Benchmarking for the Design of a Lessons Learned System in Project Quality Management

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Abstract

Project organizations are required to continuously improve the quality of their projects in terms of cost, schedule and technical performance; but the economic return of projects is eradicated by poor quality in project planning and execution. Project managers have the responsibility to implement learning processes such as benchmarking and lessons learned to move towards continual improvement and effective knowledge management if they wish to remain competitive. This paper presents the design of a lessons learned system for the Quality Management and Business Excellence Department of Eskom, the largest utility in South Africa, towards an effective knowledge management system and a continual learning organization. Benchmarking was employed as the tool to identify the required characteristics of six global lessons learned systems; and these characteristics then served as input to the user requirements specification and functional design of the lessons learned system for Eskom. The paper concludes with recommendations for improvement of the system.

Keywords
Project quality, benchmarking, lessons learned

1. Introduction

Project organizations are required to continuously improve the quality of their projects, including meeting and exceeding customer requirements in terms of project cost, schedule and technical performance (Kotnour, 2016; Nel and Pretorius, 2016). In 2013 PricewaterhouseCoopers reported that capital project and infrastructure spending is expected to total more than nine trillion dollars by 2025 and that the economic return generated for every dollar spent on a capital project lies between five and twenty five percent (PricewaterhouseCoopers, 2013). That economic return, however, is eradicated by poor quality in project planning and execution. A study conducted by Mmbengwa (2016) in Transnet, South Africa's largest freight rail organization, indicates that quality management in projects is at a maturity level of 2.95 as indicated in Figure 1 (measured to a level of 5).

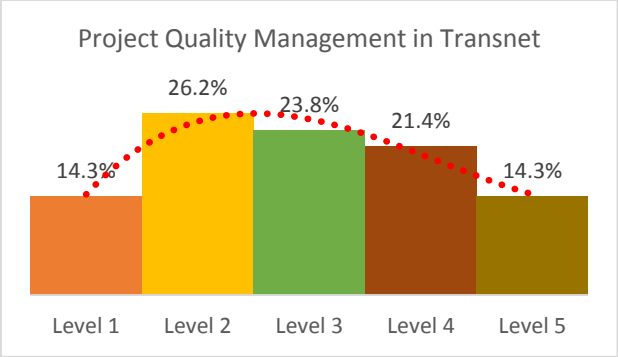

Figure 1. Project quality management in Transnet (Mmbengwa, 2016)

Since organizations are increasingly choosing project work as a flexible structure for the development of their products and services, project managers have the responsibility to implement learning processes towards continual improvement and effective knowledge management if they wish to remain competitive (Kotnour, 2000; Peters and Homer, 1996; Schindler and Eppler, 2003). Benchmarking is globally considered as a catalyst for innovation and its significance as a method for improvement is indisputable (Anand and Kodali, 2008). Sixty-five percent of *Fortune 1000* listed organizations employ benchmarking as a management tool to gain competitive advantage (Fernandez, McCarthy and Rakotobe-Joel, 2001; Korpela and Tuominen, 1996).

Eskom is the largest electricity generator in South Africa and one of the top ten utilities in the world by generation capacity. The company is a critical and strategic contributor to the economy of South Africa in ensuring the security of electricity supply in the country. It generates approximately ninety-five percent of electricity used in South Africa with twenty five operational power stations (Tjabadi, 2010). The company has an existing customer base of 4.3 million people and connects over 100 000 new customers per annum. The Quality Management and Business Excellence Department (QM) was established in 2009 in the Eskom Group Capital Division with the strategic intent to develop and implement a Best-in-Class Quality Management System (QMS) and Business Excellence Programme for Eskom (Tjabadi, 2012). At the time the Department comprised seven sections as depicted in Figure 2.

