

Knowledge Creation and Integration in Project Teams: A Study of International Telecommunications Companies in Singapore

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ABSTRACT

The purpose of this study is to investigate the knowledge-creation and integration processes of project teams in Singapore-based telecommunications companies. The study investigates how the knowledge-creation process is initiated, how project members socialize and share their tacit knowledge, the techniques or strategies that the project team uses to create concepts and methods for recording and sharing the customer proposal within the company. The study draws upon research from knowledge management on knowledge conversion and creation to develop an enhanced model of the knowledge-creation process of project teams for developing customer proposals.

INTRODUCTION

The telecommunications markets in Singapore and Asia Pacific are experiencing very strong growth due to deregulation and growing demand, and they provide business opportunities for suppliers of telecommunications systems. The telecommunications industry in Asia Pacific (excluding China) had a market potential of ~US\$27 billion in 2000 and it is expected to have an annual growth rate of 12% to 2002 (Poh 2000). These business opportunities are usually large multi-million dollar projects and very complex due to the rapid technological evolution. The RFP (Request for Proposal) is the common market practice and the sales situations that require proposals are often intensely competitive. Competition is forcing telecommunications companies and suppliers to spend more time and money developing proposals to potential new customers in the rapidly de-regulated markets or to current customers being wooed by aggressive new competitors.

The increased complexity of customer proposals is due to the high level of customization of proposals as the market and business environment become more competitive, diverse, and dynamic (Conlin 1998; Hardwick & Kantin 1992). Each customer proposal in the telecommunications industry should be considered as an intensive project in itself and project and knowledge management are directly relevant to members of project teams in Singapore-based companies developing customer proposals. Proposal development requires a multi-disciplinary project team to create and develop the offer and solutions that will meet the customer requirements and also the demanding schedule. Therefore the proposal project team usually includes specialists from various functional departments of the company; such as operations, finance, engineering, project management, and others (Lorge & Strout 1999). The project team needs to concurrently undertake such activities as determining the bid strategy, creating

and designing innovations and or solutions, writing, and estimating (Weiss 1994). Creating new knowledge and customizing the proposal to effectively respond to the client's concerns and showing a grasp of their unique issues will determine success (Asner 1992; Nassutti 1993; Padjen 1998, Ray 1998; Rosen 1994; Sant 1999; Westbrook & Peterson 1998). Other important elements in the development of quality customer proposals are effective project management and process, strong teamwork, creativity, knowledge of customers, and competitive knowledge (O'Dea 1998; Stevens 1996).

The stakes are high and a Singapore-based company's ultimate survival often depends on its ability to submit an acceptable proportion of profitable proposals. A well-prepared proposal can be an extremely effective method of making a sales presentation and a single successful proposal is capable of generating the volume of sales that may equal or exceed other sales activities (Blackstone 1995). Requests for Proposals (RFP) in the telecommunications market are getting more complex and proposal development is costly. It is the most crucial form of communication in today's customer-focused market-place – all of a company's capabilities must come together to create and produce a winning proposal (O'Dea 1998; Padjen 1998). A winning proposal means a satisfied customer, and increased revenue and sufficient money that will cover the cost of sales, generate a profit, and maintain the organization (Hardwick & Kantin 1992; O'Dea 1998). The proposition in this paper is that insight into the knowledge creation process can assist project teams to share tacit knowledge, covert this into explicit knowledge and create new knowledge for future project teams to use in preparing project proposals for clients.

THE KNOWLEDGE CREATION PROCESS IN PREPARING PROPOSALS PROJECT

The ability of a firm to integrate knowledge is a strategic asset (Grant 1996; Lorenzoni & Lipparini 1999) and this is qualified by the ability of the enterprise to transform 'dispersed, tacit, and explicit competencies into a wide body of organizational knowledge' (Lorenzoni & Lipparini 1999 p. 320). If the knowledge is refined into two dimensions, tacit knowledge and implicit knowledge it creates a mutual understanding that has a strategic implication for the management of a project team. The Nonaka and Takeuchi (1995) model of four modes of knowledge conversion deals with the process of converting tacit knowledge to explicit knowledge by socialisation, externalisation, combination and lastly, internalisation (see Figure 1).

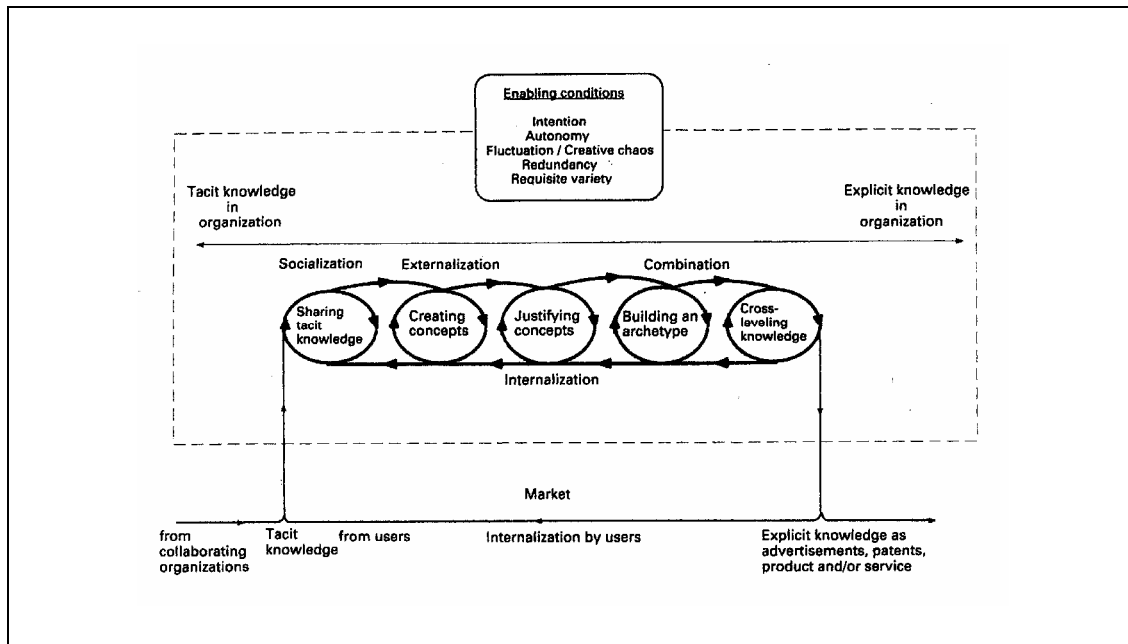
The socialization process aims at getting key actors to share personal or tacit knowledge. Project team members in an enterprise each have tacit knowledge on market trends, consumer preferences or the strategy formulation of the enterprise. At this stage, the knowledge is still primarily the personal possession of employees or the collective possession of teams. Externalisation creates new, explicit concepts from tacit knowledge. If project team members share this knowledge with other team members or peers through metaphors or analogy, such metaphors can create a common 'network of new concepts' (Nonaka & Takeuchi 1995, p. 67). In a telecommunications company operating in a country such as Singapore with a diversity of languages, cultures and business practices, the creation of common metaphors may be part of the challenge.

