Unpacking 'lessons learned': investigating failures and considering alternative solutions

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Abstract

One of the most common ways to share project knowledge is to capture the positive and negative aspects of projects in the form of lessons learned (LL). If effectively used, this process can assist project managers in reusing project knowledge and preventing future projects from repeating mistakes. Nevertheless, the process of capturing, storing, reviewing and reusing LL often remains suboptimal. Despite the potential for rich knowledge capture, lessons are often documented as simple, line-item statements devoid of context. Findings from an empirical investigation across four cases revealed a range of reasons related to the perceived quality, process and visibility of LL that lead to their limited use and application. Drawn from the cross-case analysis, this paper investigates an integrated approach to LL involving the use of a collaborative web-based tool, which is easily accessible, intelligible and user friendly, allowing more effective sharing of project knowledge and overcoming existing problems with LL.

Keywords: inter-project learning, knowledge management tools, knowledge sharing, project-based organization

Introduction

Successful organizations learn from their experiences with projects (Walker & Christenson, 2005). This is more likely if the knowledge accumulated throughout the duration of a project is preserved beyond its end and is readily available for subsequent projects (Turneret al., 2000). This, however, is not often the case, with evidence suggesting that projects rarely learn from each other, and thus tend to repeat the same mistakes resulting in unnecessary rework, errors and time overrun (Landaeta, 2008). A popular mechanism to drive inter-project knowledge sharing is a form of 'lessons learned' (LL) process designed to capture project experiences and provide a tool with which to transfer those experiences to current and future projects (Kotnour, 1999). LL are defined as key project experiences which have certain general business relevance for future projects. Validated and reviewed by a project team, LL represent a consensus on key issues that should be considered in future projects (Project Management Institute, 2004). Ideally, past lessons should provide practical learnings that assist in the planning of new projects, preventing project managers (PMs) from repeating mistakes and ultimately assisting functional areas associated with the project to improve their operations (Purdon, 2008). Unfortunately, all too often this process only partially occurs, or does not occur at all (Purdon, 2008; Newell et al., 2007; Turner et al., 2000). A growing body of literature suggests that in practice LL are seldom captured throughout the project and are only documented as simple statements in the closure phase, becoming merely a meaningless box-ticking exercise (Turner et al., 2000). The most commonly cited reason for poor LL capture is the lack of time (Brady & Davies, 2004; Davenport et al., 1998; Kotnour, 1999; Parker & Craig, 2008). Other reasons include: an incomplete LL process, lack of effective LL repositories, and a singular focus on project deliverables or the establishment of a new project rather than reflecting on project experiences (Newell et al., 2006). Although the topic of LL has been heavily discussed in the literature (Carrillo, 2005; Kotnour, 1999; Purdon, 2008;

Rose, 2007; Sharif et al., 2005), an in-depth understanding as to why the LL process is fragmented and why key project experiences are not transferred beyond project boundaries is incomplete. This paper reports on a study undertaken to achieve two distinct aims in relation to the use of LL mechanisms in a project management context: one, to investigate reasons for poor adoption and execution of LL from project to project; and two, to investigate the potential value of a software application in its ability to facilitate the capture and use of LL by project personnel.

This paper is structured as follows: the next two sections draw from existing literature to clarify the aims of an LL process and to outline existing knowledge sharing mechanisms that present as viable alternatives to LL databases. Hereafter, the methodology underlying the research is described and findings from within- and cross-case study analysis are offered. The discussion section then contrasts findings from the study with current literature and ends with a number of practical recommendations as to the optimization of the LL process.

Knowledge sharing in a project environment

In a project environment people work under pressure and often have limited time for social interaction beyond the immediate demands of the project (Riege, 2005). Moreover, specific characteristics of projects such as tight schedules and geographical dispersion reduce the amount of direct communication which can take place between projects (Hobday, 2000). When this social communication is missing project members must develop specific means to increase it (Arenius et al., 2003).

Leading project management methodologies like PMBoK (Project Management Body of Knowledge) and PRINCE2 (PRojects IN Controlled Environments) are explicit in their

acknowledgement of the importance of LL transfer in their identification of project management processes during which the transfer of LL should occur (Office of Government Commerce UK, 2005; Project Management Institute, 2004). PMBoK and PRINCE2 both provide detailed guidelines on how lessons should be produced, stored and used by other projects. Importantly, an effective LL process should consist of both positive and negative projects aspects, and so constitute an essential part of project knowledge that can be utilized by other projects during their planning phases (Kotnour, 1999).

