Project Manager's Role in Manage Project Knowledge Process:
An Approach to Enhance Project Quality

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Abstract

This research investigates the intricate integration of knowledge management in project management, focusing on the quality of explicit and tacit knowledge in generating innovative insights. Through a cross-sectional and case study design, the research analyzes the interplay of project knowledge management in UAE organizations, emphasizing the sources of input for lessons learned and their impact on the quality of project knowledge. Project management, recognized as a knowledge-intensive activity, requires a robust knowledge management framework to improve project success rates. This paper highlights the significance of managing project knowledge from project initiation to completion, emphasizing the critical role of project managers in conducting lessons-learned sessions. It also discusses the importance of a strong knowledge repository and a culture of continuous improvement in achieving organizational excellence. Furthermore, the research explores the utilization of Project Management Information Systems (PMIS) as effective tools for decision-making and risk management in the context of knowledge management. The findings underscore the intrinsic relationship between knowledge management and project success, calling for integrating diverse systems and tools to maximize knowledge utilization and overall project performance.

Key Words: Knowledge management; project management; project knowledge; PMIS; lessons learned.

1 Introduction

Every project creates new knowledge. Knowledge refers to the understanding of the subject acquired from learning or experience, which helps in drawing conclusions, and it is different from information, which refers to the refined form of data. We may say that information is free, but knowledge is not [1-2]. Knowledge can be either explicit or tacit; both are important for lessons learned. Explicit refers to what can be expressed in a word, number, or letter so it can be codified, documented, and stored easily, while tacit refers to the knowledge mind of experts, which depends on experience or belief and cannot be codified. It is worth

mentioning that both are important as each complements the other and supports the knowledge for contexts. Additionally, tacit and explicit knowledge are harmonized, and (new) knowledge is created through a continuous dialogue between the two types [3].

Project Management, according to the Project Management Institute PMI, is "…the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" [4]. Yet, Project Management is essentially a knowledge-intensive activity, and there is a growing interest in how knowledge management integrates with Project Management practices [5]. Nowadays, many organizations consider knowledge management and organizational learning as core aspects of their processes to improve project management's success rate. Therefore, PM will handle Manage Project knowledge process before the project start and throughout the project life cycle, which is essential to accomplishing project objectives, and new knowledge will be recorded as input within OPA, which will be helpful for upcoming project plans. Traditional knowledge management systems are focused on the ability to capture knowledge in centralized systems and make it available at a later date, as per [6].

There are several benefits of such a process, such as to produce or improve project outcomes and knowledge created to support organizational operations for further project implementation. This is essential as success factors differ from one project to another. As concluded by [7], the path to achieving success in project management remains elusive, with no definitive formula in sight. It is likely that there will not be a one-size-fits-all solution, as success hinges on numerous variables that can vary from one project to another and from one organization to another. Also [6], argued that by participating in a collaborative ecosystem of knowledge, organizations, for the first time, can accelerate their learning skills and efficiency, innovation, and agility.

Organizational learning requires the provision of new working models. Such models will either support overcoming concerns that occur as a thread or encourage opportunities. On the other hand, the process is not useful if it is not performed properly since only allocating the budget for the database and assigning a PM time, the organization will be partially engaged and therefore will not get huge benefits, which will be only either limited or gain no visible

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benefits, in fact, they need to invest in cultural and processual aspects to gain massive benefits and proper implementation. If your project team lacks efficient knowledge transfer, this situation leads to wasted activity and poor project performance, as argued by [8]. He added that in many cases, the team will fail to perform roles and assignments as no information management practices are implemented to share and distribute project data.

Project managers play a critical role in managing projects using project management knowledge. Project knowledge consists of new project details required for the project manager and members. Before sharing details with members, a PM must verify Project knowledge inputs like project management plan, project documents, OPA, EEF, deliverables, and others. Moreover, as determined by [9], one of the PM roles is learning from their own or others' experiences, like subject matter expert SMEs, utilizing lessons learned for early warning signs (EWS) and pretested remedies. Therefore, it is evident that the PM is responsible for the success of the project implementation when supported by proper knowledge management practices.