Combination involves integrating different bodies of explicit knowledge. In many cases this happens if project team members exchange information through documents, meetings, telephone conversations, e-mail or Intranet discussion groups. If the information is sorted, categorised or combined by manual or computerised methods, further discussion of this explicit knowledge can lead to the creation of new knowledge. In Singaporean telecommunications companies this knowledge can be dispersed across teams within the company. Externalising such codified knowledge allows it to be transmitted rapidly and to larger audiences whereas tacit knowledge is initially shared slowly in face-to-face situations under conditions of trust. Singapore-based companies differ in the kinds of knowledge development systems that they adopt. Some firms may adopt a 'theorising and codifying' form of learning bias, whereas others develop learning-by-doing systems that lead to 'tangible knowledge integration' (Sanchez & Heene 1997, p. 11). Finally, project team members internalise the explicit or new knowledge to make it part of their own expanded repertoire of tacit knowledge. In Singapore-based telecommunications companies the volume of information and diversity of project team members place high demands on the technical systems used to integrate and disseminate knowledge and on the diverse team members to absorb and act on the knowledge.

A five phase model of knowledge-creation was developed by Nonaka and Takeuchi (1995 - see Figure 1). In the first phase, individuals from different functional areas are assigned to project teams who have to share their tacit knowledge in order to create a project proposal in response to a client's request. In face-to-face dialogue during project team meetings to prepare project proposals and thus jointly shared tacit mental models are developed. This process of social interaction accesses knowledge that is embedded in the project team members.

In the second phase, concepts are created as project team members collectively reflect on the shared tacit mental models developed in phase 1. Creative thinking converts the tacit knowledge accessed in phase 1 into explicit knowledge in an environment free of excessive control or over-management (Pascarella 1997) and is considered as an iterative process (Nonaka & Takeuchi 1995). In Singapore-based telecommunications companies this proposition may be applicable in project teams.

Figure 1 -A five phase model of the knowledge creation process



(Source: developed from Nonaka, & Takeuchi 1995; Poh 2000)

In the third phase, concept justification, new concepts are screened. This process of evaluation looks for organizational 'fit' between the Singapore-based telecommunications company and societal alignment with the needs of the client. Some writers argue that this is the province of senior and middle management, and is based on their understanding of organizational vision and strategy (Nonaka & Takeuchi 1995). At this stage 'boundary-spanning' activities may occur. The concept of boundary spanning and integration could be of importance if project team members are re-assigned to different project groups and clients to react to requests for proposals from new clients.

In the fourth phase, the 'justified/approved' concept is converted into a tangible or concrete 'archetype' (Nonaka & Takeuchi 1995). This could be the proposal specifically developed for a particular client in Singapore or elsewhere by combining newly created explicit knowledge for the new client and its needs with existing knowledge based on project proposals of previous clients and generated by other project teams. In the fifth 'cross-levelling' of knowledge phase, the concepts that have been created, justified or approved and modelled are used to activate new cycles of knowledge creation (Nonaka & Takeuchi 1995). This new knowledge has the potential to trigger further knowledge creation across project teams in a telecommunications company as well as, among peers in the industry or country (Poh 2000). This created knowledge is seen as the core memory of the company and as such should be preserved to avoid loss and subsequent re-invention (Liebowitz 1998). The created knowledge is an outcome of the 'boundary-spanning' process that became important in the fourth stage.

Therefore a purpose of this research is to investigate the knowledge-creation process of project teams, in Singapore-based telecommunications companies, for developing customer proposals when responding to customer's RFP (Request for Proposal) and the

research question for this study is *How do project teams in Singapore-based telecommunications companies manage the knowledge-creation process to develop customer proposals?* There are many research issues associated with this question and these issues are highlighted in the results section.

KNOWLEDGE INTEGRATION AND TEAM MEMBER ROLES DURING THE KNOWLEDGE CREATION PROCESS

Within the telecommunications companies the roles of knowledge operators and knowledge specialists are not clear. Knowledge operators could accumulate or generate tacit knowledge of project proposals by being exposed to operating conditions of the telecommunications company or its clients. Specialists could generate or analyse well-structured explicit knowledge usually in the form of scientific or other technical data that may apply to the projects. These practitioners usually have high intellectual standards, have a wide variety of experiences within and outside the company and are able to dialogue with customers as well as colleagues (Nonaka & Takeuchi 1995, p. 154). Practitioners may also act as knowledge buyers who are searching for knowledge to solve a complex issue within a project proposal team and want to acquire insights, judgements or understanding that another project team member, specialist or client possesses (Davenport & Prusak 1998).