A case study conducted by Dixon et al. (2009) shows a best practice example of an LL process in the public sector, which was achieved through the effective application of technology-based tools and supported by a team effort. LL were first codified and uploaded to the website, some of the lessons were further summarized into documents which were printed and distributed during annual conferences. Unfortunately such stories of effective LL implementation – where the project team is actively involved in the process of capture and extraction of knowledge for future use – are rare. Evidence suggests that the process of LL remains fragmented, and the use of LL documents as a way to access past project knowledge is perceived to be far from being effective by project personnel. Despite the potential for the capture and extraction of rich knowledge in many cases only singular lessons are captured at the end of the project and documented as simple, line-item statements devoid of context, with the process then ending prematurely when the project closes (Purdon, 2008). Furthermore, the temporary nature of projects means that PMs often have no time and motivation for storing LL (Carrillo, 2005; Newell, et al., 2006). Consequently it is not uncommon after one project finishes for project resources to be relocated rather than encouraged to reflect on experiences obtained from the concluding project. Often the end of a project actively represents the end of a valuable collective learning experience. Personnel either move on to new projects or are reintegrated into their line functions. In addition, external partners or consultants, who have

provided crucial project inputs, leave the company after the completion of a project. Some consulting companies have recognized this problem and emphasize this thorough documentation of their project work. Until now, however, clients have often been reluctant to pay extra fees for this documentation effort (Schindler & Eppler, 2003).

Existing literature highlights the importance of the transfer and use of LL beyond project boundaries (Goffin, et al., 2010; Schindler & Eppler, 2003). Kotnour (1999) proposed a plan-do-study-act (PDSA) cycle (from quality management) that can be used to define the learning process that occurs within and between projects. However, neither study considered the accessibility of those LL beyond the project, or advocated strategies as to how project personnel might effectively and efficiently locate relevant project lessons. Carrillo et al. (2011) investigated text mining as a way to assist in searching for knowledge from project files and reports. Their study concluded that text mining can aid project teams to learn from previous projects. However, the downside of this approach was the amount of work required for careful interpretation of the results and a need for human experience and judgement. Based on the research conducted thus far, it is apparent that a universally effective approach to capture and re-utilize project knowledge is yet to emerge. More empirical evidence needs to be gathered; it is imperative to find an optimal way to not only capture and store LL but most importantly to disseminate and use knowledge beyond project boundaries; thus stimulating the complete end-to-end process of project-to-project learning that will enable access to the right knowledge on demand and in a timely manner.

Alternative knowledge sharing mechanisms

Firms are increasingly using information and communication technologies as strategic enablers of knowledge management (KM) initiatives. These knowledge management systems

(KMSs) incorporate various technologies (for example information repositories, data warehouses, intranets, search engines, data filters, collaboration tools and intelligent agents) to facilitate the creation, storage, transfer and sharing of knowledge both within and outside of the firm's boundaries (Alavi et al., 2006). The use of KMS tools leads to enhanced communication and increases the level of participation among staff members, ideally improving project team performance (Alavi et al., 2006; Alavi & Leidner, 1999). These mechanisms facilitate the transfer of explicit knowledge that can be generalized to other contexts, demonstrating a potential for assisting in inter-project knowledge sharing. For instance, Siakas et al. (2010) suggest that in multinational projects the use of collaborative tools, such as Web 2.0 applications, appear to noticeably support knowledge sharing, where digitally facilitated social networks create forums that facilitate contact between the knowledge seeker and those who may have access to that knowledge. This may be accomplished by posting a question in the form of 'does anybody know' or 'request for help' in the virtual discussion group. Corporate directories enable individuals to rapidly locate a person with the knowledge who may help solve a current problem (Alavi & Leidner, 2001). Siemens uses ShareNet (intranet based KM system) as a way to enable users to find knowledge within the system and to locate its owners (Ciabuschi, 2005). For this to work effectively, information has to be inserted into the system in a very specific way. However, this standardized process is time consuming and difficult to follow, and as pointed by Ciabuschi (2005), may often lead to a loss of knowledge value.

Overall, existing research concluded that information and communication technologies are necessary for efficient knowledge sharing in contemporary organizations (Bosua & Scheepers, 2007). When well implemented, structured and with sufficient storage capacity, these technologies can extend and complement human networks and cognitive processes. Although the increasing popularity of KMSs over the past few decades has resulted in a

myriad of databases and systems (Dixon, et al., 2009), the coordination of information and knowledge stored in these systems appears to be a challenge due to the growing number of solutions implemented by organizations.

To categorize KMSs, in this paper we adopt the classification proposed by Alavi et al. (2006): *Intellect Web Tools* (IWT's) which support collaboration and content management providing capabilities for messaging, calendaring, online chat, application sharing and discussion forums (e.g. wikis and other Web 2.0 applications), and *Enterprise Repositories* that consist of soft or hard copy documents and databases of codified knowledge from internal and external sources. IWTs have the advantage of offering a similar experience to that represented by a face-to-face learning environment, allowing users to collaborate, facilitating sharing and enabling learning processes (Liaw et al., 2008). Murphy (2010) argued that a key advantage of IWT's over other KM technologies is their high degree of potential customization and ability to change content, as well as facilitating additional social networking opportunities. Accordingly, IWTs appear particularly relevant for time and space dispersed projects, which have limited opportunities for collaboration and sharing of insightful knowledge.