2 Research Methodology

This research utilized two main designs as a framework for collecting & analyzing the data and to provide a plan for the study: cross-sectional & case studies. Cross-sectional design is a research methodology commonly used in various fields, including social sciences, epidemiology, and market research. It involves collecting data from a diverse group of participants or subjects at a single point in time to examine and analyze variables of interest. This approach aims to provide a snapshot or a "cross-section" of the population at that specific moment, allowing researchers to draw inferences about the relationships between variables without the need for longitudinal data collection over time. A cross-sectional design was selected as interviews with six subject matter experts in the project management field were conducted. At the same time, in the case study, we verified the approach used in managing project knowledge in organizations in the UAE. In addition, we benefited from the latest PMBOK 6th edition [10], which has a new chapter to address managing project knowledge, as this helped to enrich our understanding. In this research, the following important questions are addressed;

1. What are the sources of input for lessons learned & what do you expect to know from lessons learned?
2. How do lessons learned enhance the managing project knowledge?
3. What is expected as the outcome & benefit of lessons learned for Managing Project Knowledge?
4. What is the lessons-learned process used, and how can it be improved regarding technology related? Is the process unified in your company?
5. What are the tools and techniques used in the lessons learned process, and how to improve it?
6. Do companies use Project Management Information Systems (PMIS) for Knowledge Management Systems? How do they benefit project managers?
7. How can Managing Project Knowledge support decision-making & risk management?

3 Literature Review

3.1 Manage Project Knowledge

Manage Project Knowledge process is defined as the process of using existing knowledge and creating new knowledge to achieve the project's objectives and contribute to organizational learning, as per the Project Management Body of Knowledge [10]. Manage Project knowledge process performed throughout the project life cycle helps to use existing knowledge, which is required to accomplish project objectives and to create new knowledge that is recorded and will be helpful for upcoming project plans by improving project outcomes and knowledge that are created to support organizational operations for further project implementation.

Organizational learning, or in other words, the lessons learned process, plays an important role in providing new models, which require either overcoming concerns as threads or encouraging opportunities to occur. On the other hand, if an organization partially engages in the lessons learned process by allocating a budget for the database and assigning a PM time only, it will not get huge benefits, which will be either limited or no visible benefits, since they need to invest in cultural and processual aspects to gain massive benefits and proper implementation.

One of the project manager's roles is to manage a project using project knowledge, which is very useful; hence, it has new project details required to implement the project for both the project manager and project members. Project managers are responsible for verifying Manage Project Knowledge MPK inputs like project management plan, project documents, Organizational Process Assets OPA, Enterprise Environmental Factors EEF, and deliverables to take action to ensure the project is completed with respect to project constraints. Moreover, as a project manager is responsible for project implementation and for proper knowledge management practice, one of the project manager roles, as determined by [9], is learning from their own or others' experience, like subject matter expert SMEs. Additionally, utilizing lessons learned for early warning signs (EWS) and pretested remedies. Utilization of this is supported by knowledge sharing using a mixture of knowledge types (explicit & tacit) along with different tools and techniques to support retrieving the data and getting help for making conclusions.

3.2 Lessons Learned and Why We Need Them

Lessons learned are the documented information that contains both positive and negative experiences of a project as learning comes from project failures and successes; thus, lessons learned must be captured as an ongoing effort throughout the project's life [12]. They also argued that learning from failure will help avoid repeating previous similar situations, and learning from success will maximize the opportunity for good processes or practices to complete

existing and future work successfully. Thus, a project manager should strongly encourage the team to have this mindset as this also shows a commitment to project management excellence where well-defined processes to capture or utilize the lessons learned help to benefit.