A further role that may exist in the Singapore-based companies may be knowledge engineers who serve as a bridge between visionary ideals of telecommunications leaders and the realities faced by knowledge practitioners. They could 'remake reality or engineer new knowledge according to the company's vision' (Nonaka & Takeuchi 1995, p. 154) and they are most often found at middle management level. They are able to synthesise the tacit knowledge of both practitioners and senior executives, make it explicit and incorporate the knowledge into new products, systems or project proposals. This implies that they not only need to be able to engender trust among project members but also that they should be able to envision a future course that members can identify with. The knowledge engineers are usually skilled in project management, can formulate hypotheses or metaphors to create new concepts, and need to have the ability to 'integrate different methodologies to create knowledge' (Nonaka & Takeuchi 1995, p. 156). Skilled knowledge engineers in a project proposal team become knowledge sellers if they have a reputation of substantial knowledge about a process or subject, are able to articulate the tacit knowledge and willing to share the information or insights (Davenport & Prusak 1998).

Knowledge officers within firms manage the total organisational knowledge-creation process at the corporate level by articulating the company vision, 'establishing a knowledge vision' and setting the standards for 'justifying the value of the knowledge that is being created' (Nonaka & Takeuchi 1995, p. 156). These officers could play a knowledge brokers role as they have a macro view of the telecommunications industry and realise that certain providers can be connected to specific clients (Davenport & Prusak 1998). The officers usually also have the ability to select project managers and have a capability to 'create chaos in the project team by setting inordinately challenging goals' (Nonaka & Takeuchi p. 158). These descriptions of roles is usually applied to project teams within companies but can also be applied to business-to-business networks (Brown & Erwee 1999; Erwee & Brown 2000).

In the Singapore-based telecommunications companies the roles that project team members played during the phases of creating a project proposal to develop solutions for a customer are investigated (Poh 2000b). This paper is concerned with project team members involved in the creation of project proposals for customers or the 'knowledge creation crew' (Nonaka & Takeuchi 1995, p. 152), and not the general knowledge practitioners, knowledge engineers and knowledge officers. In contrast Davenport and Prusak (1998), argue that knowledge management will not succeed if it is solely the responsibility of a small specialist group, but needs to be a pervasive part of everyone's job.

Another dimension of the creation of knowledge (Nonaka & Takeuchi 1995), is that of the concept of knowledge integrator nodes (K.I.Ns, see Erwee & Brown 1999). The concept concentrates more on the way in which 'knowledge is managed in order to ensure the creation and extraction of value to the organization in the knowledge creation process' (Erwee & Brown 1999, p. 13). Knowledge integrators are persons who deliberately integrate explicit knowledge gained from peers in knowledge creation crews and then disseminate it across project teams or company boundaries. As Poh (2000) further elaborates, the concept of the knowledge integrator means that:

' The creation of knowledge is no longer the activity of an organization (network component) working in isolation, but the collaborative result of its members working closely in internal groups and in partnership with other organisations'.

A research issue is how is the knowledge of the project team members integrated during the knowledge creation process and who performs this role. A related research issue is about the roles that the various project team members perform during the different phases of developing the customer proposal.

METHODOLOGY

The literature covering knowledge creation in project teams is relatively limited and there is little precedence and tools to study the phenomenon in question using empirical, quantitative methods (Janesick 1994; Maxwell 1998; Morse 1994). Yin (1998) suggests that in situations such as in this present study, application of a qualitative, multiple-case study approach is appropriate.

Purposive selection sampling was used to select six major proposal project case studies from four international telecommunications companies based in Singapore. In this study, data collection techniques consisted of semi-structured interviews with four members of each proposal project team; and analysis of company documents, web-sites, archival data, and a comprehensive literature review. Before the data collection phase, a pilot case study was conducted to pre-test the case study protocol to enhance the reliability of the study. For data analysis and reduction, several techniques were used and they included content and thematic analysis, and summary tables. The use of multiple case studies and multiple sources of evidence allow for a more complete understanding of the phenomenon in question as well as providing opportunities for triangulation, validation of results, and research validity (Stake 1994; Yin 1998).

The four companies, from which the six case studies of project teams were selected, were known for their leadership roles in the telecommunications industry and

pioneering technologies and applications in the global markets. All of selected multinational companies had operations in many countries globally; and with turnover exceeding more than US\$ 10 billion in fiscal year 1999 (Poh 2000). Their Singapore operations or subsidiaries also supported the businesses in some other countries in the region. The study focused on customer proposal projects that exceed US\$ 5 million in value and involved multiple technologies and the proposal project teams consisted of managers and specialists from different functional groups. Each multi-disciplinary proposal project team was required to determine the network design, systems, products, and services; and develop the offer and solutions that would best meet the requirements and specifications of a customer.

Types of teams interviewed

In all the case studies, multi-disciplinary proposal project teams are used to develop the offer and solutions that would best meet the requirements and specifications of customer. A total of 24 interviews were conducted that enabled within-case analysis and cross-case analysis for the research issues. The research's six case studies are identified individually using two characters first, a company identification (A to D); and second, by the case number (1 or 2). This identification system preserves case anonymity and also keeps cases separate. Further, the interviewees are coded using the third / 3rd character (1 to 4). For example, A-1-1 refers to company - A, case study - 1, and interviewee - 1 (Poh 2000).

Companies tend to select certain types of team members to serve on project proposal teams. These generic types of members are managers and specialists from the various functional groups - sales or account management, product management, network planning and engineering, business management, proposal management, administrative support, and professional services and project management.