Figure 2. The Eskom Quality Management and Business Excellence Department

Quality Engineering ensures that quality and quality requirements are built into the engineering and design outputs throughout the life cycle for projects, products and services. **Procurement and Supplier Quality Assurance** supports the procurement process by providing and managing the quality assurance elements into the procurement value chain for projects, products and services. **Quality System Assurance and Supplier Audits** provides quality assurance and

control services to all global Eskom projects, products and services during the execution up to finalization phase, both statutory and non-statutory. This function includes asset decommissioning and long-term preservation. **Programme Quality Assurance and Control** supports the quality management system through internal first line quality assessments, reviews and audits; investigations of quality incidents; supplier capacity and capability assessment; and post-contract supplier quality audits. **Quality Performance, Risk and Improvement** provides management information and reporting service in quality management on Eskom quality performance. **Quality Management Systems and Business Excellence** provides strategic, expert guidance to implement the Eskom ISO-based management systems compliance and business excellence programmes. **Quality Support** provides a strategic support service to Quality and its programmes. In summary, the mandate of the Department of Quality Management and Business Excellence was to develop and implement a consolidated quality management strategy and system for all Eskom businesses, employing the philosophy of Total Quality Management. This included the management and control of the time, quality and cost of projects across the Eskom Project Lifecycle Model (Tjabadi, 2012).

In 2010 the Quality Performance, Risk and Improvement (QPRI) section was tasked to develop two knowledge management systems: the first was a benchmarking system that enabled corporate competitive advantage through the identification of best practice in project and quality management; and the second was a lessons learned system that employed information from benchmarking in its functional design and operation. Benchmarking enables corporate competitive advantage through the identification of best practices for improvement and is a tool to facilitate learning and strategic development of knowledge management systems (Martina, Hakvoort and Ajodhia, 2008; Mehregan, Nayeri and Ghezavati, 2010:877; Fernandez, McCarthy and Rakotebe-Joel, 2001). As such benchmarking is considered a catalyst for innovation and its significance as a method for improvement is indisputable (Anand and Kodali, 2008). Fernandez *et al.* (2001:282) state that benchmarking is "a process that facilitates learning and understanding of the organization and its processes…and is employed as a tool for strategic planning, competitive analysis and process analysis, team building, data collection and organizational development". It is for this organizational value that the Quality Performance, Risk and Improvement team was tasked to develop a benchmarking system and a lessons learned system to achieve the Department's strategic intent of developing a Best-in-Class Quality Management System.

This paper presents the design of a lessons learned system for the Quality Management and Business Excellence Department of Eskom, the largest utility in South Africa, towards an effective knowledge management system and a continual learning organization. Benchmarking was employed as the tool to identify best practice and the required characteristics of six global lessons learned systems; and these characteristics then served as input to the user requirements specification and functional design of the lessons learned system. The paper concludes with recommendations for improvement of the system.

2. Benchmarking Models and Classification Schemes

Various benchmarking models and classification schemes exist and Anand and Kodali (2008) conducted a comprehensive analysis of different benchmarking models and classification schemes to compare the intent and process of each model. Their paper titled "Benchmarking the benchmarking models" discuss *inter alia* the following classification schemes:

- Internal and external benchmarking (Spendolini, 1992; Codling, 1992; Lema and Price, 1995; Karlof and Ostblom, 1993; Le Vie, 1998; Nandi, 1995; as cited by Anand and Kodali, 2008: 262-265).
- Product and functional benchmarking (Spendoloni, 1992; Partovi, 1994; Malec, 1994; Lema and Price, 1995; Karlof and Ostblom, 1993; Singh and Evans, 1993; as cited by Anand and Kodali, 2008:262–265).

These classification schemes focus on quantitative measures of performance; but over time benchmarking has evolved to include qualitative comparison of best practice as well (Andersen and Moen, 1999; Teuteberg, Kluth, Ahlemann and Smolnik, 2013). Strategic benchmarking (Nandi, 1995; Shetty, 1993; as cited by Anand and Kodali, 2008:262) is one form of qualitative benchmarking that investigates and compares strategic initiatives such as lessons learned systems across companies.