Lessons learned are essential for data documentation, and it is considered as one of the main inputs of the knowledge management process. Recording the previous faults and defects would assist the project team in examining and analyzing the root causes of each error, which, in turn, will enrich current information databases. [13] stated that when knowledge is shared through social communication channels, some data remains unwritten and unspoken as tacit knowledge. The purpose of the lessons learned process is to ensure that the tacit knowledge is converted into explicit knowledge and stays available and accessible for other people as a reference so they can use it whenever they need it. Moreover, [14] added that lessons learned show both the successful and faulty sides of each project, and it is documented in the managerial summaries and detailed reports. The lessons learned (LL) session is a very important part of the lessons learned process. The project management institute published that the lessons learned are an essential approach to reduce the number of errors in the future, and LL databases can be utilized to store information about project cost, time, and scope for similar projects [13].

According to [15], recording the lessons learned can lead to better planning in the initial stage of the coming projects and can be used to support the analysis of risks. Thus, the project team can rely on the previous documents to define all possible risks and reduce the budget for unforeseen risks. Furthermore, [15] added that the recorded lessons are essential to spread additional information among project team members and other project managers. In addition, he argued that lesson learning could be used to evaluate the performance of top management and project managers as well. Sharing knowledge effectively reduces the main causes of previous schedules and cost overruns; furthermore, lessons learned can be used as evidence to clarify the recorded issues from a managerial and technical aspect.

According to [16], the analysis carried out for their paper has shown that incorporating insights gained from previously collected lessons learned in past project experiences is viewed as a crucial component of project management methodologies.

Lessons learned (part of OPA) and other project details are entered as project knowledge for new project implementation, so it is essential to be managed perfectly by the project manager to have positive project progress. Before the project starts, the project manager can have a session with SME and other project managers with experience in the same project nature to capture and get the latest and useful lessons learned. [12] highlighted that a project kick-off meeting is the best time for discussing lessons learned. Therefore, PMs communicate using different methods, such as storing files in share driver, communicating by email, or meeting with concerned stakeholders about organizational or individual knowledge with three classifications: work, method, and result. During project implementation, areas for improvements obtained from lessons can be found for both organizations as a routine

(policies, regulations, procedures, etc.) or individual as skills, experience, etc., and (working practice) knowledge. Hence, lessons are identified and then analyzed by team members; after that, they will be stored as a new or updated idea as part of new knowledge generation practice, which finally goes to knowledge storage as stored updated lessons learned and to be retrieved for upcoming projects.

Moreover, a Lessons Learned Knowledge bank could be established as recommended by professional institutes to centralize all information gained by each project manager, which can provide benefits for the same category of data for all project managers. Otherwise, an initial database is to be created with the help of experts and advisors, which will include lessons gathered from previous projects. Such a database will support eliminating duplication of the same lessons from different projects. Noting that having a number of occurrences of an issue can lead to defining common problems. Additionally, an organizational database enables the project manager and project team member to retrieve relevant lessons where lesson learned knowledge bank could be maintained by a three stages process:

1. Assessing previous project lessons learned during the planning and delivery phases of a new project
2. Recording lessons throughout the project in project logs
3. Writing lessons learned report not only during the project implementation but also during the project closure phase

Lessons Learned Register details would have new updates once the project is completed, and it will be an input to OPA that can be used for upcoming projects. Such a register will include a category for easy access to certain knowledge, description, impact, proposed actions and recommendations, challenges, risks, and opportunities. Documentation of LL purpose is to share and use knowledge to either:

- Encourage opportunities for desired outcomes.
- Eliminate the occurrence of non-desired outcomes.

As a result, organizations can make significant savings for upcoming projects in terms of time, cost, and quality; the same can be achieved by preventing the repetition of problems and encouraging opportunities. Furthermore, records on this database need to be updated and integrated with new knowledge and remove obsolete knowledge [17]. It is acknowledged that both organizations and individuals tend to learn more from failures than from success [18], and that failures contain valuable information; however, organizations vary in their ability to learn from them [19].

