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To cite this article: Ying Yang, Gina Brosch, Biao Yang & Trevor Cadden (2020) Dissemination and communication of lessons learned for a project-based business with the application of information technology: a case study with Siemens, *Production Planning & Control*, 31:4, 273-286, DOI: [10.1080/09537287.2019.1630682](https://doi.org/10.1080/09537287.2019.1630682)

To link to this article: <https://doi.org/10.1080/09537287.2019.1630682>



Published online: 19 Jun 2019.



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Dissemination and communication of lessons learned for a project-based business with the application of information technology: a case study with Siemens

Ying Yang^a, Gina Brosch^b, Biao Yang^c and Trevor Cadden^d

^aNewcastle University Business School, Newcastle University, Newcastle upon Tyne, UK; ^bSonplas GmbH, Straubing, Germany; ^cUniversity of Sussex Business School, University of Sussex, Brighton, UK; ^dDepartment of Management, Leadership and Marketing, Ulster University, Jordanstown, UK

ABSTRACT

With the recent development on a knowledge-based economy and project-based work, organizations gather and store their lessons and knowledge gained from projects to avoid ‘reinventing the wheel’ in future projects. To disseminate knowledge and experience at the group and organization levels, they further seek to develop a procedure to support project-based learning. This study conducts an in-depth case study in Siemens to investigate the perception of the individuals on barriers and enablers of implementing lessons learned. It also provides practical recommendations on how to enhance the dissemination of knowledge throughout the organization. The results of this study show that the retrieval of the information is a major barrier to lessons learned. To encourage more informal learning, organizations need to adopt various information communication systems and appropriate organizational culture and structure.

ARTICLE HISTORY

Received 21 December 2017
Accepted 8 June 2019

KEYWORDS

Project management; lessons learned; information technology; organizational learning

1. Introduction

Since the 21st century, British manufacturers have been facing growing global competition, higher customer expectations, and the dynamic and changing business environment. These factors fostered two important trends in British manufacturers. Firstly, they shifted organizations’ focus away from competing solely by their products and technological assets and made them see knowledge as a vital resource for success (Maqsood, Walker, and Finegan 2007; Claver-Cortés, Zaragoza-Sáez, and Pertusa-Ortega 2007). The idea of a knowledge-based economy in which organizations need to gather and store their knowledge for competitiveness and innovation has been widely accepted from both researchers and practitioners (Argote, McEvily, and Reagans 2003; Anand, Ward, and Tatikonda 2010). With the rising acceptance of a knowledge-based economy, the number of research in the area of knowledge management (KM) and organizational learning has increased significantly. The second trend is the boost of organization transition from a merely functional structure to a more project-based structure (Maylor et al. 2006; Williams 2008). Project-based work enables companies to adapt to a rapidly changing business environment and improves servitization and customer focus (Keegan and Turner 2001; Disterer 2002). Together, these trends present companies with a new problem, which is called the ‘project learning paradox’ (Bakker et al. 2011, 494). Although projects are seen to be especially suitable to create, acquire and

transfer knowledge, business organizations have often failed to capture lessons and knowledge after project completion. This is mainly due to the cross-functionality and temporary nature of projects. Projects are ‘inevitable discontinuities [...] in the flow of resources (especially personnel and information), across time and space, from one project to the next’ (Bresnen et al. 2003, 158). The nature of projects leads to the decentralization and fragmentation of knowledge (Disterer 2002). When project team members move on, all of the created knowledge seems to disappear (Schindler and Eppler 2003; Bakker et al. 2011). Milton (2010) found, in a study of 70 organizations, that more than 80% of them introduced lessons learned from projects (as an approach to KM) but over 60% of them were not satisfied with the results. To develop project-based businesses, manufacturers need specialized KM systems to enable the retrieval of relevant lessons from each project in order to cope with uniqueness, uncertainty, and complexity, and to establish learning as a continuous process within organizations (Perez Lopez, Montes Peon, and Vauquez Ordas 2004).

With the development of information technology, various KM systems were developed to support project-based learning and avoid ‘reinventing the wheel’ in other projects, and to promote group learning and organizational learning (Madsen and Mikkelsen 2018; Weber, Aha, and Becerra-Fernandez 2001; Bresnen et al. 2003). While the early work that came from information technology (IT) is for managing

knowledge, more recent attention is from the organizational learning literature, with a more social perspective on KM. Although business organizations made a huge investment on KM systems to capture knowledge and experience for their future work and support organizational learning, the return on investment is little. Several studies have investigated the barriers and problems in regard to KM (Schindler and Eppler 2003; Williams 2008; Duffield and Whitty 2015; Hartmann and Dorée 2015). However, the majority of them proposed holistic frameworks and concepts for learning which tend to be rather descriptive (Jugdev 2012). There is a lack of studies with practical approaches to lessons learned from projects. Lessons learned from projects are complex issues that involve people, processes and technologies. How to transfer knowledge as well as encourage learning from and across projects becomes a major problem in the literature in operations management or computer science (Duffield and Whitty 2015; Hartmann and Dorée 2015). Tan et al. (2006) further pointed out that in most cases it is knowledge dissemination and application that leads to the failure of a KM system.

This research aims to investigate how an IT system can support the dissemination of lessons learned from projects throughout organizations. Both push (passive) and pull (active) disseminated activities will be studied to support organizational learning. A case study on Siemens Power Generations, which struggles to effectively share lessons from projects and strives to identify the best approaches to facilitate learning from projects, was conducted for this research. Various qualitative research approaches have also been applied to this case study, i.e. cross-sectional interviews, analysis of company documents and informal conversations. This study gives an insight into the barriers and enablers of the lessons learned process and investigates how IT systems can support lessons learned dissemination throughout the organization. This study will contribute to the existing literature by understanding the employee perspective of lessons learned, to help managers motivate individuals to learn, and to develop appropriate organizational culture and structure to encourage learning. Based on the findings of the study, recommendations on changes are provided, including a discussion of the use of social networks and social media. The remainder of this paper is structured as follows: Section 2 reviews the literature on relevant lessons learned research topics, i.e. project management, organizational learning, KM and KM system. Section 3 is concerned with the research design of the study, including data collection and data analysis. The findings of the study are presented and discussed in Section 4. Conclusion including a short summary and limitations to the study and a prospect on future research is drawn in Section 5.