The ability of IWTs to facilitate the transfer of complex knowledge is best explained in relation to two key KM approaches that are typically undertaken: personalization and codification of information (Hansen et al., 1999). *Personalization* is typically used to transfer tacit knowledge, which requires multifaceted and interpersonal approaches (Goh, 2002). Some examples of personalization approaches include face-to-face conversations, team meetings and on-the-job training. From an IT perspective personalization may also relate to the capability of a user to customize and control the manner in which they interact with other users and the type, quantity and methods used to share information (Tiwana & Bush, 2005). On the other hand, *codification* strategies are suited to the transfer of explicit knowledge with

the purpose of storing knowledge that is easily codified and categorized. Examples of codification include the documentation of processes or the entry of data into a database or repository. IT applications have been used extensively to support these two KM strategies, and while the development of traditional KM technologies such as repositories or databases may effectively capture some explicit knowledge, a more comprehensive approach is required to adequately facilitate and capture all knowledge types, especially those relating to tacit knowledge (Schultze & Leidner, 2002). Whereas some KM technologies (e.g. knowledge repository systems) tend to favour codification aims over personalization (Bock et al., 2008) the architecture of IWT applications will in most cases facilitate both aims. An example of a basic but highly versatile IWT in its ability to offer both personalization and codification capability is a wiki. Wikis allow users to edit the content of entries, allowing them to freely create and organically grow web page content around a specific knowledge domain – a process sometimes referred to as dynamic authoring. Users can track the longitudinal changes to a document creating a high degree of accountability and transparency (Murphy, 2010). With wikis, text can be revised with little effort; users are free to change, add or even delete content. Most wikis have a revision-control feature that saves a history file allowing users to track all the revisions made. Users who want to improve a wiki text have to connect new content to what already exists. This procedure helps to reorganize and reconceptualize content and may lead to improved problem solving and knowledge building in an organization (Kimmerle et al., 2010). As such, wikis can be seen to be particularly useful for capturing project experiences, providing a common space for storing project knowledge, where a lesson related to a specific problem could be easily searchable with the ability to update and propose solutions as well as track down actions taken in relation to the problem.

Although the use of IWTs appears beneficial for inter-project knowledge sharing there are also potential risks associated with the use of these mechanisms. For example, Garcia-Perez

and Ayres (2009) conducted an experiment implementing a wiki into the workplace. Initially the implementation was very successful with a significant number of researchers contributing to the wiki and making use of it. However, its use declined over time and attempts to stimulate interest by providing incentives for contributions were unsuccessful. One year after the launch it was found that the wiki's use was minimal. A further study determined that a lack of time (for reading and contributing to wiki entries), unsatisfactory content (people felt that the wiki did not have much to offer to those who had been in the organization for more than two years), and accessibility (lack of a direct link to the wiki on their computer desktop or intranet home page which hindered its use), were the three main reasons for the 'wiki failure'.

From the literature reviewed above it appears that IWTs have the potential to provide an alternative solution to the use of LL databases and their associated failings. Accordingly, research was undertaken to first understand reasons for ineffective use of LL documents in a project management context and, further, investigate the efficacy of IWT technologies in their ability to optimize the inter-project knowledge learning cycle. We report on four case organizations and their use of Web 2.0 Wiki software tools to generate a dynamic LL knowledge repository that could potentially aid in the capture, dissemination and use of project knowledge more effectively than traditional approaches.

Research approach

This study was a part of a larger study investigating factors influencing inter-project knowledge sharing. Multiple case studies were chosen to explore the research problem and data was collected through a number of focused interviews (Yin, 2009), which explored the process of capturing, storing and disseminating LL in participating cases.

Four project-based organizations participated in this study, summaries of which are presented in Table 1. ENGAS is a large project-based organization in the heavy engineering and building sector. The company employs over 1,500 personnel, including over 300 engineering and technical specialists. The majority of ENGAS' projects are distributed geographically with project members working on project sites. Projects at ENGAS are normally large, with AUD$3–15m budgets, with up to 180 people working per project and project duration ranging from approximately two months to three years.

Table 1: Participating Organizations

Cases	ENGAS	TELCO	INFO SERVICES	ROMIN
Profile	Heavy Engineering and Building	Telecommunication	Communication Services	Mining
Project geographical dispersion	Co-located and Distributed	Co-located	Co-located	Co-located and Distributed
Company size (# of employees)	> 1000	> 1000	> 500	> 1000
Project size (on average)	Budget < AU$ 3mil Duration ≤ 3 years	Budget < AU$1.5mil Duration < 1 year	Budget < AU$1.5mil Duration < 1 year	Budget < AU$ 3mil Duration < 1 year
Interviews	E1 - E8	O1 - O6	I1 - I16	R1 - R9

TELCO specializes in a broad range of communication services including mobile, local, national and long distance telephony; business network services; internet and satellite services; and subscription television. It delivers small, medium and large projects with the budget range of AUD$20,000–$1m+. INFO SERVICES is a leader in providing communication services to government agencies, setting up phone numbers, websites or integrated service counters for an ongoing or time-specific period. The organization delivers primarily small to medium service-type projects to government agencies. ROMIN delivers technology solutions to the mining industry focusing on innovation, development and commercialization.