RESULTS

The Knowledge Creation Process In Preparing Proposals Project

Research issue 1: How is the knowledge-creation process initiated for developing the customer proposal?

In all the case studies, the knowledge-creation process is initiated with the proposal project start-up meeting and the importance of this process is shown in Table 1. This start-up meeting is a formal meeting of all the proposal team members and it is carried out as soon as possible after receiving the RFP from the customers. The main purpose of the meeting is to update the team on the customer requirements, market and competitive situation, the account strategy and plan, and review of the preliminary proposal project plan. 'It is important to keep every member of the team informed and to synchronize our effort to achieve the desired project objectives. There is really no time for double work' (respondent in case study: A-1-1).

Table 1 - The importance for proposal project start-up meeting

Case studies → Rating ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Very important	3	3	3	3	3	3
• Somewhat Important						
• Not too important						

(Source : Poh 2000 Analysis of interview data)

Generally, the culture and environment of the proposal team is open and everyone is encouraged to express their views and comments on the information and issues presented during the proposal start-up meeting. As discussed in research issue 2, when an issue is raised, the relevant members provide their views, share their knowledge, and the team then discusses the options; before deciding and agreeing on the most appropriate and desired course of action. There is also a strong respect for the individual opinion and his or her viewpoints as everyone is treated as a specialist in his or her own specific field or discipline.

Research issue 2: How do the project members socialize and share their tacit knowledge?

Predominantly, all the case studies show that sharing of the knowledge by the project teams is very important to the successful development of a competitive, winning offer in the proposal (see Table 2). The assignment of the project team members is based on the requirements of the customer’s RFP and the specialist or functional knowledge of each individual.

Table 2 - The importance for the project members to share their knowledge

Case studies → Rating ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Very Important	3	3	3	3	3	3
• Somewhat important						
• Not too important						

(Source: Poh 2000 Analysis of interview data)

Table 3 - Methods means and techniques for sharing tacit knowledge

Case studies → Techniques / methods ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Open discussion	3	3	3	3	3	3
• Meeting (face-to-face)	3	3	3	3	3	3
• Conference call	3	3	3	3	3	3
• Email	3	3	3	3	3	3
• Internet			3	3	3	
• Formal / pre-scheduled	3	3	3	3	3	3
• Informal / ad-hoc	3	3	3	3	3	3

(Source : Poh 2000, Analysis of interview data)

Within the proposal project team, this socialization and knowledge sharing process is done through both formal meetings and informal discussions; and performed throughout the project life cycle (see Table 3). Sharing of tacit knowledge within the project is done

at two (2) levels. At the overall proposal team level, it is done in formal meetings with a pre-determined agenda and schedule. For each identified issue or problem, sufficient time is allocated for open discussion by the relevant subject matter specialists to solve the problem and create the solution. At the specialist sub-group or team level, which generally consist of specialists from similar or related disciplines, it is done more on an informal, ad hoc basis depending on the issue/s to be resolved. Similarly, the importance of sharing knowledge within the proposal project team is also observed. All methods of communication are used to share knowledge. However, the use of the Internet is lower or less frequent in cases A-1, A-2 and D-1.

Research issue 3: What are the techniques or strategies used by the project team to create concepts?

Generally, the development of the offer and solutions for major projects require a relatively high level of customization of products and services and also the development of new ones. Customization refers to the adaptation of standard or ‘off-the-shelf’ products as well as the creation of new products and services. No two operators are identical and each has its own needs and requirements. Customization is always required for RFP of major sales’ (respondent in case study B-1-1). The level of customization that is required for developing the offer and solutions in each customer proposal project or case study is shown in Table 4. In cases B-1 and C-1, the interviewee rate their offers slightly lower than the others because their projects are an expansion of existing networks and systems which are less complex.

Table 4 - Level of customization for the offer and solutions

Case studies → Level of customization ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Very high	3	3		3		3
• High			3		3	
• Average						
• Low						

(Source: Poh 2000 Analysis of interview data)

Table 5 lists the techniques or methods that are used for developing new concepts and solutions. Brainstorming is the common technique used by all the case studies to create new concepts, solutions, and design for the offer of the proposal. Similar to the findings in research issue 1, it is most commonly done through open discussion in face-to-face meeting, conference call, and email; with cases A-1, A-2 and D-1 using the Internet less frequently.

Table 5 - Techniques used for developing new concepts and solutions

Case studies → Techniques / methods ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Brainstorming	3	3	3	3	3	3
• Open discussion	3	3	3	3	3	3
• Face-to-face meeting	3	3	3	3	3	3
• Conference call	3	3	3	3	3	3
• Email	3	3	3	3	3	3
• Internet			3	3	3	

(Source: Poh 2000 Analysis of interview data)

As observed in all cases, the creation of the solutions and offer usually begins with the

sales or account manager updating the team on the a) account plan and sales strategies, b) customer's requirements in the RFP, c) other special commitments and requirements, and d) the preliminary or proposed offer by the company. Next, the team members discuss the issues; offer their views, comments and suggestions; discuss the alternatives; and then follow with the decision by the team. 'This process enables the proposal team to leverage of the knowledge of the relevant specialists and collectively try to find the most optimal solution to the issues' (respondent in case study A-2-1). The sharing of the tacit knowledge and creation of new concepts and solutions are highly interrelated activities.

In all cases, key managers for different specialist or functional groups participate at the overall proposal level to create the solutions and offer. Some cases include all members of the proposal project team. The need to involve representatives from each specialist group is very important because each group has its own very specialize knowledge and competencies, which are critical to the development of the overall offer for the customer proposal.