2. Literature review

2.1. Lessons learned from projects

Lessons learned is knowledge or understanding gained by experience, which must be assumed to have significant impact on future operations to improve organizational learning (Carrillo, Ruikar, and Fuller 2013). It is one of the most

frequently researched topics on KM practices associated with project work. Individuals can learn lessons from either positive experience to spread best practices or negative experience to avoid making the same mistakes again in the future. Due to the cross-functional and transient nature of projects, researchers see lessons learned from projects as especially suitable for creating knowledge and link them in many ways to KM (Schindler and Eppler 2003; Bakker et al. 2011). Perez Lopez, Montes Peon, and Vauquez Ordas (2004) even stated that KM and learning go hand in hand. However, lessons learned are not an overly simplistic KM practice (Jugdev 2012). Lessons learned needs a personalized, self-directed process as well as a highly subjective and social construct. Several studies have found dissatisfaction with the lessons learned approaches (Keegan and Turner 2001 and Milton 2010). In addition, the literature suggests that organizations are often concerned with the identification of lessons rather than the dissemination of the lessons. Various practices, like lessons learned workshops, after action reviews, post project appraisals/reviews, project milestone reviews and project audits, have been developed to identify lessons to learn (Jugdev 2012; Duffield and Whitty 2015). While some people mistakenly think that the process ends after capturing lessons, lessons learned from projects actually start after these practices. Accordingly, Weber, Aha, and Becerra-Fernandez (2001) stressed that there is a difference between identified and stored lessons, and actual lessons learned which need to be implemented and reused. Knowledge application and implementation often require a significant effort, commitment, and understanding of people behaviour at both individual and organization levels. In fact, organizational learning from projects rarely happens or fails to deliver the intended results (Keegan and Turner 2001). Williams (2008) further stated that there is a need for wider research into how lessons from projects can be disseminated throughout an organization and incorporated into organizational practices (Duffield and Whitty 2015). In most cases, it is the dissemination and application of the knowledge that lead to the failure of KM (Tan et al. 2006). Therefore, how to disseminate knowledge throughout an organization and promote organizational learning is the aim of lessons learned from projects.

2.2. Lessons learned to contribute to organizational learning

Individuals and organizations learn knowledge not only by passively adapting to the demand, but also by actively selecting aspects that provide opportunities for incorporation into their own needs (Bateson 1972; Chia 2017). Individuals compare the information received to their existing knowledge and construct new knowledge and understandings based on what they already knew and believed. However, individual learning is not automatically organizational learning (Argyris and Schön 1996; McClory, Read, and Labib 2017). In contrast to humans, who have the central nervous system to process information, organizations need to create analogous structures to enable the individuals to learn as one holistic group (Duhon and Elias 2008; Duffield and Whitty 2015).

Individual learning is the first vital step to enable group learning and consequently organizational learning. While it is true that organizational culture, procedures and processes might influence learning, it is still the individual who has to perform the task. This study, thereby, emphasizes that firstly the individual has to learn before the whole organization can benefit. It agrees with Duhon and Elias (2008), who stated that an 'organization knows something if at least one member knows it' (5), however to get from individual learning to organizational learning the information needs to be independent of one particular individual and therefore needs to be shared and distributed throughout the organization. Wilson, Goodman, and Cronin (2007) reviewed research papers on group learning and stipulated that 'group learning occurs when the members possess both the knowledge [...] and an understanding that others have the same knowledge, and it is a property of the group' (1045). This means that the knowledge now is independent of any particular individual and a new group repertoire exists. Hence, group and project-based learning can be seen as a precursor to organizational learning and often, instead of focussing on information sharing between individuals, researchers concentrate on group-to-group learning or inter-project learning (Prencipe and Tell 2001; Hartmann and Dorée 2015). Organizational learning is supported by the knowledge bank through the KM system, but in order to be realized, it must be accompanied by individual learning (McClory, Read, and Labib 2017).

2.3. Barriers to the lessons learned from projects

Despite the efforts made, progress in improving lessons learned from projects appears to be slight (Hartmann and Dorée 2015). We followed the framework developed by Nakamba, Chan, and Sharmina (2017) for the literature review by identifying sources and keywords; selecting articles; classifying articles; and analyzing data. As the keyword 'project-based lesson learned' is not widely accepted and used in academic journal publications, we refined search strings and eventually identified them as 'learning/knowledge sharing/knowledge management', 'project management' and 'organizational learning'. We were particularly interested in these topics with the implementation of the IT system and published in peer-reviewed journals with good citations (Nakamba, Chan, and Sharmina 2017). The literature review revealed various barriers to lessons learned (Table 1), which were divided into nine main groups: (1) a lack of resources, (2) a lack of motivation, (3) a lack of perceived value, (4) no cultural acceptance in which people do not want to learn from others and there is a blame culture, (5) a lack of management support, (6) lessons learned process is not included into the project work, (7) the project environment in which projects often are unique and quite specific, hence difficult to compare, (8) a poor IT system, which is difficult to access and (9) bad quality and thereby no applicable information in database.

Most studies in the literature focus on the key reasons for the difficulties of sharing knowledge, not the situated nature

of knowledge. According to learning theories, learning is embedded in practice, context and culture, and developed through interactions with other people, not only in their own mind (Hartmann and Dorée 2015; Duffield and Whitty 2015). This study thus considers the influence of organizational factors, project procedures, and information systems to investigate lessons learned from projects from a practical aspect rather than a theoretical aspect. The first research question of the study is to address the main perceived barriers: *How do employees rate the importance and success of the lessons learned process and what do they perceive to be barriers to the learning from lessons?*

Individual employees as the end-users of lessons learned from projects are responsible for the retrieval of stored lessons and apply them to their future projects. Therefore, this study is also interested in enablers to individual learning. *How can the employee's individual learning be facilitated and how can employees be motivated and attracted to actively learn and share knowledge?*