3.3 Lessons Learned Process, Tools, and Techniques

According to [12], there are three levels under lessons learned for organizations that need action and intervention from the project manager. These levels are: Level-1 is the lessons learned process, level-2 is the Evaluation of the Lessons Learned Repository, and level-3 is related to lessons learned metrics.

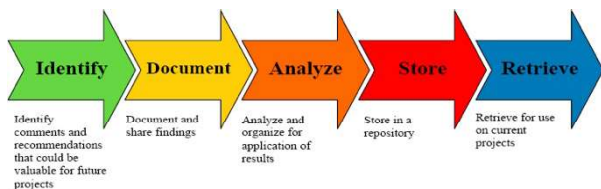Source: Rowe, S. F. & Sikes, S. (2006). Lessons learned:

Figure 1: Lessons learned process

taking it to the next level. Paper presented at PMI® Global Congress 2006—North America, Seattle, WA: Newtown Square, PA: Project Management Institute.

Level-1 lessons learned process:

It consists of five steps: identify, document, analyze, store, and retrieve. These steps are required in order to define activities needed to capture and use lessons learned successfully. Therefore, the project manager needs to encourage the participation of team members to gain higher results.

The first step is to Identify Lessons Learned. In this step, concerns are identified as experiences or recommendations of opportunities that occurred during the existing project. This step consists of two activities: preparing the session and conducting the session. There are three key questions for this step: what went right, what went wrong and what needs improvement; it recommends that the facilitator share what would be discussed earlier and guide the discussion.

The second step is to Document Lessons Learned, where the project manager should report captured lessons learned and inputs from participants from the conducted session, then share it with stakeholders in detail, and submit a summarized report to management while the final report should be included with the other project documentation.

The third step is about analyzing lessons learned, where analyzing and organizing of captured lessons learned would take place as this includes needed training or improvement in the project management process.

The fourth step is to store lessons learned. In this step, the Lessons Learned Register could be updated with the outcome from the above-mentioned step. The same can be included in project documents or project share folder/drive to have feasible access to all team members. Also, update or store to be with an appropriate keyword search capability to ease retrieving appropriate lessons.

The fifth step is to retrieve lessons learned. The lessons learned process is to retrieve lessons to be used for either running projects or upcoming ones to overcome issues or encourage opportunities. Retrieve should be for most appropriate and updated data.

Level-2 Evaluation of Lessons Learned Repository:

Effective tools and starting analysis of stored lessons learned are what organizations need at level 2. Where the process became part of organizational culture. Although organizations consistently capture lessons learned, they are not fully utilizing them, as noted by [12].

Based on the lessons learned process, identified, and gathered data are collected in the organization's repository, which is the project manager's primary responsibility. In level 2, the project manager and others involved will start the analysis of available documents in order to provide action to raise project knowledge and implementation. For a successful analysis, it is important to empower the person doing the analysis to enable him or her to implement the approved solution. Therefore, there is a need to enhance such tasks by enhancing the project manager and member's knowledge with specific training. Additionally, existing processes or procedures may require changes to adapt to new setups, and it is worth mentioning that there should be a unified template called lessons learned inputs forms as a key tool to have consistency of input that plays an important role in identifying recurring issues and providing proactive solutions, see Figure 2.

Figure 2: Lessons learned template

Source: https://vgpblog.files.wordpress.com/2015/03/ lessons- learned-plan-value-generation-partners.png.

Such templates should be shared with project members during team sessions that include previously defined fields like category, lessons learned, action taken, results after action taken, root cause, and keywords. Such identification needs to be added to the lessons learned repository.

Based on gathered data, different types of reports are classified as levels 1 and 2. Lessons learned detailed and summary reports obtained from the session that could be shared immediately with stakeholders fall under level 1. On the other hand, a level 2 report can be found as a detailed report, having responses gathered during sessions for each lesson along with findings as recommendations. Then, approved actions need documentation in detail while implemented.