According to Carpinetti and Melo (2002:245; as cited by Kluth, Ahlemann and Smolnik, 2013) benchmarking can be classified according to its objective and they distinguish between strategic, product and process benchmarking. Strategic benchmarking is seldom industry-focused and can roam across different companies and sectors to identify

winning strategies that enable high-performing companies to be successful in their markets. It is a qualitative benchmarking methodology that influences the longer-term strategy and competitiveness of a company and enables a firm to anticipate market and economic changes. Performance benchmarking, on the other hand, compares the performance levels of a specific process, product or activity across high-performing companies. Consequently, the Quality Performance, Risk and Improvement team designed a benchmarking system that included strategic and performance benchmarking methodologies and proceeded to benchmark various industries over period of three years (Nel, 2010 - 2013).

Since Eskom is the largest utility in Africa, strategic benchmarking required comparison with international best practice and companies. The team employed an academic/research-based model as presented by Anand and Kodali (2008:267) to develop a methodology that compared industries, systems and companies using information, data and knowledge from published journals, books and official company websites. The model was called desktop benchmarking and was employed to conduct strategic benchmarking for the development of a lessons learned system for Eskom. Once the benchmarking system and methodologies were established and documented, the QPRI team was tasked to develop a Quality Lessons Learned System with the following objectives:

(i) To identify best practice in lessons learned systems employed by global companies and institutes;
(ii) To assess the operating characteristics and success criteria of these systems;
(iii) To define the desired functional capabilities of a lessons learned system for capital projects; and
(iv) To implement and operate the Lessons Learned System in the Eskom Group Capital Division.

The QPRI team employed desktop benchmarking to identify the operating characteristics, strengths, weaknesses and challenges of six global lessons learned systems across different sectors; using this information to design, implement and refine a lessons learned system for Eskom. Initially the system was designed manually in Microsoft Excel, but later it was converted to an automated knowledge management system employing Hyperwave content management software (Hyperwave, 2016).

The following section provides an overview and summary of each lesson learned system identified for the desktop benchmarking, and lists the distinguishing features and characteristics of each system that were employed in the design of the Eskom Lessons Learned system.

4. Global Lessons Learned Systems

4.1 NASA Lessons Learned Information Systems (LLIS)

The following section is a direct extract from a review of NASA's lessons learned information system dated March 2012 (NASA LLIS, 2012):

> Since 1994 NASA's principal mechanism for collecting and sharing lessons learned from Agency programmes and projects has been an online, automated database called the Lessons Learned Information System (LLIS). The information in LLIS is drawn from personnel in engineering, technical, science, operations, administrative, procurement, management, safety, maintenance, training, flight and ground-based systems, facilities, and medical. The primary purpose of LLIS is to provide a searchable repository of information that allows NASA managers to learn from past activities; but the usefulness and value of LLIS are contingent on managers and engineers routinely submitting information to the system. Albeit the LLIS is designed to be searchable and available across the Agency to the broadest extent possible, it was found that NASA programme and project managers rarely consult or contribute to LLIS even though they are directed to do so by NASA requirements and guidance. Over time NASA has relaxed its internal requirements regarding the level and timing of project managers' use of and contributions to LLIS and disparate funding levels for LLIS activities and processes were found at the different Centres. Two additional challenges were the lack of monitoring of the system and the lack of a comprehensive strategy for knowledge management (NASA LLIS, 2012).

4.2 The Incident Learning System (ILS)

"An incident learning system is the set of organizational capabilities that enable the organization to extract useful information from incidents and to use this information to improve organizational performance over time. Its components include identification and response, reporting, investigation, root cause analysis, recommendations, communication of incident learning, and the implementation of corrective action" (Cooke and Rohleder, 2006). One of the prominent benefits of the ILS system is that it provides a risk control process for the business. The detail of each process is briefly described below (*ibid.*):

- **Identification:** the organization is sensitized to learning from incidents and deviations from normal behaviour.
- **Reporting:** An incident can only be investigated if it is reported comprehensively and accurately.
- **Incident investigation:** involves examination of the site, interview of witnesses, gathering and evaluating all available data to establish the sequence of events and to determine the root cause of the incident.
- **Corrective action implementation:** is required to eliminate systemic and root causes of incidents.
- **Incident recall and visualisation:** this process is valuable for stimulating ideas and reinforcing learning amongst team members.
- **Capture and communicate the learning:** from the incident, including the effectiveness of the corrective action.