2.4. Knowledge sharing and knowledge management system

The knowledge-based view suggests that the goal of an organization is to encourage the efficient utilization of individual knowledge (Sarin and McDermott 2003). Effective knowledge sharing can help individuals and project team members to exploit knowledge-based resources, and capitalize on them, which will contribute to the sustainable competitiveness of an organization (Davenport and Prusak 1998). Nonaka (1994) created a framework to explain the conversion and sharing of explicit and tacit knowledge and postulated four different modes. It can be seen as a cycle of knowledge conversions in order to generate group knowledge. Several frameworks and models have been designed for KM. One of the most popular seminal frameworks is SECI-model by Nonaka and Takeuchi (1995). In the SECI-model knowledge flows through different modes in a spiral form, with the interaction between tacit and explicit knowledge being strengthened through each mode (Nonaka, Toyama, and Konno 2000). Lessons expected to be learned from projects are tacit knowledge, which is personal, and difficult to formalise, communicate and distribute to others (Nonaka and Takeuchi 1995). While the importance of KM is widely accepted by organizations, this is not always done effectively and systematically. Carrillo, Ruikar, and Fuller (2013) stated that a big problem is that most lessons are 'tacit' and held in peoples' 'heads' or 'minds' and therefore cannot be captured easily. Fong and Chu (2006) found in their research that 48% of UK construction contractors are unable to access the knowledge they require using practices in place.

In recent years, with the development of IT, several technologies have been suggested in the literature as knowledge repositories, i.e. intranets and extranets, competitive intelligence portals, social network platforms, online discussion forums, and e-learning platforms. The IT-based KM systems make use of techniques that allow users to simultaneously store and process information effectively. They in many ways

Table 1. Barriers to lessons learned.

Author and year	Journal	Research Findings	Coded barriers
De long and Fahey (2000)	The academy of Managemetn Executive	<ul style="list-style-type: none"> - Research in more than 50 companies found organizational culture as major barrier - Culture influences the perception about useful important or valid knowledge - Culture dictates what knowledge belongs to the organizaition and what knowledge remains in control of individuals - Culture influences social interaction and communication - Culture shapes adoption of new knowledge 	<ul style="list-style-type: none"> - Organization: cultural acceptance
Disterer (2002)	Journal of Knowledge Management	<ul style="list-style-type: none"> - Projects lead to decentralization and fragmentation of knowledge - Necessary work after project must be dropped due to missing time resources - No open and constructive atmosphere to analyze errors - Prospective benefit for single employee to vague - No way of systematically recording knowledge - Complicated to search for and retrieve documents 	<ul style="list-style-type: none"> - Project environment - Lack of resource/time - Organization: cultural acceptance - Value
Tseng (2008)	Expert Systems with Applications	<ul style="list-style-type: none"> - Study with interview of 20 project management office leaders - Lack of authority of facilitators - Time pressures - Staff rotation - Fear of airing mistakes publicly - Lack of senior management support - Difficulty in accessing past lessons learned - Reflection just at the end of the project 	<ul style="list-style-type: none"> - Quality of the information - IT system - Lack of resource/time - Project environment - Organization: cultural acceptance - Lack of management support - IT system - Project integration
Julian (2008)	Project Management Journal	<ul style="list-style-type: none"> - Unique and discontinuous nature of project-based work - Lack of comparability of projects - Lack of motivation due to unclear value - Competition between project teams due to scare resources. 	<ul style="list-style-type: none"> - Project environment - Motivation Value - Organization: cultural acceptance - Lack of resource
Bartsch, Ebers, and Maurer (2013)	International Journal of Project Management	<ul style="list-style-type: none"> - Study with 41 construction contractor organizations - LL only at the end of a project - Not wanting to share problems or to learn from other people's mistakes - LL are repeated, already exist in a different format - No motivation due to lack of perceived value - Internal competition - Reduced quality of data due to legal concerns - Silo environments of project team, lack of communication - Lack of time - Culture of blame. 	<ul style="list-style-type: none"> - Project integration - Organization: cultural acceptance - Value - Motivation - Quality of the information - Project environment - Lack of resource/time
Carrillo, Ruikar, and Fuller (2013)	International Journal of Project Management	<ul style="list-style-type: none"> - Study at Iranian gas and petroleum companies - Categorize and rank barriers according to people, technology, process/organization, environment and knowledge type - Lack of appropriate reward - Lack of technical support of integrated technology - Weak performance measurement system - Lack of teamwork - Lack of time. 	<ul style="list-style-type: none"> - Value - Motivation - Organization: cultural acceptance - IT system - Lack of resource
Ranjbarfard et al. (2014)	Journal of Knowledge Management	<ul style="list-style-type: none"> - Time constraints - Lack of perceived value, unclear purpose - Needed balance between generalization and specification - LL not part of the project work. 	<ul style="list-style-type: none"> - Lack of resource/time - Value - Project environment - Project integration
Hartmann and Dorée (2015)	International Journal of Project Management	<ul style="list-style-type: none"> - Time pressure - Poor IT - Blame culture - Knowledge is power - Social barrier. 	<ul style="list-style-type: none"> - Lack of resource/time - IT system - Organization: cultural acceptance
Duffield and Whitty (2015)	International Journal of Project Management		

support organizational KM process, particularly for knowledge sharing. The benefits of knowledge sharing are well documented including creating new knowledge, developing skills, improving problem-solving, improving organizational performance and sustaining competitiveness (Darroch 2005). By implementing IT, business organizations efficiently

manage organizational knowledge and create company-wide knowledge repositories which map the internal expertise of the organization (Alavi and Leidner 2001). The Ford Motor Company managed to cut its car development time from 36 months to 24 months through internal knowledge sharing (Alavi and Leidner 2001). While the intentions of KM systems

are good, some researchers criticize overreliance on IT and little contributions to individuals (Beach 2004; Duffield and Whitty 2015). Sarnikar and Deokar (2017) even stated that KM systems are often implemented as separate systems independent of business processes.