Figure 2 shows a sample of how the template looks, and it could be customized based on need. A real example captured from the interview can be found in the appendix.

Level 3: Lessons Learned Metrics

The executive level is mainly interested in metric data for further approval and decision. Therefore, it is essential to convert obtained data from the completed analysis to metrics since executives seek the "Evelyn Woods Speed Reading Technique" or equivalent due to their busy schedules [12]. Subsequently, an executive lessons learned report requires clear data and information supporting expediting approval or decision-making. Such a report can contain the first page as an overview of analyzed data and recommended next step, and the following two pages can have graphic presentations such as a pie or bar chart with a clear legend in order to

reflect data registered on the first page, providing a clear picture of what was wrong and how it changed after correction action. Therefore, effective metrics reports will be generated and available as key achievements that capture consistent and maintained lessons learned from a centralized repository.

Generally, in order to achieve higher outcomes, a group of team members, SMEs, and other project managers must work with project managers to document the lessons learned to ensure that all elements and issues are recorded. In addition, the assigned group will help project managers revise the important files and key findings, which will facilitate the analysis of captured data, and they will be able to distinguish between several types of faults related to similar projects. In addition, sharing the lessons learned and discussing the previous defects is essential to strengthen the social relations between project managers and all stakeholders and enhance their ability of thinking and negotiation skills.

Overall, achieving an effective metric report depends mainly on the quality and type of data captured in lessons learned, which must be consistent and maintained in a centralized repository.

3.4 Lessons Learned Tools and Techniques

There are several tools and techniques that the project manager or facilitator can depend on to gather data needed for knowledge management, which contain both explicit and tacit knowledge [10].

1. Subject matter expert or expert judgment guidance and feedback
2. Knowledge management
3. Information management
4. Gather feedback from project team members by way of formal and informal interviews
5. Use closed focus groups to develop lessons learned
6. Keep an active register for the lessons learned
7. Share lessons learned with peers in other projects
8. Continuous research into new methods for achieving similar projects
9. Emails and meetings
10. Collaborative tools such as portals, surveys, and data capture forms to gather lessons
11. Relevant information from other projects
12. Organizational learning

3.5 Improvement of Lessons Learned Process, Tools and Techniques

Deming's Cycle, or PDCA, is a simple, straightforward process that is recommended to be used for improvement concepts. From PDCA we can have and improve lessons learned and use lessons learned in a continuous life cycle. Indeed, to increase the project success rate and develop organizational learning, the lessons learned process needs to be improved.

One of the most important steps for improvement is to capture LL throughout the project life cycle and not only at the end. So, the PM should encourage all members to

participate and record such learning (best practice and area for improvement) from failure or success; the same is applicable and useful to improve the process, which is considered part of procedures and expected deliverables from project management. Additionally, recommendations for best practices are to be included in the summary and in the first paragraph of any executive report to enhance organization processes and procedures.

Through a cycle of continuous learning, a culture of successful projects can be created as this helps to avoid making mistakes or reinventing the wheel at each project start, [13]. Hence, the 5-step continuous process for capturing knowledge is recommended to be used by project managers and Project Management Offices PMO, as shown in Figure 3.
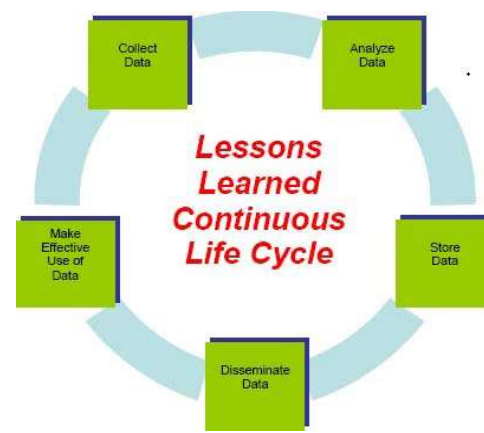

Figure 3: Lessons learned continuous life cycle

Source: Trevino, S. A. and Anantatmula, V. S. (2008). Capitalizing from past projects: the value of lessons learned. Paper presented at PMI® Research Conference: Defining the Future of Project Management, Warsaw, Poland. Newtown Square, PA: Project Management Institute.