4.3 Lessons Learned for Major Projects

A paper on "Lessons Learned in Engineering Development for Major Projects" was delivered at the annual meeting of AACE International Conference in 2011 (Zein, 2011). The author and his team developed a lessons learned map from challenges faced by five major refinery projects during the front-end engineering and design phase that led to significant performance issues. The lessons learned on these projects were generated using workshops at close out, a series of questionnaires to the project team and personal interviews. The results were then analyzed and categorized into four different main categories, namely front-end loading development; project execution; project controls and estimating; and organizational capability and alignment. The lessons learned that were generated were focused on the team's understanding of the business priorities, the level of scope definition and the impact of the environmental regulations on the scope and schedule. Of particular interest in the study were the lessons identified for quality management of projects; one being that the establishment of a lessons learned register for projects is essential to ensure continual improvement.

4.4 An Accident Model Based on Systems Theory (STAMP)

"The Systems-Theoretic Accident Model (STAMP) was designed to identify lessons learned from systems and its premise is that system theory is a useful way to analyse accidents, particularly system accidents" (Leveson, 2004:12). The STAMP framework is based on the assumption that an ineffective control structure is the root cause of an accident; and therefore accidents or unforeseen events can be prevented with effective control system and theory. In STAMP, systems are viewed as interrelated components that are kept in a state of dynamic equilibrium by feedback loops of information and control (*ibid*.).

4.5 Transportation Lessons Learned

The Kentucky Transportation Center of the University of Kentucky was tasked to benchmark and design a centralised, web-based lessons learned system for the Kentucky Transportation Cabinet that collects, archives and disseminates lessons learned for the design and construction of roads and bridge ways (Goodrum, Yasin and Hancher, 2003). The model was designed to accept both texts and attachments through file uploads and it can be integrated into an existing post-construction review process. During the primary phase of the project development process, the system will be used to identify constructability issues through an online query function. The system requires implementation within a process before it can be effective in improving the performance within an organization. The user cannot query across multiple databases within the system (*ibid.*).

4.6 CALVIN

Context Accumulation for Learning Varied Informative Notes (CALVIN) is a system that stores lessons about how to learn information, and captures lessons about where and how to find information relevant to the user's decision-making. These lessons are used to provide future users with suggestions of relevant information resources (Leake, Bauer, Maguitman and Wilson, 1999). "CALVIN possesses the capability for users to add textual annotations to resources describing important points, and uses concept mapping tools to provide a map for the user's growing knowledge of the domain as research progresses. As the user browses documents, CALVIN maintains a global context consisting of the user-selected task and topic indices and the keywords extracted from the resources the user has viewed. The system captures records of the resources that are useful in a given context, to facilitate future research by the same or other designers" (*ibid*, p.2). Williams (2004:278) states that "the use of mapping tools has been found useful in showing the chains of causality set up in a project, and particularly where feedback is set up causing dynamic behaviour which is difficult to predict intuitively".

5. Design Principles of a Lessons Learned System

The principles employed for the design of a lessons learned system for Eskom were based on the process demonstrated in Figure 3; and the operating characteristics derived from the global lessons learned systems, and from academic research, served as input to the user requirements specification and functional design of the system. Figure 3 indicates that a lessons learned system consists of five sub-systems, including collection, verification, storage, dissemination and reuse or implementation (Weber, Aha and Becerra-Fernandez, 2000:1).