2.5. Implement information technology for lessons learned

Project-based businesses require a consistent organization-wide database to enable the retrieval of relevant lessons. An effort has been put into updating the system to prevent the falling into disuse due to obsolete information, or into misinterpretation through the lack of contextual information (Hasan and Crawford 2003). However while people think knowledge has been created and updated with a database, in most cases it is the dissemination and application of the knowledge that leads to the failure of a KM system (Tan et al. 2006). Wijnhoven (2003) claimed that a lot of KM systems failed, because their complexity is underestimated and usually fail to live up to the expectations regarding the dissemination of knowledge. Knowledge can be disseminated by push (passive) and pull (active) activities (Andrade et al. 2008). Push dissemination takes the initiative to either broadcast lessons as bulletins or actively cast information according to people's interests and job roles (Weber and Aha 2003). In contrast, pull dissemination relies on the individuals to search for relevant information and commonly used systems are repositories or databases (Chirumalla 2016). Lessons learned is not only to push the knowledge to individual passively but is active learning pulled by individuals through knowledge seeking (Yuan et al. 2013). Searching processes are thus critical for active lessons learning. They take individuals through encountering pieces of information and lead to new directions and ideas until satisfying knowledge is gathered (Bates 1989). For example, area scanning strategy can be especially seen in a physical library, where the surrounding areas of a found piece of information are also investigated for relevant information. This searching strategy can be adapted to web databases by including a section like 'other users also looked at' (also used by Amazon). It has been stated that the more different strategies searchers can use, the more retrieval effectiveness and efficiency is possible (Bates 1989). However, the most common approach to start searching for information is a keyword search, like used by Google. Studies have found that this type of search supports the users, who do not specifically know their target (Wilson, Schraefel, and White 2009). The searching process of an individual might not be well-formed at the start, but evolves and focusses through encountering new pieces of information, which in turn can lead to new directions and ideas to search until satisfying knowledge is gathered (Bates 1989). Understanding individual different searching strategies can also help them to adapt IT systems better and to meet their individual behaviour requirements in order to promote learning.

Recently, an increasing number of researchers have investigated social networks and informal knowledge sharing in

order not to depersonalize employee interaction (Davison, Ou, and Martinsons 2013). A social network is combined with various other media tools, such as interactive IT communication tools, videos, audios, photos and feedback systems (Davison, Ou, and Martinsons 2013; Kwahk and Park 2016). Through a social network, individuals can easily share not only their explicit knowledge through written communication but also their tacit knowledge, which may be difficult to express in written form (Kwahk and Park 2016). The use of a social network model or knowledge map allows people to depict colleagues with different types of expertise and to have a positive influence on knowledge sharing (Newell et al. 2006). In addition, knowledge sharing is a social-relational process, which individuals need to establish a shared understanding and the potential abilities to transform this understanding (Boer 2005). Social network allows individuals to initiate their diffusion which is a bottom-up approach. This attracts individuals and groups to spread their knowledge across their network. This process is different from traditional collaboration tool where users have passive roles in the process. Taking the aforementioned subjects into account the last research question will be *How can information technology enhance dissemination activities and facilitate learning from projects?*

3. Research method

3.1. Case study

Case studies are widely used in business research and focus on understanding the dynamics present within single settings (Eisenhardt and Graebner 2007). They allow the questions to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon (Voss, Tsikriktsis, and Frohlich 2002). Unconstrained by the rigid limits of questionnaires and models, case studies can lead to new and creative insights, development of new theories, and have high validity with practitioners (Voss, Tsikriktsis, and Frohlich 2002). A case study was chosen for this study to understand why organizations are struggling with lessons learned processes and to give them practical recommendations for future improvement. With the overall aim to give practical recommendations to a specific problem, this research adopts a pragmatist stance, which allows the adoption of different philosophical concepts in order to answer the research questions in the best way. Pragmatism has a relevance-to-practice principle and 'seeks relative rather than absolute truths' (Watson 2011, 208). The research, therefore, accepts that different people with different backgrounds and different roles create different meanings. The validity of case study can additionally be increased by triangulation of data collection methods, thereby this study uses cross-sectional interviews as well as the analyses of company documents and informal conversations (Voss, Tsikriktsis, and Frohlich 2002).

3.2. Case company

Siemens Power Generation is a Siemens AG subsidiary dedicated to repairing and maintaining gas, steam turbines and generators, and offering specialist assistance on maintenance and operations services to power plants. It, nowadays, has also specialized in-service operations additional to traditional manufacturing processes. In recent years, Siemens has been striving to seek an effective approach to compete on value. They are trying to change their focus from what to offer to what value the offer brings to their customers. Therefore, they shifted from the mere production and assembly of finished goods with a product-service oriented system. Such a process, leading to the offering of a unique combination of product and service, is more difficult to replicate than the mere products. This will also provide opportunities for business innovation and increase long term profitability.

The case company overall retains its functional organizational structure, the employees sit according to departments, while at the same time different individuals are members of different project teams. Although a cross-functional project team is created for each project in order to provide high-quality customized service, and at the end of projects, there are lessons learned sections facilitated by a neutral moderator. The company is struggling on two aspects: (1) the gathered information after each project is not used regularly and the knowledge does not spread through the organization, (2) different databases across departments have been adopted. The gathered information is stored at the departmental local SharePoint and not shared with other departments. These scenarios have made the knowledge more vulnerable by increasing the possibilities of losing it which could also compromise customer service. The case company seeks a new effective IT system to allow the data transferred/combined.

3.3. Data collection

Across-section individuals were interviewed in order to ensure a highly diverse view on the topic. The rationale for gaining a heterogeneous sample is that any commonality found across a diverse group of cases is more likely to be a widely generalizable phenomenon (Robinson 2014). Overall eight semi-structured interviews and various non-standardised informal conversations were conducted in order to find out people's perceptions. Before each interview the participants received a cover letter, stating the aims of this study, the contents of the interview, the voluntary nature of the participation and the protected anonymity (Robinson 2014). All interviews lasted 40–60 min and were recorded to support a detailed analysis of the answers (Yin 2003). While there was an interview scheduled with fixed questions and topics, according to the answers of the respondents additional or different questions were asked (Eriksson and Kovalainen 2011). At the end of the study, each interviewee had the opportunity to raise any issues which were not addressed during the interview.

In addition to the aforementioned interviews, company documents, i.e. procedures, project reports and lessons

learned documents, were examined in order to get a better understanding about the status quo. Seeing the limited time frame of the study conversations, meetings and informal discussions were used to complete the gathered informal information. Some of the findings of this were addressed afterwards in the interviews.