3.6 Culture and Social

For team members to generate ideas and share them for improvement or reporting matters related to lessons learned, they need to be motivated; therefore, the PM should ensure the motivation of the team members and build a trustworthy environment as well as be aware of individual's responsibility, expertise and influence, authority levels and their awareness regarding organization policies. Knowledge transfer and learning occur through social, situated learning, and de-coupling the lessons learned process significantly reduces their value [20]. Project teams' social capital is conducive to overcoming barriers to learning in project-based organizations [21].

As per [10], Face-to-face interaction is usually the most effective way to build the trusting relationships that are needed to manage knowledge, and there is an important role of political awareness as it helps the project manager to plan communications based on two aspects, which are project environment and political environment. Additionally,

leadership should encourage project stakeholders to use the process, tools, and results [12]. The project manager is responsible for conducting lessons learned sessions for all projects with key internal and external stakeholders and the need to align environmental culture and project culture [22].

For example, the culture and method in the agile project lie in leveraging team knowledge and producing deliverables, which shows that some of the practice is inbuilt knowledge-sharing mechanisms. Also, this emphasizes that face-to-face interaction is more effective for knowledge sharing and building relationships of trust and respect among the team. This is supported by the finding of [5] as face-to-face interactions and agile approaches facilitate knowledge transfer and strong relationships between them.

Figure 4 shows the integral model for Enterprise Environmental Factors (EEF) that can influence managing project knowledge [23].
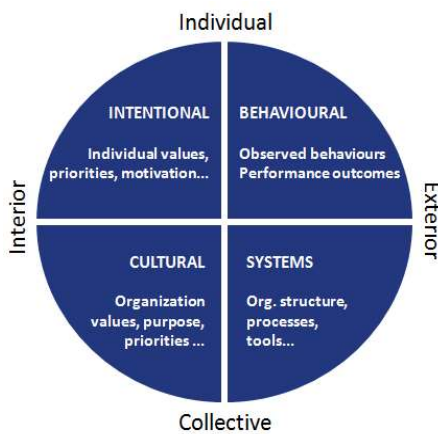

Figure 4: Model for enterprise environmental factors

Source: Rowley, J. (2018), 6th Edition PMBOK® Guide– Process 4.4 Manage Project Knowledge: Inputs. Available at: https://4squareviews.com/2018/02/03/6th-edition-pmbok-guide-process-4-4-manage-project-knowledge-inputs

Cultural - The need to share knowledge in a relationship of trust among all team members and stakeholders to allow managing knowledge

Systems - Show how the team's location affects the knowledge share and how its knowledge plan is to be accessed and shared, along with the level of confidentiality of project information and who to identify the people who specialize in knowledge management.