Each interview took approximately one hour. Informants included mostly PMs as centres of project knowledge directly involved in the LL process, as well as other parties including program managers, senior management and project officers who provided a broader perspective on project-based knowledge sharing and practices. Collecting data from multiple sources, with the aim to corroborate the same fact or phenomenon, helped to achieve data triangulation (Yin, 2009). A case study protocol was used, with a specific set of questions

guiding the data collection process. During the interview session informants were asked:

- What communication means do you normally use when you seek knowledge outside your project?
- What would be your preferred means? Why?
- Do you review LL documents during the planning phase of the project? (If not ask why?) (If yes, do you find them useful and why?)
- In what stages of a project do you normally produce LL?
- What is included in LL documents?
- How are LL captured in your organization? (Text file, word doc, pdf etc?)
- Are LL easily accessible?
- Does the company offer collaborative web-based tools to promote inter-project knowledge sharing?
- Do you use them? What is your attitude towards these tools?
- Can you give an example of when inter-project knowledge sharing worked really well and why it worked well?

The data analysis process began with an extensive coding exercise during which passages from transcribed interviews were coded into issue specific ‘nodes’ and ‘tree nodes’. Whereas a number of nodes were theoretically pre-determined and created around the research problem, others emerged during the coding process. First, a within-case analysis was conducted, which enabled the researcher to become intimately familiar with each case as a stand-alone entity before the cross-case analysis began (Eisenhardt, 1989; Yin, 2009). A range of analytical techniques were then used to conduct a within-case analysis, including pattern-matching logic, numerical counts analysis and a range of queries (such as a text search query) annotations and memos were employed (Bazeley, 2007).

A series of cross-case analyses were then undertaken with the aim of identifying similarities and differences between cases by comparing several categories at once, and looking for within-group similarities and intergroup differences (Yin, 2009). Utilizing the matrix coding query functionality offered by the qualitative data analysis software NVivo 9 enabled data from all four cases to be categorized in a range of different ways, thus avoiding premature or even false conclusions against which Eisenhardt (1989) warns. Furthermore, the use of pattern-matching logic allowed us to compare cases, and therefore determine similarities and differences between them for the purpose of building and strengthening the theory (Eisenhardt, 1989). Finally, the use of explanation-building assisted in understanding 'how' and 'why' certain events occurred; thus providing a rich understanding and explanation of events emerging during the cross-case analysis process. Careful use of these analytical tactics and addressing rival explanations of the phenomenon ensured greater internal validity of the research (Yin, 2009). Furthermore, the use of replication logic, executed by replicating the findings to a second, third and fourth case, assisted in ensuring the validity of emerging findings (Eisenhardt, 1989).

Within-case analysis

This section reports on the findings from each of the four cases, focusing on how the process of LL occurred and what alternative ways were used to share project lessons in each case.

Case ENGAS

As a part of the project management methodology, ENGAS employees were required to capture and store project knowledge in the form of LL. Most of the respondents recognized these lessons as an important source of useful information and as a way to avoid repeating the

same mistakes in their projects. However, respondents consistently reported they were often reluctant to produce and review existing LL documents, mostly due to their perceived lack of consistency, visibility and uniformity guidelines. A review of organizational documentation revealed that each project had a separate folder in which LL were filed, but few employees would search these folders because they were not in a central location and it was hard to find relevant information. One respondent reported:

> I've found some documentation that's highlighted areas of concern, but it's not really been all of the requirements pulled together in a concise location. So normally I'll refer to discussions with the other project managers (E1).

There was also an LL spreadsheet, which consisted of several columns including the description of lessons, recommendations for improvement and action taken. A review of this spreadsheet clarified that only a few LL had been actioned and recommendations for improvement were often ignored. This could indicate that LL were only stored because of a mandated, formal requirement; they did not serve the purpose of benefitting present or future projects. This was further confirmed by respondents, who reported that during 'wash-up' meetings, many good ideas were presented, but nobody was responsible for documenting the LL, analysing or developing them further to initiate change. Respondents recognized a range of problems related to LL, including a lack of consistency and clear uniform guidelines in the LL process and a lack of willingness to action LL spreadsheet items. Overall, interviewees from ENGAS indicated that LL were infrequently captured throughout the project, and/or stored in an inconsistent format and location, as a result valuable knowledge was lost or forgotten.