4. Data analysis and research findings

CAQAD tool NVivo 11 was used to analyze the audio-recorded data and a three-stage coding scheme suggested by Strauss and Corbin (1998), namely open, axial and selective coding, was followed.

4.1. Barriers to the lessons learned from projects

The first research question on the barriers to lessons learned was analyzed by a deductive content analysis following Elo and Kyngäs's (2008) approach. The answers were coded and allocated according to the pre-formulated thematic scheme from the literature (Yin 2003; Eriksson and Kovalainen 2011). After the open coding of the literature, the identified issues were grouped together as 10 main barriers according to their relations (axial coding). For a further level of abstraction, those barriers were then allocated to four main categories, namely technology, people, project work and organizational factors (selective coding). The preformulated topics were then used to analyze and code the interview answers to test which barriers are existent. Table 2 shows the answers given by the participants regarding perceived barriers.

The frequency of the statements was recorded in order to rate the respective importance of each barrier. Figure 1 shows the percentage of respondents, which mentioned the perceived barrier.

All interviewees stated that the retrieval of the information is a major barrier to lessons learned from projects. The old database, as well as the local SharePoint, lists the lessons learned information with limited functions. While the old database consists of a list of individual lessons at the local SharePoint, all lessons are grouped together in a project report, but again those reports cannot be searched for directly. *'You have to have a reasonable idea of what you are looking for. Because if you are just going in blind and starting to troll through all the information there, it will take forever'* (Participant H). Interviewees also stated that the information in the databases is a *'massive list'* (Participant B), which is *'very difficult to analyze'* (Participant A). One participant even stated that he does not know where to find relevant lessons learned information. Also, all respondents mentioned their concerns on the quality of the information in the databases. Some information is simply *'irrelevant'* (Participants F, G) and should be filtered out, others mention that *'not all of the important issues get captured', especially because 'sometimes the workshops take place long after the end of a project'* (Participants E, F, G). Halawi, McCarthy, and Aronson (2007) also found that information quality is significantly related to

Table 2. Coded and analyzed answers to perceived barriers.

Literature	Interviews							
	Participant A	Participant B	Participant C	Participant D	Participant E	Participant F	Participant G	Participant H
Project environment	At project end, assigned to new projects		Projects sometimes one-off, too specific	No communication of LL to people not involved in project	Limited sharing due to differed projects	Only project team know; lack of communication		
Project integration			Need to be fed back into new projects; it is not daily routine yet	Only lessons learned on larger projects	Time between lesson learned and projects end; LL as after thought	Make it happen as soon as projects end	Workshop long after activities, only at the end	Not mandatory to attend workshops
Organisation cultural acceptance		Culture of just satisfying the process; point-scoring	More ticking the box; People too defensive	Lessons learned not high priority; personnel affects atmosphere	Not contract work but admin; can't be bothered			
Value		People repeatedly coming with same issues	Ticking the box rather than value adding		Other things more important			Other things to do; don't find things of use
Lack of management support								
Lack of resource/time	People need to take time; lack of resources	Need more common discussion but no time	Lack of time	Lack of time	Lack of resources and time			Lack of resource; No time
Ownership of follow-up action	Need improvement on "follow-up"	For somebody else to deal with it	Ownership of following up actions			Lessons not implemented	Lack of management support to improve system	
Motivation	Sit and read through; People take time; Motivation until end	Rely on one people reading it; repeatedly same issues; demotivation	Too much reading	Troll through lot of lesson learned	Can't be bothered	Troll thought all that; demotivation because lessons not be implemented		Not turn up to workshop because something more important to do
Quality of information	Consistent form; need full story	Identify lesson learned not comprehensively	Might miss main issues	Not applicable information; not really clear	Few bits might get missed	Irrelevant information needs to be filtered out; often too general	Lot of irrelevant information	Not always capture all the information
IT system	Multiple database; Documentation and retrieval difficulties	Waiting through lots of information; massive list	Find relevant information; grainy list of actions; multiple, different databases	Troll through lot of lessons learned; list of every problem	Don't know where to look	Just a list of projects; need to be better filtered	Just listed by projects; hard to search	Perceived as difficult to find; need to know what to look for

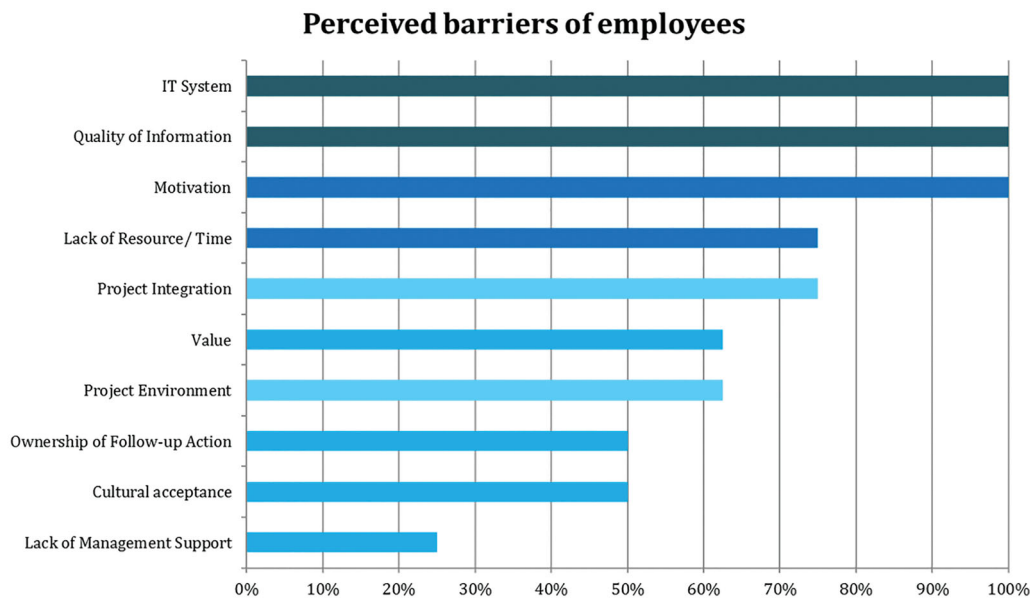


Figure 1. Frequency of perceived barriers mentioned during interviews.

future uses. Higher-quality information better fulfils users' needs, thereby users will increasingly use it.