At the functional or specialist sub-group or team level, brainstorming is also used to develop and create the options or solutions for the identified issues and problems. The discussions at the sub-group or team level are led by the senior specialists or managers, and then presented to the overall project team. 'Due to the complexity of the offer and problem, it is not possible for any single person [to possess the knowledge] to solve the customer's problems. The final offer must operate seamlessly and it is very important to consider all aspects - commercial, product planning and availability, technology and technical, and project management and service' (respondent in case study C-1-1).

Research issue 4: How do the project teams justify the concepts that are created by the project team?

The purposes of evaluation and justification of the created concepts are to ensure that they meet both internal or company and external or customer requirements; and to achieve an optimal, win-win situation. Table 6 shows the major criteria that are used by the case studies for evaluating the created concepts. For cases A-1, A-2 and D-1, pricing is not a major consideration because the offers include new and state-of-art technologies, which the customer specifically requests and there are no past market references. For companies A and B, the marketing and sales budget is not a major consideration because it is managed centrally at the country level and allocated to each project as part of the fixed or allocated expenses.

Table 6 - Criteria for evaluating the created concepts

Case studies → Major criteria ↓	A-1	A-2	B-1	B-2	C-1	D-1
• External / customer requirements	3	3	3	3	3	3
□ Technical	3	3	3	3	3	3
□ Commercial	3	3	3	3	3	3
□ Project plan	3	3	3	3	3	3
□ Pricing			3	3	3	
• Internal / company requirements						
□ Financial objectives	3	3	3	3	3	3
□ Account plan / strategy	3	3	3	3	3	3
□ Budget (M&S - marketing & sales)					3	3
□ Technical	3	3	3	3	3	3
□ Resources	3	3	3	3	3	3

(Source: Poh 2000, Analysis of interview data)

For all the cases, the approval process is required by corporate policy and it is a critical part of the customer proposal development process. The evaluation and approval is done by the senior management and executives of the companies and usually include the country president or leader, product vice-president, and financial controller. The account manager or director manages this approval process with a meeting between the senior executives and key members of the proposal team.

In the approval meeting, the account manager first provides the summary of the customer requirements, the preliminary offer developed by the proposal team, and the financial statements. It is followed by an open discussion between the executives and key members of the proposal team to enhance their understanding of the project. Subsequently, the final approval and decision is obtained; either wholly or by modifying the proposed offer which might be due to some new business situation, considerations, and constraints.

Research issue 5: How is the customer proposal recorded and shared within the company?

From the findings of the case studies, it is very important to share the completed proposal within the company (see Table 7). However, they are restricted to those on a 'need-to-know' basis. In all the cases, the completed proposal is stored electronically and restricted access to the information is secured through password protection. For some, paper copies are also provided for selective people and on-demand basis. Generally, the sales or account manager is responsible for this activity because he or she is ultimately responsible for the effective management of his or her respective customers.

Table 7 - The importance for sharing the information and knowledge within the company

Case studies → Rating ↓	A-1	A-2	B-1	B-2	C-1	D-1
• Very important	3	3		3	3	3
• Somewhat important			3			
• Not too important						

(Source: Poh 2000, Analysis of interview data)

The major purpose for sharing the knowledge is to prepare for the next stage of the

selling process after the submission of the customer proposal - proposal evaluation process. This follow-up stage may involve modifying the original offer to effectively meet new customer requirements, which may not be covered in the initial RFP. As such, the original knowledge serves as the reference for proposal project team in its new cycle of new knowledge creation to create and develop the revised offer, if required. 'Revising and re-designing the original offer is very common for major sales' (respondent in case study A-2-4).

Another major purpose for recording and sharing the knowledge created in the proposal is to provide the critical reference information for any new member that may join the project team in the later phases of the selling process. 'Frequently, new members are required to join the sales or project team and they [new members] have to catch up with what is happening real fast. Speed is critical in the fast-paced and competitive business environment; and they [new members] are required to hit the road and start running - fast. The market and customer aren't going to wait for you' (respondent in case study D-1-2).

Through the process of developing the customer proposal and the inherent knowledge sharing process within the team, it enables the project team members to acquire new knowledge outside his or her functional specialization. 'I am new to the company and through this process, I have significantly enhanced my product and technical knowledge, which are important when I interface with the customer and also our internal people in my normal or regular work' (respondent in case study B-2-4).

Knowledge Integration And Team Member Roles During The Knowledge Creation Process

Research issue 6: How is the knowledge of the project team members integrated during the knowledge creation process and who performs this role?

The integration of the knowledge within the project is done at two (2) levels. At the overall proposal team level, it is performed by the sales or account manager through formal meetings with a pre-determined schedule and agenda. At the specialist sub-group or team level, which generally consist of specialists from similar or related disciplines, integration of the knowledge is performed by the senior specialist or manager; and is usually informal and highly dependent on the issues and requirements.

In cases A-1 and A-2 (see Table 8), the integration of the knowledge for the overall offer of the proposal team is jointly performed by the sales or account manager and proposal manager. However, for the rest of the case studies, the sales or account manager performs the critical function of integrating and managing the knowledge of the overall proposal team. For each functional and specialist sub-group or team in all the case studies, the senior specialist or manager is responsible for integrating the knowledge for the group. 'One of our major problems in this type of major RFP is the chaotic and often confusing situation of coordinating and integrating the relevant information [knowledge] from the different members. We have established a central point of contact for each different group to eliminate redundancy and miscommunication, although it might slow things down a little' (respondent in case study: A-1-4). 'Effective management and integration of the information [knowledge] at the specialist groups and overall [proposal] team is critical and important to minimize confusion and redundancy' (respondent in case study: D-1-1). The interviewees are selected based on availability and to represent the different functional groups.