Top management at ENGAS recognized the problem of poor LL capture and dissemination, and introduced an alternative approach to LL in the form of an IWT tool: a wiki. During the

data collection process the wiki was on a trial period. The wiki aimed to serve multiple purposes including an LL repository, a space for storing static information such as contact numbers, general information about projects, and a more flexible approach to the organization of social events. A person responsible for setting up the wiki reported:

> …we do a monthly off site lunch, so we've actually been using the wiki to organise the lunch…. So it's a way of getting people familiar with sort of the basics of it (E4).

A program manager from ENGAS identified the wiki as a potential tool for capturing LL early in the project and improving its visibility. He stated that before introducing the wiki valuable knowledge was lost because experienced people had moved on and were unavailable or had difficulty recalling the requisite information. Before the wiki was introduced, each project had its own folder and LL were captured and stored in the project files where no one would look:

> …when knowledge landed in the document it was stuck in the document, or a lessons learned register somewhere, it wasn't really communicated to everybody else... [LL] were all quite isolated so you wouldn't get a [sic] sharing (E4).

Now each project type had its own space and it was acknowledged that since the wiki was introduced there was evidence of an increase in interactive collaboration and knowledge sharing: 'everything is in a shared location that everyone can edit.'

Nevertheless, there were also concerns with the maintenance of the wiki. The main one being that if not used wikis can easily become outdated or have poor quality entries: 'once you start getting really busy that's kind of at the bottom of the list, you don't maintain it and it becomes useless' (E5). There was also a risk relating to the lack of time to update the wiki or the perception that it is simply another IT tool to maintain and people who use alternative, localized tools will neglect the central wiki. According to respondents, most of these potential

risks could be overcome by employing someone responsible for updating and maintaining the software:

> You've got to have the maintenance to put data in there because as soon as it comes bad, people don't trust it and they don't go back to there to use it (E2).

Also, it was proposed that the risk of poor quality entries was to be resolved by project management quality control, where wiki entries related to project lessons firstly went to PMs for quality assessment before they were entered into the system. Finally, at least three respondents (E1, E2 and E4) commented that the use of the wiki depends on how much support is given by senior management.

Case TELCO

TELCO employees were also required to capture project knowledge in the form of LL. Normally, LL were captured during a review of project closure documents and discussions about problems that occurred during that project. However, the interview data indicated that only a few PMs searched through these historical documents.

Our analysis revealed some weaknesses associated with the sharing of LL and there were remarks stating that LL are not done effectively. There was no specific location where LL were saved, instead being stored in many locations – some could be found on a shared drive, some on databases, some on wikis. In addition, LL were often captured in a Word document and transferred to the server. This, according to respondents, was not conducive to sharing and made it hard to find the relevant information. One PM commented:

> …you can put all the stuff [LL] in [a] document, file your document in the folder and file away, so you can ticked [sic] that you have done your lessons learned, but you never see it again (O2).

Another reason for the poor production and sharing of LL was a lack of time:

> …everyone is too busy, they've moved onto the next one, there's another customer waiting and we're already late so we're constantly moving on, moving on, moving on and nobody actually stops and looks back (O6).

Respondents also commented on a lack of LL ownership, a person or group responsible for implementing changes and following up on the progress, as well as the lack of formal processes to review and share LL.

Several years ago TELCO also implemented a wiki to achieve more collaborative knowledge sharing. Since then, the wiki has been utilized to capture some project information. Although the respondents recognized a great advantage in having a wiki for storing and accessing project lessons, the majority declared that wikis remained too formalized and controlled. For most people in TELCO a wiki was used as a database to capture static information, not as an interactive tool to exchange knowledge. TELCO did not fully utilize the wiki's capability and only rarely used its space for collaboration and tacit knowledge exchange. Respondents also commented on the poor search ability and accessibility of wiki entries:

> …there is also another aspect of the quality of info [sic] that is put on, you don't want to search through thousands of information just to find info you look for (O4).

Overall, the interviews at TELCO brought to light that there were weaknesses associated with capturing and sharing LL documents, and respondents recognized a range of problems related to the lack of consistency in the way LL are produced and stored. While the wiki provided a space for some LL, it remained too formalized and controlled to enable the effective sharing of project lessons and access to insightful knowledge.

Case INFO SERVICES

At INFO SERVICES, LL were stored in a spreadsheet containing large amounts of historical information. However, the interview data indicated that only a few PMs searched through the LL documents. Respondents complained that the spreadsheet was too long, with over 120 line items making it impossible to deal with. Everyone agreed that searching though it was time consuming, and that they preferred to talk to other PMs rather than refer to this database. One PM admitted that she produces LL rarely because 'we've got much more pressing things to do... they can be shared in a verbal way' (I5). Furthermore, LL were focused primarily on process improvements and the feedback given by PMs was used to improve processes. However, the results and actions taken were not reported back to the managers leading to a breakdown in the loop learning process. In this circumstance PMs did not see much value in LL, producing LL only because it is was formally required – that is, just 'to tick the box'. Interviews revealed that people did not properly document their LL throughout the project, which resulted in poor quality LL reports and important LL being forgotten; one PM admitted:

> I would like to get better at it [capturing of LL]. So mostly a lot of it [LL] is in my head and by the time, because the project you know, the project might finish and you know, it all went okay that kind of thing but then I might not get to do my end project report for another two months or three months, depending on how busy things are so by that time you really can only remember the big things (I2).