There is a new perceived barrier mentioned by several interviewees – ownership of follow up action. *'In every lessons learned, you should, normally it all segregates the problem. Somebody needs to prevent it happening again. Like, someone to take ownership of the problem'* (Participant D). This means the interviewees are interested to know how lessons created from previous projects benefit their future work. They would like to involve their department for group learning. *'How, as a group or as a department, the lessons associated with them will get the information and learn from the lesson'* (Participant F). When individual people who are personally involved in creating the lessons or problem-solving processes, they often want to be a part of a project's documentation and to know the contribution of the lessons they created. If there are follow-up actions, they usually take their new experiences with them and share with other people when they return to their line functions after having completed their tasks in projects (Argyris and Schön 1996).

It is also very interesting that none of the participants directly saw the employee's motivation as a barrier although they perceived it as a significant influencing factor. In fact, respondents often linked the employees' motivation to other barriers. For example, they see a link between motivation and the lack of time and resource of the employees, because there is *'too much reading and reviewing'* (Participant C) and it does not seem to be *'effective'* (Participant B). The interviewees also acknowledged that lessons learned are *'not high priority'* (Interviewee D) and the process is more a *'tag on, it's an afterthought'* (Participant E), which eventually correlates with the cultural acceptance and the integration of the lessons learned process in the project work. Some participants see a demotivation in the fact that the follow-up actions are not implemented. *'I think the big thing that puts people off lessons learned is that bit, where if they're repeatedly coming with the same issue they do not see anything happen'*

(Participant B). *'It's fine that all these meetings are assayed, but if we do not follow and close all the actions, the whole process is a waste of time'* (Participant C).

Overall, every barrier found in the literature review was mentioned during the interviews. Although the employee's own motivation was never mentioned directly as a barrier, demotivation was mentioned as a result of the other barriers. There are various issues which can demotivate employees. For example, participant A stated that people use IT system as an excuse for not researching the database. *'So regardless of what system we have, people will always have problems'* (Participant A). Motivation needs to be seen as a crucial factor that drives and sustains the desired employee behaviour (Pinder 2008) and influences an employee's willingness to participate (Turner and Pennington 2015). Most studies stated that people share their knowledge for personal outcomes, i.e. self-esteem, expected to be viewed as skilled and knowledgeable. However, knowledge sharing motivation stemmed from an expectation of community-related outcomes, rather than individual (Chiu, Hsu, and Wang 2006 and Ozlati 2015). Although motivation alone might not be the constraining factor to influence individual behaviour, individuals also seek opportunities from the environmental or contextual mechanisms that enable action (Siemens, Roth, and Balasubramanian 2008). While there is a lack of opportunities or abilities, individuals will be demotivated and sometimes blame other things. In order to prevent the culture of blame, a positive organizational culture is needed to promote lesson learned. *'I think right culture needed for lessons learned. You do the lessons and then it's for somebody else to deal with how to implement the corrective measure. So we just put something in place to satisfy the process'* (Participant B). It needs to focus on the psychosocial interaction where individual, departmental, and organizational characteristics play a major role. One respondent mentioned that *'people sometimes might get too defensive in pressured situations and there might be "point-scoring" in a way that people try to*

distract from their own mistakes, by pointing out mistakes from others' (Participant E). To promote lessons learned, a supportive culture should offer employees development opportunities, encourage employees to improve their abilities and also engage the sense of collegiality, collaboration and sharing.

4.2. Enablers of lesson learned

To answer the second and third research questions a more inductive approach was chosen and the qualitative data from the interviews was coded without pre-existing topics. It was an iterative process. Findings and coded topics from the initial interviews have been reviewed after subsequent interviews. Voss, Tsiriktsis, and Frohlich (2002) emphasize that the research needs to be aware of patterns even prior to the formal data analyses since there is an overlap between data collection and data analysis. Again, the frequency of mentioned topics was used as a reference to establish a ranking on what people expect from a good lesson learned system.

It is very interesting to notice that the conception of motivation as a barrier changed further. All interviewees stated that incentives cannot influence their motivation to learn, instead, learning has to be the employees' own drives. When asked about what would be the strongest motivation to learn, half of the participants answered that it is simply because they want to do a good job and achieve self-esteem. *'If a job goes well, it's a lot less stressful'* (Participant D). The other half stated that it is important to make the people aware of the benefits, not only personally, but also for the whole business. *'It's demonstrating the benefits to people. It's the improvement that we make. It should make everybody's job and life easier. It should get to greater customer satisfaction. In doing that the organization probably get better business opportunities and become more profitable'* (Participant C).

All interviewees recognize the importance of lessons learned and have a self-driven motivation to learn, however, the barriers affect their motivation. They stated that individual motivation is not easily influenced positively. In combination with the results of the first part of the interviews, it is reasonable to believe that although the motivation is not a barrier itself, it is a fixed variable and influenced and decreased by all the barriers. Facing difficulties with the IT system, not seeing follow-up actions of lessons learned implemented, all those factors decrease employees' motivation.

The interviewees pointed out that the overall open, productive and collaborative organizational culture, as well as the group culture, are important for lessons learned. *'I would say, the culture in this organization is pretty good in terms of people wanting to do a good job'* (Participant H). They also stated that companies need to encourage learning at different levels not only during project team meetings, but also in their functional department members. The majority of respondents even agreed that it is a benefit that the organization has a functional structure. *'We have a very good communication system within the business. Again the way we sit, it*

tends to make you appreciative even more, because you have all the other departments sitting very close to you. We do have meetings, but it's also easy for people to pick up the phone or just walk around and speak to people' (Participant F).

Respondents further pointed out that they discuss their problems formally during meetings and informally conversations as well (see Figure 2). These open discussions are very valuable and in fact, people rated learning through conversations and discussions as their second preferred way of learning- only after 'learning-by-doing'. The lessons learned practice, namely 'reflecting on actions', is the third preferred learning style. Everyone stated, that they would ask their colleagues for help and that they would be interested in that experience. At the same time, the motivation to share their knowledge and experience is high, simply in order to help others and *'make things as easy as possible for other people within the organization'* (Participant H).