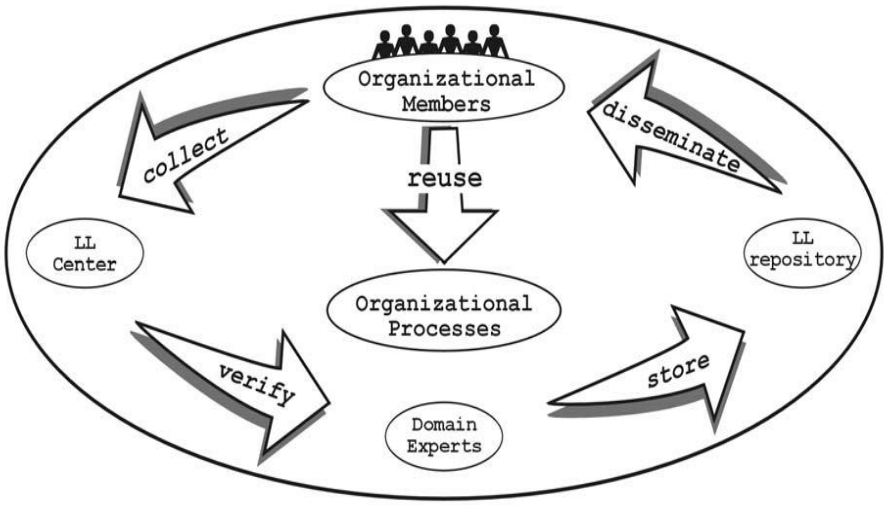

Figure 3. Lessons learned process (Weber *et al.*, 2000)

Design Principle 1: Collection of data and information

The collection of correct, timeous information is an important design element of lessons learned systems. The quality of information, and the timing for its capture, are both important considerations (Mohammad, Zakaria, Ching and Fung, 2005). Schindler and Eppler (2003:220) argue that "the risk of a *knowledge loss at a project's end* is a serious problem for organizations" and they identify the regular capture of project experiences directly after important

milestones, as a key success factor of a lessons learned system. Weber *et al.* (2000:2) identify five potential methods for information collection, namely:

1. Passive Collect, where organizational members submit their own lessons using a template.
2. Reactive Collect, where lessons are obtained through interviews.
3. After Action Collect, where lessons are collected during or near completion of a project.
4. Active Collect, where processes are scanned in search for lessons.
5. Interactive Collect, where lessons are identified via a dynamic, intelligent elicitation system.

Kotnour (2016:395) identifies inter-project learning and intra-project learning for projects: "Inter-project learning is the combining and sharing of lessons learned across projects to apply and develop new knowledge" and "intra-project is the sharing of knowledge within a project". Schindler and Eppler (2003) add three documentation-based methods for collecting information, including micro-articles, learning histories and RECALL. Micro-articles require the originator to write small articles of half a page to reflect project experience; and learning histories involves a storytelling approach by describing relevant experiences from the view of the involved individuals. RECALL is an approach using a database front-end to collect lessons learned (*ibid.*)

Design Principle 2: Validation and verification of captured lessons learned

Schindler and Eppler (2003) suggest that original lessons should be verified and validated by a team of experts or by experienced team members. Weber *et al.* (2000:1) agree and state that the objectives of validation and verification are to ensure "correctness, redundancy, consistency and relevance"; to integrate or adapt complementary lessons; to remove irrelevant lessons; return incomplete lessons to the originator; or archive lessons that have been raised previously. The objective of this exercise is to ensure that the project team has reached consensus that the identified and recorded lessons are "a key insight that should be considered in future projects" (Schindler and Eppler, 2003:220).

Design Principle 3: Storage and representation of lessons learned

The design criteria to be considered in the storage and representation of lessons learned include indexing of lessons, coding and categorization, formatting, and the structure of the repository's framework (Weber *et al*., 2000). Representation of lessons may be graphical, in text and / or coded. Schindler and Eppler (2003) state that the codification of project lessons is usually limited to occur at the end of the project, if it happens at all. Therefore, coding or categorization of lessons as an important characteristic for design should occur during submission or validation of the lesson.