Table 8 - Roles of the interviewees in the knowledge-creation process

Company		A								B								C				D			
Case study / project team		A-1				A-2				B-1				B-2				C-1				D-1			
Interviewee →		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Functional role ↓	No.																								
• Sales / Account management	6	X						X			X						X				X		X		
• Proposal project management	1				X																				
• Professional services / project management	4						X			X				X										X	
• Subject matter specialists																									
<input type="checkbox"/> Product Management	5					X						X				X		X				X			
<input type="checkbox"/> Technical	4			X					X										X						X
• Administrative support	1												X												
• Financial / business management	3		X												X						X				
Total number of interview	24																								
Knowledge creation role ↓	No.																								
• Knowledge practitioner																									
<input type="checkbox"/> Knowledge operator	17	X	X			X	X			X	X	X	X	X	X	X	X		X	X	X		X		X
<input type="checkbox"/> Knowledge specialist	22		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
• Knowledge engineer	14	X	X	X		X	X		X	X	X	X					X	X				X	X	X	
• Knowledge officer	0																								
• Knowledge integrator (K.I.N.)	17	X	X	X	X	X	X	X	X	X	X	X					X	X			X	X	X	X	X

(Source: Poh 2002, Analysis of interview data)

Research issue 7: What roles do the various project team members perform during the different phases of developing the customer proposal?

Based on the analysis of the interviewee data, Table 8 shows the functional and knowledge creation roles that each interviewee performed during the knowledge-creation process for the customer proposal projects. The functional roles of the interviewees in each case study are evenly dispersed and this is due to the specific effort to ensure that they are from the different functional groups. Collectively, the main groups of the interviewees are from the sales or account management (6 interviewees), project management or professional services (4 interviewees), and subject matter specialist (9 interviewees) - five each from product management and technical. Interviewing people from different functional groups of the project team provides more comprehensive information for analysis and triangulation; and contributes to the validity and reliability of this study.

Most of the members perform more than one roles in the knowledge-creation process although he or she might perform only one functional role; and the role he or she performs during the knowledge-creation process for the development of the customer proposal is consistent throughout the project. 'Every member of the team plays multiple roles in the development of the overall jigsaw [the solutions and offer]; and the three most important things are teamwork, teamwork, & teamwork' (respondent in case study: D-1-2). The knowledge specialist is the dominant role as noted in 22 of the interviews. The knowledge operator and knowledge integrator node are each mentioned in 17 of the interviews; whereas the knowledge engineer is identified in 14 of the interviews. A related important finding is that the role of knowledge officer is not relevant in the customer proposal project team.

It is very important for one or more team members to perform the role/s of integrating the knowledge and information during the knowledge-creation process of the proposal project team. These critical integrating functions are done at the overall proposal team level and also the specialist sub-group or team level. They are necessary to ensure the proper functioning of the knowledge-creation process within the proposal project team.

In summary, the findings show that each team member performs more than one knowledge creation role to ensure successful knowledge management and creation; to develop the innovations and solutions for the customer proposal, and the roles of knowledge engineer, knowledge practitioner, and knowledge integrator are critical and important in the knowledge-creation process for developing the solutions and offer in the customer proposal. However, the role of knowledge officer is not relevant or applicable in the knowledge-creation process of the proposal project team.

DISCUSSION

THE KNOWLEDGE CREATION PROCESS IN PREPARING PROPOSAL PROJECTS

Initiating the knowledge-creation process for developing the customer proposal

The results of the study indicate that the proposal project initiation or start-up is a critical and important first phase of the knowledge-creation process for customer proposal projects. Its main purposes are to update the project team, discuss the customer requirements and issues, and then follow with knowledge conversion and creation

activities to develop the necessary innovations and solutions to meet the customer's requirements. These results confirm the research by Turner (1999) which suggests that a structured project start-up process is an essential part of project management.

Socialization and sharing of tacit knowledge

The results indicate that the sharing of tacit knowledge by the members of the proposal project team is one of the critical success factors for developing high quality customer proposals. Tacit knowledge is primarily the personal possession of individuals and bringing together people with different knowledge and experience is a necessary condition for knowledge conversion and creation (see for example Chase 1997; Choo 1998; Gore & Gore 1999; Nonaka & Takeuchi 1995). The study confirms that knowledge creation lies in the mobilization and conversion of tacit knowledge and both types of tacit knowledge (technical and cognitive) are important for developing organizational core capabilities.

The findings also provide support for the literature that suggest spontaneous and planned, formal and informal, personal and impersonal human interaction are necessary for sharing tacit knowledge (Choo 1998; Hansen, Nohria & Tierney 1999; Leonard-Barton 1995; Madhavan & Grover 1998; Nonaka & Takeuchi 1995). In this study, open discussion, either in a formal or informal way, through face-to-face meeting, conference call, and email are the most commonly used methods and techniques for sharing tacit knowledge within the proposal project team.

Lastly, the results show that the sharing of tacit knowledge within the project is done at two levels, the overall proposal team level and the specialist sub-group or team level. This is due to the complexity of the projects and the involvement of different people from multiple disciplines or specializations for creating the solutions and offering customer proposals. The practical implications for project managers to enhance project team effectiveness are a) to ensure that sufficient opportunity and time are provided for members to share their knowledge in solving problems and creating solutions for the customer proposal; and b) sharing of knowledge could be done at both project team and sub-team levels to effectively facilitate the knowledge sharing process.

Techniques or strategies used by the project team to create concepts

This study's findings indicate that the creation of solutions, concepts, or offer is an important phase in the development of customer proposals for major sales that involved multiple technologies and multi-disciplinary projects as suggested by Beck and Wegner (1992), Hardwick and Kantin (1992), King (1994), and Lenehan (1998).