4.3. The implementation of information technology on lessons learned

Table 3 lists their expectations on the information system. It is surprising to find that employees perceive the IT system and the quality of information are the main barriers after Siemens made a huge investment in their IT systems. Respondents stated that they see the retrieval of lessons from the IT system as a major barrier and need improvements in this area in order to encourage the individuals to reuse the lessons learned information. In fact, Duffield and Whitty (2015) stated that technology only accounts for 10% of the success of the information system, the people factor accounts for the other 90% as the main reason for failure. In addition, Siemens relies on its database for lessons learned. This is a pull dissemination method applied for the employees to search for information. Yuan et al. (2013) found that these databases and digital archives typically do not have built-in tools that allow searching or communicating with document contributors, hence, their value for developing an awareness of expertise distribution and social capital is limited.

It is very interesting to see organizational culture and structure, projects environment and human factors being mentioned for the implementation of IT for lessons learned. Specifically, the following three aspects have been highlighted:

4.3.1. Develop organization culture and structure for both formal and informal knowledge sharing

The interviewees stated that information systems contribute to formal knowledge sharing but organization culture and structure can help informal knowledge sharing. Similarly Davison, Ou, and Martinsons (2013) found in their case study that informal knowledge is often highly contextual in nature and held in a tacit form by individual employees. In contrast to formal information dissemination, people frequently rely on personal networks when searching for past experiences, through either asking someone they know or seeking an

Preferred ways of learning - "I can learn a lot when ..."

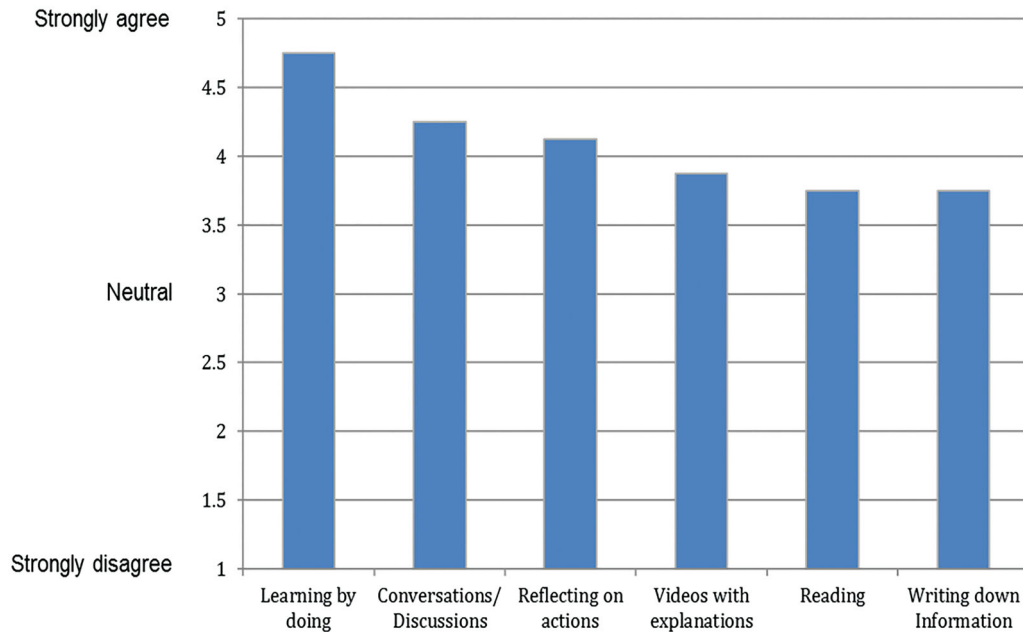


Figure 2. The preferred ways of learning.

Table 3. Ranked expectations on information system.

Expectations of a lessons learned database	Mentioned by
1. Effective, quality-filtered lessons	Participant A, B, C, E, H, G
2. Easy accessibility of information	Participant A, B, E, H, G
3a. Clear actions with indication about active measures in place	Participant C, D, F G
3b. Additional filter for departments	Participant A, D, E, F
4. Minimal maintenance and administrative work	Participant B, G
5. Short summary of lessons	Participant F

expert familiar to their contacts (Chirumalla 2016). Active sharing of informal knowledge is very much part of the organizational culture. It also was derived from our interviews that the culture of the case company is open and collaborative which still exists in the functional organizational structure. The close and open seating arrangements in the offices foster informal knowledge sharing and conversation. This means that a mixed organizational structure would work for project-based manufacturing. This is in accordance with the view of Principe and Tell (2001) that 'pure project-based firms lack the organizational mechanisms for the knowledge acquired in one project to be transferred and used by other projects' (1391). The conversions with colleagues of the same department are formal ways of knowledge sharing and functional departments are also essential for their explicit knowledge. However, organizations need to prevent boundaries between departments being too rigorous, which can lead to internal competition (Sandhawalia and Dalcher 2011; Carrillo, Ruikar, and Fuller 2013).

Additionally, Claver-Cortés, Zaragoza-Sáez, and Pertusa-Ortega (2007) emphasized the positive influence of fewer hierarchical levels, thereby a horizontal structure in order to

encourage discussions and interaction between all staff members. Business organizations need to facilitate effective and easy communication channels for individuals and groups. This can include chat applications, instant messaging, social communities or forums, everything that fosters informal knowledge sharing. Through these informal discussions (socialisation), valuable tacit knowledge can be transferred. The idea to build up a social network or knowledge map, something like 'internal yellow pages' with a directory about the participation of employees in projects, experience and expertise knowledge should be considered. This 'who knows what' directory provides employees with opportunities to access not only explicit knowledge codes but actually with the source of the knowledge (Disterer 2002; Newell et al. 2006; Andrade et al. 2008).