3.7 Project Management Information Systems (PMIS)

Lessons Learned Database Software is a project management solution, and cloud-based knowledge created by sector-solutions helps businesses capture experiential knowledge from key projects. It is a tool that discovers and manages valuable content and categorization and will be available anytime for staff. Project management information systems can be utilized as an effective tool for project planning and monitoring of phases. Furthermore, [24] argued that project management information systems are useful for project managers as they store and organize enormous amounts of data. Implementing such systems can facilitate the managing process of simple and complex projects; below (Figure 5) is an example of a project dashboard using Primavera PMIS, where we can fit project size based on its simplicity or complexity.
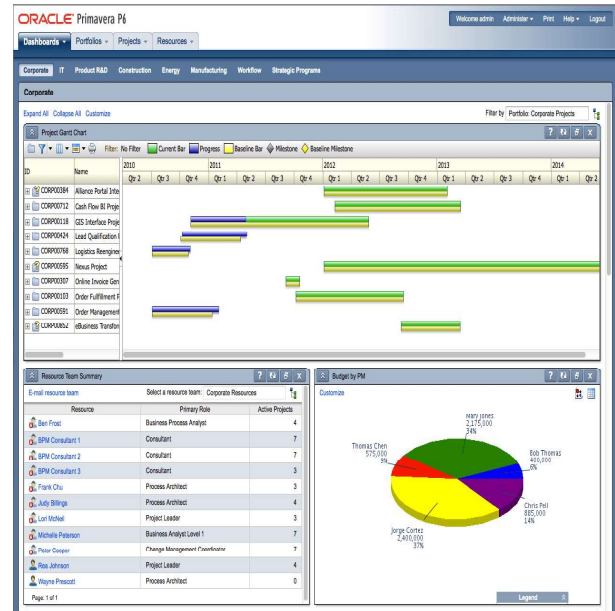

Figure 5: Primavera   project   management   information
           systems

Source: Powerful Tools for Global Project Planning available   at: https://www.oracle.com/ae/applications/ primavera/products/project-portfolio-management

In addition, integrating the lessons learned through project management information systems can increase information availability, which is essential for short and long-term planning and decision-making. Furthermore, the collected data's size and accuracy affect the managerial decisions' efficiency. Additionally, [25] mentioned that self-hosting applications require a specialized person to effectively manage financial and human resources. The study covered a sample of 100 project managers selected from different countries in Europe, the Middle East, and Africa (EMEA). The results showed that the level of satisfaction with the current project management information systems was above 60% in Western Europe and the Middle East and 72% in Africa. The level of satisfaction per industry from the highest to the lowest: information system (79%), manufacturing (77%), construction and government (71%), energy (55%), and defense (45%). The participants mentioned some limitations correlated with the current systems, such as the lack of uniformity and integration with enterprise resource planning (ERP) and insufficient support to access open-source folders.

On the other hand, they mentioned some compelling features for lesson learning and data storing. For instance, they added that PMIS could be utilized to create risk registers, implement an earned value management that focuses mainly on evaluating the actual performance against

the planned one, and provide a technical support during project planning.

Integrating all systems and tools for knowledge management to maximize the benefit is very important. Although some companies have systematic learning to provide competency, they fail to use it effectively [26].

3.8 Managing Project Knowledge Can Support Decision-Making and Risk Management

"Those that fail to learn from history are doomed to repeat it." Winston Churchill (1874-1965). Managing Project Knowledge will have updated Lessons Learned Register, which include type, description, risk level, occurrence, solution, proper process, etc. that can expedite decision-making and action to perform for similar concern. Regarding risk management, it supports overcoming issues by being proactive to eliminate issues from occurrence. For cases with multiple occurrences, it provides an indication to verify the root cause and ways to eliminate occurrence.

3.9 Project Knowledge Management Best Practices

Following is knowledge management as best practices that can be obtained from lessons learned, which are critical for projects and support decision-making and risk management [22].

1. Align with The Sponsoring Organization's Knowledge Management Practices - Avoid reinventing knowledge management and engage the sponsor company knowledge management practice
2. Use Existing Knowledge - Project teams must quickly familiarize themselves with the organization's knowledge as an essential aspect of the project. Failing to understand the organization's existing knowledge can lead to potentially explosive political situations. For instance, it's crucial to avoid allocating resources to a feasibility study that has already been completed or inadvertently contravening the organization's established strategy and best practices
3. Validate & Assess Knowledge - Validate and assess the existing knowledge prior to using it.
4. Be as open as possible with project knowledge - This is to ensure the reduction of any resistance to the project
5. Communicate & Socialize Knowledge Deliverables - Use the different methods for communication at the right time and in the right way
6. Establish Project Principles That Layout Your Knowledge Management Approach - This will be a guideline to help everyone follow
7. Identify the long-term owners of knowledge - Set a clear process to hand over the knowledge to the company as the project is transitional
8. Integrate Project Knowledge with Organizational Knowledge - Connect and combine both project knowledge & organization knowledge

