforce the same view a single subcategory was kept but marked with a double symbol depending on the interviewees positive or negative perspective. In some instances the concept, category and subcategory did not present either a positive or negative viewpoint, rather they contributed to the overall impression of the support environment.

Figure 3: Themes and Category Associations Sample

Theme/Category	Frequency
Knowledge	**84**
Expertise	4
Use of knowledge	2
Knowledge sharing	6
Motivation for sharing	5
Knowledge	3
Knowledge Aquisition	42
Knowledge Capture	2
Knowledge Discovery	5
Knowledge Sharing Barriers overcome	2
Overall knowledge management	12
Reason for sharing	1
Processes	**60**
Motivation	1
People	1
Process	58
Software maintenance team requirements	**57**
Barriers	1
Expertise	2
Job role motivation	1
Leadership	3

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Theme/Category	Frequency
Motivation	6
Norms - culture	11
People	19
Process	6
Time	4
Time barriers	1
Tools	1
Tools and Technology	2
Leadership	**26**
Leadership	12
Motivation	1
Norms - culture	4
Norms - expectations	2
Role	7
Platforms - Virtual/real space	**26**
Real space	7
Tools	1
Tools and Technology	4
Virtual space	14
Knowledge Management	**24**
Barriers to Knowledge Sharing caused by	21
Evidence of Barriers to Knowledge Sharing	3
Tools	**18**
People	1
Process	3
Tools	6
Tools and Technology	8
Culture	**15**
Norms - culture	10
People	5
Grand total	**310**

Team knowledge management within an outsourced business systems software maintenance environment: a case study using grounded theory methods

Proposition 1: Communication is the core of almost all support activity but whether the communications tools are as effective as they could be is debatable.

Knowledge: As the topic recurring most frequently amongst the sample group it is clear that knowledge is a significant concept for the group and one can assume the teams as a whole. Knowledge acquisition, discovery, capture and application, as well as how knowledge is used were all discussed during the interviews.

How knowledge is used:

- From their management, team leads, portfolio managers
- By talking with the business community
- In the course of support activities to get the required outcome, to support other team members, satisfy client needs
- The team leads and portfolio managers use knowledge to motivate and engage the teams in their roles. This is in order to reduce the turnover of staff which would affect team productivity
- Data held within monitoring and support tools is used to plan and resource team activities as the planners have knowledge about what events are coming up and what is support is needed.
- As the subject matter for training team members
- By team members in the execution of their support duties.

How the teams source knowledge:

The interviews present a number of ways by which the participants come to possess knowledge. These include:

- Technical and business domain training which can be self study, formal courses, from Subject Matter Experts (SMEs) or other team members according to individual learning preferences
- Documentation, either created by other team members or external sources like the internet
- Sessions with members of their own immediate or wider teams. This includes the SMEs
- Using the informal or formal communities of practice within the client and server provider organisations
- Via knowledge exchange sessions with the client
- Structured knowledge transfer sessions, particularly for new team members
- Reviewing old incident records on the incident support tool
- Reviewing notes and emails created or saved by other team members in the knowledge repositories
- By resolving issues and finding new ways to view a subject
- The interviews suggest the teams recognise the value add offered by the SMEs making use of them whenever possible
- They also recognise that the deep knowledge they possess is accumulated over time.

Knowledge management: Through their responses the participants have demonstrated that the client and service both have a fairly comprehensive knowledge management strategy, although the team exhibit varying degrees of engagement with it. One or two of the responses suggest that some team members are not involved in any knowledge capturing activities for example although no reason for this was given.

Proposition 2: Documenting and communicating the purpose of processes for better understanding across the support teams which could improve the process performance.

Processes: From the data it was clear that the team members interviewed were subject to a high number of processes. 83 % of the processes mentioned were specific to the support area, 10 % were processes more typically found in software development projects and 6 % referred to knowledge acquisition processes. Only two process types were recognised in the interviews: *Knowledge Acquisition* and *Organisational processes,* and some of the team described processes as being both important and useful. Important because they are part of the support team's responsibilities and team members needed to be aware of them in order to perform their role. The processes were also described by one participant as time consuming. This individual added he did not know what the processes, specifically the organisational processes, were for. He had not been given any information

about the tool and thought they might be a marketing tool to the company. Another participant noted that some but not all of the organisational processes such as the handing over of an incident to a different support team were not documented and felt that doing so might be a good idea.