Results indicate that brainstorming is the commonly used technique and it is done through open discussions, face-to-face meetings, and conference calls. The sharing of the tacit knowledge and creation of new concepts and solutions are highly inter-dependent activities; and a high level of customization of the offer is required to effectively meet the customer's unique needs and requirements (see Leonard-Barton 1995; Nonaka & Takeuchi 1995; Wikstorm & Normann 1994). Recommendations to project managers are to use brainstorming techniques to create and develop innovative solutions to meet customer's requirements and also to solve problems encountered in the project and to use all types of interaction such as open discussions, face-to-face meetings, and conference calls to create sufficient opportunities to share tacit knowledge and create new concepts.

Justifying the concepts that are created by the project team

The findings showed that the approval of the concepts for proposal project is a mandatory requirement in the company's operating policies. These findings confirm the research by Choo (1998), and Nonaka and Takeuchi (1995) which suggest that the newly created concepts are evaluated at the organizational level to determine its 'fit' with the organizational intention and meet the needs of society at large. It also confirmed that the screening and approval process, and the justification criteria are typically formulated by top and middle management based on their understanding of the overall organizational vision and strategy and the criteria are derived from both internal and external requirements (see Choo 1998; Nonaka & Takeuchi 1995). The findings of this study suggest that this approval process is managed by the sales or account manager with the senior management and executives from the relevant business groups.

Recording and sharing customer proposals within the company

The sharing of knowledge within the proposal team and company is managed by the sales or account management representatives; by storing the customer proposal (created knowledge) electronically and providing access only to relevant people within the company (see Choo 1998; Nonaka & Takeuchi 1995). The findings contradict the literature about sharing the knowledge throughout the organization and also with external organizations (Wilkstrom & Normann 1994) as it suggests that the access of this knowledge is restricted only to the project team and the relevant people within the company; and not everyone in the organization. This restriction is due to competitive and strategic reasons because of the confidential and sensitive nature of the knowledge. The findings also disconfirm the need to import knowledge as suggested by Leonard-Barton (1995).

The sharing of knowledge enables the company to (a) gain leverage on the newly acquired knowledge for new cycle of knowledge creation in the later stages of the selling process and new business opportunities, (b) enhance the knowledge of the team members, and (c) preserve the knowledge so as not to re-invent the wheel; which would enhance organizational effectiveness. These findings confirm the KM literature which suggests that the concepts that have been created, approved, and modeled by the team are used to activate new cycles of knowledge creation; known as cross-leveling of knowledge. The new knowledge in turn triggers more knowledge creation in other units or departments, as well as at different levels of the organization and this shared knowledge is the core of organizational or group memory and it is essential to the preservation of expertise or process knowledge so as not to re-invent the wheel (Choo 1998; Liebowtiz 1998; Leonard-Barton 1995; Nonaka & Takeuchi 1995; Wikstorm & Normann 1994).

Review and control activities in the development of the customer proposal

The findings show that review and control meetings are critical and important components of the knowledge-creation process in customer proposal project. The findings confirm the suggestion in the literature that the progress and status reporting are important aspects of project management; and the effective control of work, resources, and time is very important to ensure project success (Cash 1992; Davies 1994; Reeder 1995; Ward 1994). The main purpose is to check the status and development of critical project activities to ensure that the proposal project would be completed on time; as the proposal submission date specified in the RFP must be strictly followed. Thus,

these findings contribute to the literature by developing a better understanding of the knowledge-creation process in customer proposal projects.

KNOWLEDGE INTEGRATION AND TEAM MEMBER ROLES DURING THE KNOWLEDGE CREATION PROCESS

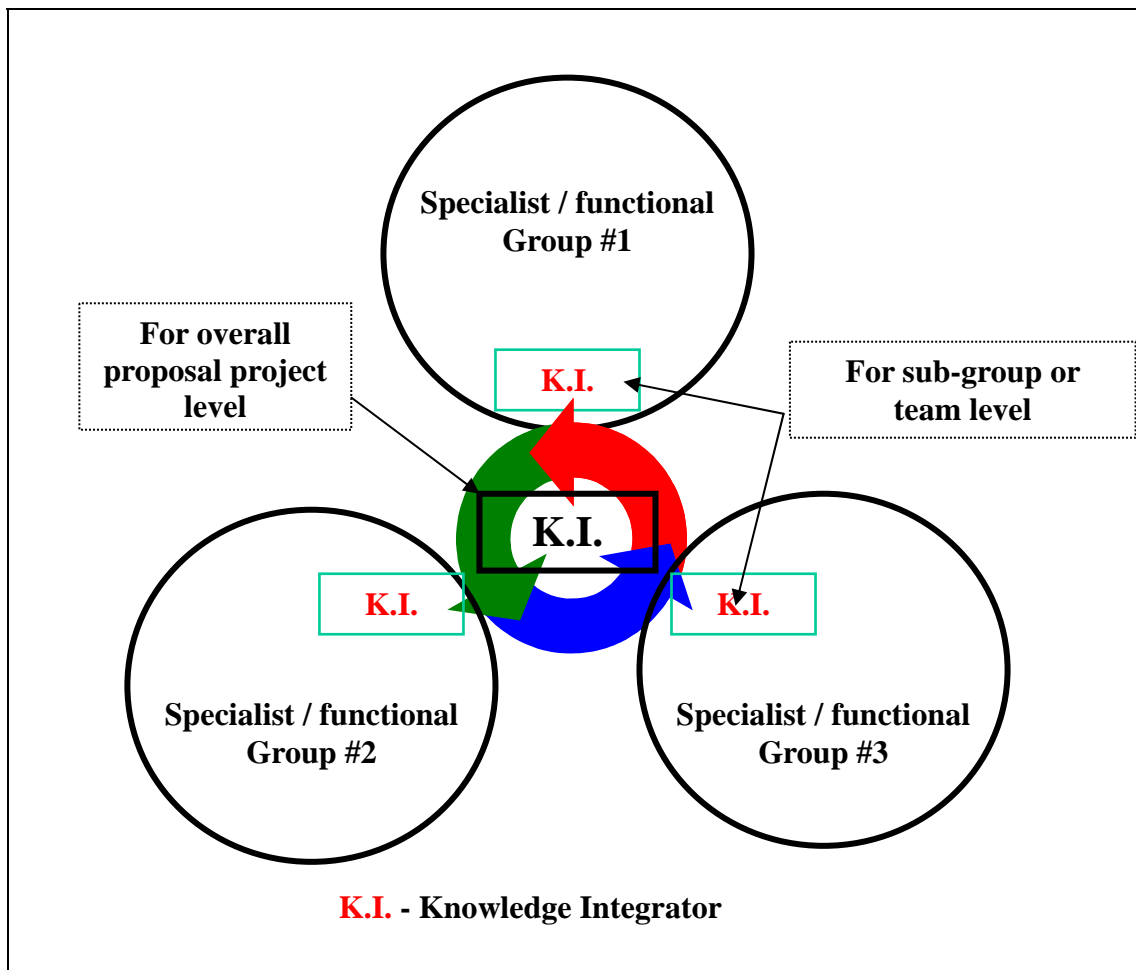
Integration of the knowledge of the project team members