Respondents agreed that poor capture and transfer of LL resulted in unhappy customers, rework and overdue projects. Many PMs identified problems with the lack of LL transparency. Overall, examination of the data revealed a lack of visibility of how LL were progressing, who was taking ownership of them, and whether PMs' suggestions for improvements were considered.

In 2006 there was an initiative to introduce a wiki at INFO SERVICES. The intent was to create an environment similar to that in Wikipedia and so a trial period was developed:

> …That's when we actually started sharing information, sharing knowledge and making sure that was transferrable well and truly after someone has kind of moved on, either to another project, another department or physically left the organization (I4).

The person who developed this internet channel strategy went on long service leave and his successor made the decision to not proceed with this initiative. After his return, two and a half years later, he commented, 'learnings from earlier projects have not been remembered or learned or utilized and the same mistakes were being made over and over again' (I4). He concluded that this would not occur if wikis were implemented. Nevertheless, respondents identified that if wiki entries are not updated with the frequency and depth required then they become worthless. Furthermore, there were remarks from respondents stating that it was necessary to create a culture that supports wiki use. Cultural norms promoting the use of wikis and support from managers would ensure wiki success and were considered essential. Overall, although INFO SERVICES did not have an established corporate IWT, at least three respondents (I4, I5 and I9) commented that they saw significant potential in this type of technology in helping to overcome the inter-project knowledge sharing needs reflected in the organization.

Case ROMIN

At ROMIN, project management as a discipline appeared to be in the very early stages of maturity. There was no formal project management methodology – only internally designed templates aimed to assist in project execution. Respondents commented that there was no feedback in the system and that project documentation was not visible to others. When reports were sent for approval they were only visible to people with approval rights, with other

project leaders or members not able to view them. There were remarks from respondents stating that these templates are just 'bureaucratic tools that do not assist in running the project, but have to be filled up to satisfy admin requirements' (R1).

At ROMIN there was no formal requirement to produce LL, nor did they hold formal project debrief meetings. Two respondents (R2 and R4) reported that, unless requested by the client, LL reviews were rarely prepared. There was only a requirement to provide plan and milestone reports, mainly to track project progress. Cross-project knowledge sharing happens informally during ongoing face-to-face or e-mail interactions: 'I guess if you learn something really useful you might send out an email to the group and say hey we should do it this way' (R8). Nevertheless, some project documentation and knowledge was captured in a wiki, which was established in 2005. Since then the wiki has become the most frequently used internal tool for building an enterprise knowledge base. The wiki was used: (1) to store project archives, (2) to share information with clients, (3) to store a raw level of project planning, (4) to maintain contact lists, (5) to collaboratively write project reports, (6) to store specifications and (7) more broadly as a discussion board.

Respondents recognized a range of advantages associated with using the wiki for inter-project knowledge sharing. According to respondents, the wiki was perceived as a way to maintain information flow, especially in groups experiencing rapid growth. It was also considered to be highly searchable, to save time because information was only entered once, it worked as a memo, was easy to use and was integrated – everything could be found in one place. One respondent who heavily used and contributed to the wiki commented:

> I think what the advantage of having wikis and stuff like that is that you have permanent records of what was discussed, you know, the discussion and it keeps going, there's no like, timeline [delay]… it actually starts happening (R1).

ROMIN respondents also recognized top management engagement in promoting wiki use as an important driver for its success. It was reported that ‘once you show them [PMs] how to do things [use wiki] and they find it at least remotely useful then they’re more than happy to go along with it’ (R3). Overall, at ROMIN the wiki was used as an organic, collaborative tool to share project knowledge; however, this sharing normally occurred within a project. There was a lack of structured approach to capture and deal with project lessons to achieve an inter-project learning process, thus recognizing valuable lessons and avoiding mistakes from past projects.

Cross-case analysis

This section reports on findings from the cross-case analysis, primarily looking for similarities and differences across the cases with an attempt to explain the reasons for these similarities or differences. It provides an in-depth explanation of why the process of LL was ineffective in participating cases and proposes an alternative approach to sharing project knowledge based on the cross-case findings.

Issues with lessons learned

In three cases (ENGAS, TELCO and INFO SERVICES), LL documents were required at the end of each project. However, our analysis demonstrated that PMs seldom searched through LL documents: ‘We produce lessons learned, but we use them poorly’ – this statement summarizes the overall stance in the cases that used LL databases.