When it came to the subject of processes the responses indicated a wide acceptance of a number of processes applicable to the support environment. Regular service reporting, structured client communication, problem escalation and handover were a few of those specifically named suggesting that there is high visibility of the range of processes that exist. However the response indicated that some of the processes were not consistently applied across all teams such as application or domain specific business awareness training for new team members. It was also noted that some but not all of the processes were documented.

It was felt that the processes helped the participants feel part of a team, especially for the offshore team members who felt included in the operation, gaining familiarity with the issues onsite. The regular team meetings used to review current problems and to impart news both social and work related, helped the individuals see themselves as part of something. It also helped build the confidence of individuals in their capabilities as they could see a positive response to their contributions in meetings and acknowledgement at team level at least of their work for the team.

In terms of knowledge, the participants made reference to a number of knowledge acquisition processes such as training from the subject matter experts (SMEs) or the documentation created by team members and shared with their colleagues. Some team members felt that more could be done to publicise and recognise efforts to contribute to the enhancement of team knowledge, particularly for new recruits

Software maintenance team requirements:
The interviews suggested that the team dynamic is strong. Members are aware of their own roles and responsibilities to the team and to each other. This was determined from the reference to team work and creating tools or documentation for team mates, the fact that they are able to approach anyone either within their immediate team or extended teams.

In terms of the support role, the interviews outlined some of the activities team member are expected to perform and the behaviour protocols they should adhere to. The role itself requires team members to carry out or participate in the investigation of and resolution of as many problems as possible.

The interviews also indicated some the attributes and attitudes a support team member needs to have to be successful as outlined by these quotes from interviewees:

"The ability to learn, grasp quickly and communicate"

"to absorb information and internalise it for future use"

"Acquire knowledge or understanding of issues"

"Acquire knowledge about the application, technology and business"

"They should have correct approach in problem solving in a very short span of time"

"Team working"

"[Communicate] - Interact with users"

"...establishing relationships"

"[be..] curious about knowing the root cause [..rather than] just fixing it"

Software skills were also mentioned but not excessively, in fact only one team member made direct reference to it at all.

Communication is a very important component within the team. Amongst team members it helps to find solutions to problems, exchange and share information and knowledge, find new solutions to existing issues and keep team members up to date with events and activities. It was also suggested by their awareness and interest in each others previous work experiences and skills although this was not true across all participants. For some roles, such as the business co-ordinators, communication is a part of building close relationships with the client and gathering information about a problem.

As far as learning about teammate experiences and skills is concerned some felt they had nothing personally to gain from it. The interest in understanding what their teammates are

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and skills, keeping up to date with issues with the group or as a means of resource management. The former was relevant where participants were keen to improve their technical skills or business knowledge, however, although the intention was expressed the team indicated that they did not always have enough time for training: themselves or others. The latter, monitoring the current team activities, served several purposes for the more senior team members: to ensure rotation of tasks amongst the team to maintain their enthusiasm, to ensure they were trained on and had received practical experience of as many aspects of the role as possible to mitigate the loss of knowledge should a team member leave and to also ensure the work was done correctly and on time.

From the interviews it seems teams are motivated and keen on performing well, and participating in team activities. They are well informed about their role and understand what is expected of them but there is a constant need for more information and the main source for this appears to be other team members. Whilst this is perfectly acceptable it does raise the question whether the teams have sufficient or adequate means to communicate. Certainly from observing the teams and the secondary data source from initial environment investigation it seems the only mode of communication is the telephone. From the observations and the interviews it was not possible to know what the information was or to gauge whether the requested information was ever received or whether once received it was captured in any way.

Proposition 3: Although the support teams seem to be well versed in what is expected of them the leadership influence is not consistent. The management might consider ways to communicate the same messages to the whole team proactively rather than on an intermittent one to one basis.