Design Principle 4: Dissemination of lessons learned

Figure 3 indicates that a lessons learned system should be cyclic and iterative and contain feedback loops. Williams (2003) states that feedback systems and modelling are required in large projects to identify the cause of complex and messy problems. "It is important to recognize causal structures and particularly feedback loops quickly, and hone in on those loops during the analysis that identify lessons quickly and efficiently" (*ibid.*, p.277). Cooper, Lyneis and Bryant (2002; as cited by Williams, 2003) state that it is imperative that efficient dissemination and reporting processes are designed to ensure that the correct feedback to organizational members occurs timeously and effectively. Schindler and Eppler (2003) support this design requirement by affirming that iterative evaluation and analysis of project experiences are a key success factor of lessons learned.

Weber *et al*. (2000:2) list five methods for the dissemination of lessons:

1. Passive dissemination, where the search system for a lesson is a stand-alone tool.
2. Active casting, where the lessons are broadcasted to potential users via a dedicated list server.
3. Active dissemination, where users are pro-actively notified of relevant lessons.
4. Proactive dissemination, when the system is built such that events on the user's interface are used to predict when to prompt for relevant lessons.
5. Reactive dissemination, when the users search for lessons if and when they need additional knowledge.

Design Principle 5: Implementation and reuse of lessons learned

One of the primary challenges for the effective implementation of lessons is that a lessons learned system is often isolated and not integrated into existing business systems. Schindler and Eppler (2003:219) state that "our research with various project teams over the course of three years shows that knowledge and experiences gathered in different projects are *not* being systematically integrated into the organizational knowledge base". They recommend that lessons and consequent learning should be integrated into project management as a standard practice and that the lessons learned system should be formalized. Kotnour (2000:394) concurs and offers the Plan-Do-Check-Act cycle as a model that can be followed for the learning process in a project environment. Another suggestion for effective implementation and reuse of lessons is from Cooke and Rohleder (2006) who implemented the Incident Learning System as a risk assessment and management system and lessons can therefore be integrated with the company's existing risk system and managed according to pre-established procedures.

6. Design of the Eskom Lessons Learned System

6.1 User Requirements Specification

Table 1 provides the key operating characteristics that were extracted from the desktop benchmarking. These served as input to the user requirements specification and functional design of the lessons learned system for Eskom Quality Management and Business Excellence Division. Initially, some characteristics were excluded from the design as determined by the-then resource capability of the organization.

Table 1. Key operating characteristics and user-requirements for the Eskom lessons learned system

Lessons Learned System	Key Operating Characteristics	User Requirement Specification for Eskom Lessons Learned
NASA Lessons Learned Systems (LLS)	- The system is an online, automated database.	- Design a system that is online and automated employing Hyperwave software.
	- The repository is searchable.	- Collect current lessons learned across the QM division and develop an initial repository that is searchable.
	- Information is drawn from different disciplines across the organization.	- Ensure that all sections of QM are involved in the capture of lessons learned; and reflect the categorization of lessons per Section.
	- The value and usefulness of the system is dependent on continual input of data and information.	- Identify and design systems that collect and record lessons internally to the organization; and through benchmarking with external organizations.
	- Organizational directive is required for the effective implementation of a lessons learned system.	- Develop and formalize the organizational procedures for a lessons learned system. - Develop the knowledge management strategy for QM.
The Incident Learning System (ILS)	- Incidents and near-misses are recorded.	- Include incidents and near-misses. - Include lessons learned and best practice.
	- Formal reporting of incidents is vital.	- Design effective reporting mechanisms for lessons learned internal to the QM Division and external to Eskom Group Capital.
	- Root-cause analysis (RCA) and corrective action are required for continual improvement. - The ILS is a risk system for the organization.	- Include a risk assessment system that employs the Eskom risk matrix; and includes RCA if required. - All lessons to include corrective action.