The within-case analysis found a range of reasons why PMs were reluctant to use LL databases. For example, in most cases the process of capturing, storing and reusing LL was partial and ineffective. At ENGAS it was reported that every LL document had a different

format, different questions, no set structure and a lack of common theme. PMs from TELCO and INFO SERVICES complained that LL are usually done at a high level, focusing primarily on process improvement, and the results and actions taken were not reported back to the managers, leading to a breakdown in the learning process. In this circumstance, PMs did not see much value in LL, producing them only because it was formally required 'to tick the box'. LL issues identified in the within-case analysis are captured and summarized in Table 2 and are grouped into problems related to quality, visibility and lack of appropriate LL processes. LL quality represents the clarity of their content and scope. Visibility corresponds to the degree to which LL can be accessed in the organization. Processes refer to the development and implementation of LL.

Table 2: LL issues

ISSUES	ENGAS	TELCO	INFO SERVICES
QUALITY	Lack of consistent set of structure to produce LL		
	Only some project managers update LL documents		
	Captured and stored in a way that is not conducive to sharing		
VISIBILITY	LL are not stored in a concise location		LL spreadsheet contains a large amount of historical that is hard to deal with
			Lack of visibility to see how LL are progressing
PROCESSES	Lack of LL ownership – a person or group responsible for implementing changes and following up		
	Lack of process to ensure LL are captured throughout the project		
	Lack of process that would require searching through LL documents – only an individual's initiative		

Wiki – a potential for integrated inter-project knowledge sharing

The attitude towards the use of a wiki as a tool for knowledge sharing appeared to be very

positive across all four cases. This stance was also present among respondents whose organization did not employ a wiki (INFO SERVICES), who commented that the decision to discontinue using the wiki was one of their worst decisions. Nonetheless, across all four cases there were also concerns associated with application of wikis in relation to quality of information and the lack of time for updating and maintaining wiki entries. A SWOT analysis presented in Table 3 outlines the strengths, weaknesses, opportunities and threats associated with wikis across the four cases.

Table 3 SWOT analysis on wikis across the four cases

STRENGTHS	WEAKNESSES
• Shared location that everyone can view and update • Interactive tool • Allows discoverability • Allows visibility/transparency • User friendly • Useful source of knowledge for a range of project stakeholders • Allows sharing of tacit knowledge • Useful for business intelligence information • Alternative communication type for distributed projects	• Too little information • Poor quality of entries
OPPORTUNITIES	**POTENTIAL THREATS**
• Fast and informal knowledge sharing (also tacit) • Improved visibility • Knowledge can be found in one space • Better systematised LL • Ability to capture LL in the earlier project stages • Ability to capture LL more informally	• Can easily become out-dated if not used • Poor quality of entries • Lack of time to maintain • It is just another IT tool to maintain (people who use alternative tools will not update wikis) • Relatively new tool; people are resistant to use it and/or do not know how to use it

Our data also showed that the case organizations did not fully utilize their wikis. For example, TELCO used wikis mainly to store static information including contact numbers and general information about the project, while ENGAS was primarily focused on capturing LL. Overall comments from respondents strongly indicate that wikis, if appropriately implemented and

maintained, could become a new avenue for LL and the best way to share both tacit and explicit knowledge across geographical locations. Finally, the evidence from ENGAS and ROMIN suggested that active leadership engagement improves wiki use. In both cases, data revealed that their leaders recognized the need for collaboration and knowledge sharing between projects, and the need to promote a collaborative approach. For example the recent establishment of wiki at ENGAS, which was actively supported by the new leader, was the reason for increased project visibility and integrated processes. Therefore an appropriately implemented wiki, supported by top management and a collaborative culture is likely to assist in sharing project knowledge and breaking silos across dispersed projects.

Discussion and practical implications

This research showed that all cases lacked a systematic way to capture, store and disseminate LL. As a result, little use was made of the project documentation stored on databases. The lack of consistency and clear uniform guidelines surrounding LL processes appeared to be the main reason for their limited use and application beyond project boundaries. Turner et al. (2000) and Newell et al. (2006) found a similar pattern, with Turner et al. (2000) concluding that the practice of storing knowledge often becomes a meaningless administrative exercise. This research builds upon these findings, revealing a range of issues relating to LL quality, processes and visibility, that result in poor use of past LL and ultimately in lost knowledge. Respondents across all cases recognized that there were no processes in place to ensure that LL are captured and stored throughout a project and reviewed at the beginning of a new project. Furthermore, the reasons why PMs did not search through past project knowledge was related to time pressure, ease of access and data visibility. Projects are time-orientated and from our case data it is apparent that the pressure PM's experience to deliver project outcomes has a detrimental effect on the knowledge sharing process. Thus, they have little

time and motivation to search for knowledge in databases, which are normally in an inflexible format and are difficult to search through and leverage for future projects. They also have limited opportunity to reflect on their experiences and document knowledge for future use. Overall, the main issues related to LL include:

- a lack of consistent structures to produce, store and share LL
- poor LL visibility (no one, specific, location where LL are stored and can be accessed, or overloaded LL spreadsheets that contain a large amount of historical data which is hard to deal with)
- a lack of feedback to see how LL are progressing
- a lack of LL ownership; someone who is responsible for managing LL, implementing changes and following up.