The findings show that the integration of the knowledge within the proposal team during the knowledge-creation process was critical and important; and it was performed at two levels (a) the overall team level, and (b) the specialist sub-group or team level. These findings confirm with the research by Erwee and Brown (2000) which suggest that the integration of the knowledge from different functional teams or groups in the organization is important to effectively create new knowledge and develop solutions for problem solving and innovation of new products and services. The knowledge integrators effectively integrate the knowledge from various sources and share them with the internal and external groups of the firm.

The findings showed that the knowledge integration activities for the overall proposal project team is performed by the sales or account manager; and for the functional or specialist group, it was performed by the senior specialist or manager. Thus, these findings contribute to the literature by developing a better understanding of how the explicit knowledge is integrated in project teams for developing customer proposals and it suggests the two level concepts of integrating the knowledge within the proposal project team; as shown in Figure 2.

Based on the research findings, the implications for managers of project teams are to effectively develop and manage the process of integrating the team's knowledge. It is important to identify people who assume the role of Knowledge integrators for the functioning of these teams. The knowledge integrators that operate at both levels then have to take on the responsibility on behalf of the teams to integrate the knowledge and to continuously cooperate to facilitate the process. If not, the whole system of knowledge conversion and creation within the proposal project team would not work. Due to the complexity of the major proposal project and the involvement of the multi-disciplinary team, the integration of the large volume of information and knowledge could be done at the sub-team level and also at the overall proposal team level. This strategy would also be applicable for other major, complex projects that involve multi-disciplinary project teams.

Figure 2 - Knowledge integration in the customer proposal project team



(Source: Poh 2000 Analysis of interview data)

Roles of project team members during the different phases of developing the customer proposal

Each member of the customer proposal project team performs more than one knowledge creation role during the knowledge conversion and creation process within the proposal project team. And the important roles are knowledge engineer, knowledge practitioner, and knowledge integrator.

These findings confirm the research by Nonaka & Takeuchi (1995, p. 151) which suggest that the knowledge creation requires the participation of front-line employees, middle managers, and top managers, known as the 'knowledge creation crew'. However, there is one exception, the findings showed that the role of knowledge officer is not relevant or applicable in the knowledge-creation process. This could be due to the function of Knowledge officer in being responsible for managing the total organizational knowledge-creation process at the corporate level as suggested by Chait (1999), Davenport (1996), Guns (1998), and Nonaka and Takeuchi (1995).

The findings also confirm the research by Erwee and Brown (2000) which suggest that members performing the knowledge integration roles integrate various aspects of the knowledge creation crew. Their main function is to actively ensure that a knowledge spiral will be built by drawing out tacit knowledge from various sources and sharing

them with other Knowledge integrators in the project team; as shown in Figure 2. The knowledge integration roles are performed at two levels - the overall proposal team level and the specialist sub-group or team level. The implications for managers are to identify the various knowledge creation roles, especially the knowledge integration role, during the early stages of the proposal project. Early identification and assignment of the relevant knowledge creation roles will minimize confusion and miscommunication; and thus, enhance the efficiency and effectiveness of the proposal project team.

Limitations of the study and recommendations for future research

The most significant weakness of this study could be attributed to the chosen case study research methodology. Yin (1994) cites several known limitations and criticisms of the case study research methodology such as perceived lack of rigor, subjectivity, and voluminous documents. As this study is an exploratory case study with a limited sample size, the findings cannot be generalized beyond the context of this study. In addition, the scope of this research only examines the internal knowledge-creation process of project teams in telecommunications companies for the development of customer proposals. Another limitation of this study is the initial resistance of the interviewees to participate due to confidentiality of company information, but this is managed by careful adherence to research ethics.

Future research could compare and contrast results between different types of customer proposals and the level of complexity; and using companies from different industries where RFP is common practice for major or multi-million dollar projects. Further research could use a larger sample and quantitative research methods for the purpose of statistical generalization.

A worthwhile area for future research is to explore knowledge management as the tenth knowledge area in the field of Project Management. The research could focus on knowledge conversion and creation for problem solving and developing solutions in project teams, cross-organization knowledge sharing through the effective capture and transfer of knowledge within the project teams, and leveraging on organization knowledge and intellectual assets through the re-use of knowledge created by project teams.

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