Lessons Learned System	**Key Operating Characteristics**	**User Requirement Specification for Eskom Lessons Learned**
	- Group visualization and incident recall are effective processes for reinforcing learning.	- Design systems for effective data collection, dissemination and reuse.
Major Project Lessons Learned	- Data collection for lessons was achieved by triangulation, namely workshops, questionnaires and personal interviews.	- Identify and design systems that collect and record lessons internally to the organization; and through benchmarking with external organizations.
	- Categorization of lessons into main project phases.	- Include relevant lesson categorization.
	- Continual learning in projects requires the implementation of a lessons learned register.	- Collect current lessons learned across the QM division and develop a repository that is searchable.
An Accident Model Based on Systems Theory (STAMP)	- Effective control systems and structures are required for prevention of accidents.	- Include validation and verification of lessons. - Design effective feedback loops for lessons.
Transportation Lessons Learned System	- Lessons learned is a centralised, web-based system.	- Design a system that is online and web-based employing Hyperwave software.
	- The model accepts text and attachments through file uploads.	- Include this characteristic if feasible.
	- The system employs online query functions.	- Develop a repository that is searchable.
CALVIN	- The system stores lessons about how to learn information.	- Design a pro-active search function once the system is implemented and operating.
	- The system employs conceptual mapping tools to develop a map for the user as the research progresses.	- Map and design the knowledge management system in Hyperwave.

In summary, the user requirements specifications were defined as follows:

> Design and implement an online lessons learned system and database that captures best practice and lessons learned from internal (intra- and inter-) and external quality- and project management experiences and benchmarking. Categorize the information so that it be relevant to the different sections of Eskom Quality Management and Business Excellence. Ensure that all members of the QM Division are involved in the capture and recording of lessons learned; and include validation and verification by the senior members of the project or divisional team. Establish the current state of lessons learned and develop an initial blueprint repository which can be expanded as new lessons are recorded. Ensure integration of the system into existing risk assessment and management processes for effective root-cause analysis and corrective action. Measure the effectiveness of the corrective action and monitor continual improvement. Develop a documentation management system with input templates and reports for effective communication.

6.2 The Eskom Lessons Learned System

The Eskom lessons learned system was initially designed in Microsoft Excel according to the identified user requirements specification. Once the system was established, it was mapped and transferred to the Eskom knowledge management system in Hyperwave. The lessons were collected actively with interviews, documentation review and benchmarking with externally identified companies; and an initial lessons learned repository was established across the different QM sections. Once the lessons were collected, they were coded to a predetermined categorization schedule per QM section and identified as a best practice or a lesson. The lessons were then validated by a senior sectional team. Once they had been validated, the lessons were identified for action as per the legend below, with the following options: (1) the lesson has already been implemented; (2) the lesson is in progress of implementation; (3) the lesson will be considered for implementation depending on timing and resources; and (4) the lesson is not

applicable and will not be implemented. Figure 4 presents an example of the lessons learned register for the category *Incident Investigation*.

CATEGORY	LESSONS LEARNED / BEST PRACTICE	BP / LL	IMPLEMENT	ACTION
Incident Investigation	NCR numbers must be reflected in the ITP to ensure the timeous completion of corrective/preventive actions.	Lesson Learned	For consideration	To be actioned by QE. Change NCR process. To be managed by Mike Bottom.. Implementation in QM 58 by July 2013.
Incident Investigation	In the workshop environment drawings always take preference over other documented instructions. Process Planners must avoid instructions such as "… i.a.w. procedure or drawing".	Best Practice	For consideration	Can be actioned. Albert Marquart – SASA
Incident Investigation	The required content of the Data Pack for final hand-over must be defined.	Lesson Learned	In progress	In-progress and working successfully.
Incident Investigation	The storage location of the completed Data Books as well as the eventual ownership must be defined.	Best Practice	In progress	Busy with new data book procedure. To be completed by end June 2013.