Realizing these issues helps to make sense of why so little use was made of the project documentation stored on the databases. Some practical implications to improve LL quality, visibility and processes have been drawn from the cross-case analysis and practices used by participating organizations, they include:

- introducing an easily accessible, intelligible and user-friendly LL storage space
- introducing LL ownership – a person accountable for LL implementation
- cataloguing LL according to themes
- keeping LL in one place
- developing a clear action plan for capturing, documenting and sharing LL throughout the project.

Our review of IWTs indicated that they have recently become an alternative to more static knowledge repositories. IWT's serve to not only store explicit knowledge, but are also used for collaboration and tacit knowledge exchange (Alavi et al., 2006). IWT tools such as wikis were found to have the greatest potential to develop and solve cognitive problems (Kimmerle et al., 2010). Having the ability to generate concepts and thoughts, wikis are able to expand organizational knowledge. Our study revealed that IWTs in the form of wikis can become

both an avenue for LL as well as a facilitator for tacit knowledge sharing between geographically dispersed projects, improving the visibility and capture of LL more informally throughout the project and providing a better alternative to project folders or LL spreadsheets.

The implications for how to ensure an updated and dynamic collaborative tool for inter-project knowledge sharing were drawn from the comments raised by respondents across the four cases and are presented in Table 3. According to respondents the design of the IWT tool should be user-friendly and intelligible, have search capability with indexing for a more intuitive way of finding knowledge, and be integrated with project management processes and quality systems to manage projects from end-to-end. Feedback from respondents provided data on the types of information and project knowledge available and stored, including static information, links to processes, LL, valuable links, technical information and a space for collaboration and knowledge exchange. Consequently the entries should be categorized by the level of control and maintenance required: (1) require ownership for maintenance and quality control, (2) require moderate ownership control and maintenance, and (3) free entries. It was heavily stressed that the tool must have an owner – a person responsible for updating and maintaining some of the entries, especially those related to static information and LL. The other entries, associated with collaboration and sharing of tacit knowledge, should be maintained by employees who are encouraged to use the tool by their leaders and an open organizational culture. A comprehensive, intelligible and user-friendly tool supported by leadership engagement, a collaborative culture and ownership will be more likely to ensure an effective and vibrant tool for inter-project knowledge sharing. This finding adds to the previous research on KMS usage (Lin & Huang, 2008). Table 4 provides some suggestions on how to ensure an updated and dynamic collaborative tool for capturing and disseminating project knowledge.

Table 4 Suggestions on how to achieve an updated and dynamic tool for inter-project knowledge sharing

UPDATED AND DYNAMIC TOOL FOR INTERPROJECT KS

CONTENT AND MAINTENANCE OF ENTRIES

REQUIRE OWNERSHIP AND QUALITY CONTROL	REQUIRE MODERATE OWNERSHIP, CONTROL AND MAINTENANCE	FREE ENTRIES
Explicit knowledge	***Tacit and explicit knowledge***	***Tacit knowledge***
• Static info • Links to processes	• LESSONS LEARNED • Valuable links • Technical information	• Space for collaboration and knowledge exchange

DESIGN

- User friendly (for example have search capability with indexing for a more intuitive way of finding knowledge)
- Intelligible
- Comprehensive (includes all types of knowledge and end-to-end processes)

ENVIRONMENT

ORGANISATIONAL CULTURE

- Cultural norms and practices supporting the use of IWT

LEADERSHIP ENGAGEMENT

- Active support and engagement from top management to use IWT

OWNERSHIP

- A person responsible for updating and maintaining entries (e.g. Project Management Office (PMO)

An appropriately implemented IWT can assist in better inter-project knowledge sharing. If properly maintained, it could become the way to share both tacit and explicit knowledge across geographical locations.

While the contributions of this research provide greater insight into LL processes, there are also a number of limitations. The focus solely on one type of enterprise repository (LL) and one type of IWT (wiki) is the main limitation of this study. These two mechanisms were those primarily reported by respondents to contribute to inter-project knowledge sharing. Nevertheless, it is important to acknowledge that there are a range of other technology mechanisms not covered in this research, including Knowledge Café and Knowledge Management Communities, which could potentially contribute to inter-project knowledge sharing. Those who are interested in investigating a broader range of knowledge sharing mechanisms may want to refer to Alavi et al. (2006) and Murphy (2010). Furthermore, this study was limited to the management level such as project and program managers due to their key role in knowledge flow. Including other project members, who normally come from different backgrounds and professions, could potentially introduce unwanted complexity. Future studies could consider investigating knowledge sharing behaviours of other project members, taking into account project complexity and the backgrounds of these individuals.

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