Leadership: The role of leadership, in the form of team leads, team managers and section service department manager, both onsite and offshore is to define the objectives, goals and for the organisation and the support teams and, in theory, these are filtered to the team member top down through the organisation via email communications, newsletters and company forums. For the onsite/offshore model the high level messages are the same but one

interviewee commented that the difference in type of work and pressures are not the same in the two locations. Leadership plays a part in the objectives for the teams and the activities they are responsible for.

Proposition 4: Invest in better quality, more reliable telecommunications and video conferencing technology so that it can be used to overcome the issues caused by teams working in distant locations.

The preliminary research in the early stages of the study showed the teams have access to a wide range of both virtual and 'real' facilities including web conferencing and videoconferencing technology and a sophisticated telephone system supporting international calls using abbreviated telephone numbers or 'short dials', wireless networks and private LANs as well as a wide range of software and computer hardware. However little of this featured in the responses. In fact video conferencing was only acknowledged when introduced into the conversation by the researcher. In terms of available platforms the telephone, internet and email were commonly the only concessions made as means of communication and information gathering. The interpretation of platform tended towards the technology upon which the business systems were built and hosted.

When analysing the theme Platforms - Virtual/real space four broad areas were mentioned: virtual spaces, real spaces, Tools, Tools & Technology and Process. The virtual space featured prominently in responses both as a barrier and an enabler to team activities. The responses suggest the participants feel there are pros and cons to virtual spaces depending on what they are to be used for. As a team building exercise, for communicating with the offshore team the video conference facilities were thought to be a good idea because it enabled the team to share experiences of the challenges facing the onsite and offshore halves of the team. At the same time it was felt that for training purposes, for example, video conferencing was not appropriate as too much personal contact was lost. The optimum situation for training ,according to one participant, is face to face because it allows the exchange of core information, the really important low level, very granular information at a pace to suit the expert and the recipient. The following comments were made in relation to using video conferencing for training:

"…video conference and working on internet, it doesn't really do the job."

"… person can't hear you properly or because I think face to face, the face expressions, the whole body language is a huge part of the conversation. Sharing - face to face, more of an impact and it is easier to explain things to people face to face rather than phone or email."

One of the downsides of the onsite/offshore model mentioned in an interview is that is it difficult to convey the different pressures faced by the team to their counterparts in another location. This is particularly relevant if one side is depending on the other for a specific reason. The pressures offshore many come from the company and presumably workload whereas as the onsite teams face a different type of workload as well as demands from the client. The comment was made however that with the virtual technology it is possible for the teams to share information to a certain extent, such as documents in shared locations, tools accessible remotely or communicating by email so there is a level of visibility and means of communication across locations.

Proposition 5: Awareness and acceptance of support processes is not widespread. Documenting and communicating the purpose of processes for better understanding across the support teams could improve the process performance.

Another downside of the model is the lack of person to person contact, which one participant actively did not like as he prefers, for at least some of the time, to work in the same location as his teams in order to establish relationships with them. Working in the same location need not be permanent but in the situation where he is training a new recruit on a complex application the distance affects the quality of communication and therefore the level of detail passed on during the training.

An advantage of onsite working mentioned in the interviews is that there is a much closer relationship with the client. The role of business co-ordinator is an example of this. It does however increase the need for the co-ordinator to pass on any information they obtain to ensure the offshore team are kept up to date with issues and events but this is not always practicalable.

Overall, the consensus appears to be that the virtual space has its place within the team although it does bring its own challenges with it. The suggestion was made that these challenges could be mitigated if more advanced tools were made available. The interviews specifically articulated improvements where if existing technology such as web conference tools were made available to the individual in their workspace they could communicate on a one to one basis more effectively. Increased capacity for video conferencing and remote working was suggested as a possible improvement to communications between offshore and onsite teams as well as accessing shared tools or repositories.

The teams have access to a range of software tools provided by both Client and Supplier organisations to use in the execution of their role such as those used for system alerting and monitoring, problem and change management, document repositories like Sharepoint and software development.

The team drew a distinction between job required for their role and those required by the organisations citing timesheet application as an example. However there were differing views as to the usefulness and quality of the organisational tools. In some situations the team felt the tools took up a lot of their time for no obvious reason. Equally some felt there was not enough clear information about what the tools were for or were cumbersome to use. The sentiments echo those found when assessing the platform topic.