Figure 4. Eskom lessons learned register

The complete lessons learned register was then submitted to the Management Review Committee, a team of the senior managers representing project and quality management, who determined the financial feasibility and risk of implementing or not implementing the identified lesson with corrective action. If the corrective action was deemed feasible, or if the risk thereof was high enough to demand immediate action, the necessary corrective action would be implemented in all systems and procedures. Figure 5 illustrates the systemic flow of a lesson through the process.

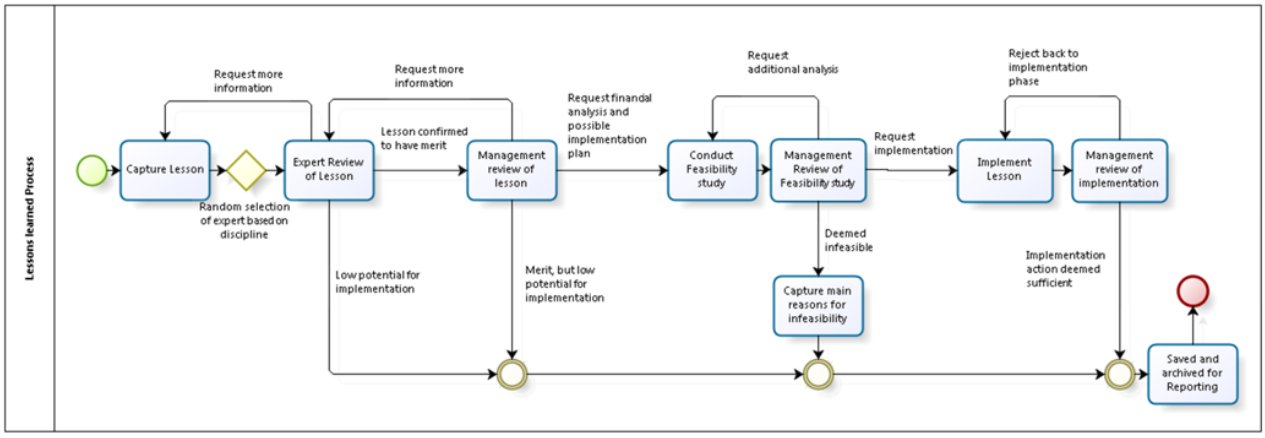

Figure 5. Lessons learned process

6.3 Recommendations for Improvement

The following recommendations were received from the Quality Management teams during the lessons learned verification meetings and were subsequently implemented.

1. Establish lessons learned as an agenda item on each monthly sectional meeting, and submit progress reports to the QM Departmental and Management Review meetings.
2. Establish sectional lessons learned improvement teams that report to the sectional monthly meetings.
3. Appoint champions for the lessons learned teams.
4. Link lessons learned to risk and manage the implementation according to the risk management and reporting process.
5. Continuously Update the Hyperwave lessons learned system.
6. Ensure access for all identified users to Hyperwave lessons learned.
7. The system should be design for simplicity and ease of use and understanding.
8. Ensure that all identified users have the relevant skills to use the system effectively.
9. Recognition should be given to colleagues that use the system continuously and effectively.
10. Ensure that the lessons learned register is reviewed prior to the start of a project.

7. Conclusion

Kotnour (2000:404) concludes from his research that "project organizations should focus on building knowledge because increased knowledge is associated with increased project performance. To support knowledge building the organization must focus on the learning both within and between projects". Knowledge management and continual learning and improvement is an additional requirement also recommended by the latest ISO 9001:2015 Standard (ISO 9001:2015). This paper presents work over three years conducted by the Eskom Quality Management and Business Excellence Department to move towards a learning organization by benchmarking six global lessons learned systems, and then designing and implementing a customized lessons learned system for projects, project management and quality management. The system was later improved and automated and employed as the blueprint for the design of a lessons learned system for the project division of Anglo American Platinum, one of the world's largest mining companies (Anglo American Platinum, 2016); and for the design of QTrac, an automated quality and cost management system designed for BIE International (QTrac, 2015). Qualitative analysis will be conducted in a second paper to validate the design of the system.

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