4.3.2. Develop effective and easy use information communication system

Business organizations need to facilitate effective and easy communication channels for individuals. Davison, Ou, and Martinsons (2013) explained that interactive IT tools like chat applications 'are often preferred to face-to-face interaction between both co-located and distributed workers because they are unintrusive and commonly support multitasking'. The participants, however, expressed their preference of face-to-face interaction or telephone calls. Although the enterprise social media called Siemens Social Network is in place, they have not received the potential benefits from it. In the future, interactions such as 'commenting' to provide feedback, 'bookmarking' to save information for a later point of use or 'tagging' to share relevant information with specific

people, can be seen as big benefits. The use of enterprise social networks enables knowledge sharing by making it possible to unobtrusively traverse the activities and connections of others through media streams and notifications of user activity (Ellison, Gibbs, and Weber 2015).

Interviewees mentioned the need for an additional category for searching relevant information when indexing lessons. This would simplify the searching process in a way that it filters relevant information. Weber and Aha (2003) highlighted that indexing lessons learned according to applicable tasks rather than occurred problems will promote a retrieval based on applicability and hence will again simplify the search. Bates (1989) used 'berrypicking' to describe a common approach to finding relevant and useful data. Berrypicking can include a mix of different searching strategies with a subject search, some abstracted or indexed topic (Bates 1989). Instead of searching for potential problems they might face in the future, different searching strategies also let users find similar tasks and satisfy their needs for applicable and relevant knowledge. For example, visual data, like photos and pictures, can also be used for searching indices. Some lessons can be explained better with visual data, making it easier for individuals to understand the context of a lesson.

4.3.3. Refine project management processes

Lessons learned workshop should be a fixed routine in project work: firstly, it is important to have the lessons learned workshop shortly after projects end, because the motivation for sharing their experience as well as the memories for the lessons are still fresh. Secondly, it is beneficial to start gathering lessons as the project progresses, because again, the memories are new and things that would have been forgotten in the end, still get collected. This ensures consistent quality and especially the language of data. It means no 'one-liners' as explanations of lessons and also that all lessons are inputted in the same language. Therefore, a fixed role with the responsibility to check the quality of the inputted lessons is recommended. It is also important to combine lessons learned database with an individual profile, where users can pre-select their interests. This can have two benefits: on the one hand, this can support push dissemination, sending alerts to the profile, when new interesting lessons are added (active casting). On the other hand, these profiles at best could be used in combination with the 'yellow sites'. Again the easy contact information might lower the inhibition threshold to contact the person and foster informal conversations.

5. Conclusion

Overall, this study sees lessons learned as a valuable tool aligning people, organization and technology factors in order to help organizations to learn from their project experience. The literature lists a number of barriers to the process and especially stresses the people factors as the main reasons for

the failure of the KM system. In contrast to that, however, this research finds that the IT system rather than people factors act as the main barrier to the lessons learned process and dissemination of lessons learned information. Although the employees are motivated to learn, the difficulties in finding relevant and applicable information in the database are demotivating. Other concerns are the quality of the information and a lack of time, also emphasized in this study. This study also identifies the influence of organizational culture and structure on the effectiveness of the information communication system. Apart from formal knowledge sharing, this research also stresses the importance of informal knowledge sharing for project-based business. While it is crucial for an organization to have a functional structure to support formal knowledge sharing and to facilitate organizational learning, informal knowledge sharing should also be emphasized through interactions of individuals within their departments and across different departments, especially for project-based businesses. The application of social networks and social media is very limited and would need to be expanded further in the future. This study, therefore, gives practical recommendations, regarding the lessons learned database in order to help the dissemination of knowledge through the whole organization.

Future research needs to further discuss the potential use of social networks. At the moment, the use of companies' own social networks is not widespread, but the trend is growing. The use of social media in order to enhance informal information sharing and the influence of such platforms on social capital needs to be addressed in the future. Additionally, ways of increasing the motivation of employees should be investigated more closely in order to enhance the reuse of lessons further. Lastly, the interviewees indicated that there are not only ties between barriers and the motivation, but that there are correlations between the different barriers themselves. Future research, therefore, should aim at defining the relationships between those barriers in order to give even more specific recommendations, and which barriers might influence the reuse of lessons learned and individual learning the most.

By interviewing project team members from different departments, project managers and a senior manager, this study ensured a most differentiated view on the topic. However, it is a lack of empirical data that limits the generalization of the results and recommendations. While some of the recommendations are specifically aimed at the studied organization, it is still plausible to assume that most of the recommendations are equally useful for other organizations, since they are based on an extensive literature review.

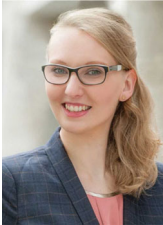
Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors



Ying Yang is a senior lecturer in Newcastle University Business School, Newcastle University, UK. She received her Ph.D. in operations management from the University of Ulster, UK. She has published in journals such as the *International Journal of Production Research*, *Supply Chain Management: an International Journal* and *International Journal of Logistics Management*. Her main research interests are e-commerce, operations management and strategy, supply chain management and performance management.



Gina Brosch has started her career with a BEng in Mechanical Engineering and an apprenticeship as a Mechatronics Engineer which was both funded by Siemens AG, Regensburg, Germany. After that she obtained an MSc in Operations, Logistics and Supply Chain Management with Distinction from Newcastle University, UK, where she discovered her research interests in knowledge management and operations and performance management in manufacturing. In her recent position as a technical purchaser at a special machine construction company, she works on various projects in the automotive and aerospace industries. In order to enhance the knowledge management at her company, it is her responsibility to compile any necessary specifications for future projects and investments.



Biao Yang is a senior lecturer in Operations Management at the University of Sussex, UK. He received his Ph.D. in manufacturing engineering from Loughborough University, UK. He has published in journals such as *European Journal of Operational Research*, *IEEE Transactions on Engineering Management*, *International Journal of Operations and Production Management* and *International Journal of Production Research*. His main research interests are supply chain management, service operations management and stochastic models for inventory and production.



Trevor Cadden is a senior lecturer in Operations Management at the University of Ulster. Trevor has considerable experience in Supply Chain Management and Operations Management. His experience working for many years in US multinationals in supply chain systems implementation, project management, inventory control and management, and performance measurement has provided a fundamental platform for his career in academia. Trevor has previously published in journals such as *Supply Chain Management: An International Journal*, *Production Planning and Control* and *Journal of Purchasing and Supply Management*.

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