Opinions were also divided in terms of the tools the team used in their role. Some tools were inherited from development teams and so were not specific to support. This was not considered a major issue as the team often designed and built tools that were specific to a support requirement.

From team comments it appears that they do not always have access to tools appropriate to their job and suggested tools they had worked with previously. This was particularly true for one participant working on a mainframe application who cited code version control tools as a desirable addition to the toolset. Another comment was that they resorted to the internet when they needed help on various issues. Comments from the participants also indicate that the availability of or the understanding of what the tools are for is not

consistent across teams. Whether this is due to poor communication about the tools or is the responsibility of the team member is not clear as the participants worked on different applications using different technologies and toolsets.

'for example, information about certificates, there is nothing internally.'

In a similar vein, another participant pointed out that if more members of the team were to contribute more information to the knowledge management tools, the centrally held knowledge repository for example it would provide a richer source of information for the team as a whole creating the option for the team to help themselves rather that seek the information from a colleague.

Proposition 6: Culture does not impede the support operation at team level however there may be a need to revisit the client/service provider relationship at management level to review the impact of the working relationship.

The results themselves suggest that of the areas mentioned three broad types of culture are apparent: national, referring to beliefs and behaviours commonly found within country boundaries; occupational, referring to the norms of the job and organisational, referring to the behaviours the client and service provider organisations expect from the support teams.

The interview responses offered evidence of occupational behaviour by referring to the presence of communities of practice, a sharing culture where there is a propensity for team members to share information, clear understanding of what is and is not acceptable in the work place. One interviewee also defined what culture means to them:

'people culture - good attitude, punctual and recognization'.

This is a literal quote taken from the questionnaire completed by an offshore participant.

The expected gender differences common to Indian culture were not thought to be an issue for the team: there was no perceived difference between male and female team members, however one participant noted national differences affecting both team and

management behaviour in the reluctance to challenge the client or internal management on certain matters. Whether this is a display of strictly national culture as opposed to inequalities of the client/supplier relationship the participant could not be sure. The only other reference to cultural difference at national level was a situation where a participant was introduced to the concept of a *'partner'*. A colleague was living and had children with his partner but they were not married. This surprised him as it was not something he has come across before.

Organisational culture was recognised as the practices the participants felt their company encouraged, namely that knowledge should be shared and that because of this team knowledge management as well as the structure of the company itself is evidence of an organisational culture keen to promote knowledge management.

Conclusion

The use of a control interview for both information gathering and familiarisation with the interviewing procedures, following the example of more experienced academic research work was a productive way to address the researcher's lack of experience as a qualitative field researcher. The overall interviewing and research experience meant that some of the challenges of the interviewing, transcribing and coding processes can be avoided in future such as leaving more quiet time between questions for the interviewee to think and respond, or using transcription software to reduce the time to generate the scripts. This was investigated during the study but time did not permit it adoption.

Due to the small scale of the study and the relatively narrow window for its execution there was no opportunity to extend the sample group to other support teams, the client teams or the management. The results from such a experiment may be very different particularly as regards the influence of cultural differences.

The framework used in the study proved to be useful in the assessment of the knowledge management capability for the maintenance teams as was found to be the case in the research by Eppler and Sukowski

(2000). However the study has concluded that the concerns raised by Garcia-Perez and Ayres (2009) about the impact of poor communication were not mirrored in the study. This may be an influence of the collectivist trait (Hofstede, 1981) of the sample group who are from either India or Pakistan. Further research into this could be interesting.

The study also concurs with Zakaria, Amelinckx and Wilemon (2004) in the sense that the available technology cannot be credited with the knowledge management and sharing observed in the study. It can be said that the study confirms it requires trust and positive team dynamics to create an effective knowledge sharing environment.
Other areas that were not developed in the study were the more technical aspects of the maintenance function and the different maintenance types as elucidated by Sneed and Brössler (2003). Future research could expand the use of the framework to incorporate the client perspective which could be insightful when assessing for example critical success factors from the client viewpoint. Or perhaps the extent to which the framework supports the success criteria for software maintenance.

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