4 Data Collection

The qualitative approach has been used to represent the participant's point of view since inductivism theory emerged from obtained data. Interviews with six subject matter experts in the project management field have been conducted. The candidate answered seven questions. These data, in addition to data obtained from PMBOK 6th edition [10], articles from the internet, and research papers, were used to support obtaining a more rounded and clearer picture regarding our research topic.

4.1 Source of Input for Lessons Learned and Expect to Know

Lessons learned captured during the course of the project from all stakeholders involved are essential to be managed perfectly by the project manager to have positive project progress as per [27] and this need to capture various incidents and stages during the project as it may have both positive and negative points, risks handled, etc. and can serve as a guide and reference to future project managers [28] [29].

As per the interviewees, there are several sources of input to lessons learned that can be helpful to add to the Lessons Learned Register such as;

- Failed projects, processes
- Mistakes made during projects
- Success during projects
- Alternative/solutions generated during projects
- Encountered problems and remedies implemented
- The previous Lessons Learned Register
- Staff meetings & different social source
- Detailed analysis of project variance or deviation by dedicated team
- Study of historical project data and processes.
- Subject matter expert advice

In [27], believes that Enterprise Environmental Factors (EEFs) must be considered as they could provide either opportunities or threats to any project. These details will be added to the Lessons Learned Register with some of the specifications and categories such as type, description, risk level, occurrence, etc.

4.2 How Do Lessons Learned Enhance the Managing Project Knowledge and the Benefits

In [28] and [29] advised that lessons learned serve as a reference and help set benchmarks for future projects as they document the events, risks, problems, solutions, etc.; [30] added that it enhances project managers' knowledge, experience and enhances risk management, which enhances project maturity. This is supported by implementing new processes and enriching the project knowledge as lessons learned build the knowledge base, [31, 32, 27] highlighted that lessons learned help avoid repeating the same errors committed in the previous project, analyze the scope of improvement, and reduce risk, cost & time. These incrementally add to project knowledge and support the continuous improvement of the project management processes. This results from the right storage and files to ease access to lessons learned and have data analysis for what was learned, according to [30].

[27] added an example for that: if an issue occurred while the project was implemented and the same was already recorded in the Lessons Learned Register, then fast response and proper action can be taken to put the project back on track while this may take more time in case of no previous knowledge was there.

4.3 Expected Outcomes from Lessons Learned

Based on multiple feedback from interviewees, the section below summaries the significant contributions of lessons learned;

- Lessons Learned Register that supports in reusing existing knowledge and creating new knowledge.
- Enriched Lessons Learned Register with new update
- Opportunities for improvement
- How to improve
- Enforces what has been done well
- Mistakes committed in the project
- Problems that could have been avoided
- How to archive data
- How to avoid future project risks
- New processes or frameworks of improvement
- New and improved ways to achieve/implement similar projects
- Achieving similar projects faster and more efficiency
- Savings in projects due to possible reduced timelines and wastage
- Create & update the company repository

4.4 Lessons Learned Process Used and How It Can Be Improved

The lessons learned started from day one of the project and even before that while lessons learned from previous projects have to be shared and communicated with team members in the kick-off meeting, as well as to be visible any time for them to obtain great results as advised by [27] [29]. It also includes other processes like change requests, reporting, documentation, etc., and classifying the lessons as all to be updated in the Lessons Learn Register. In [32] added that each project is implemented in accordance with expert opinions, decisions, and support from subject matter experts together with historical data or trends.

This will keep the register always updated including need modification to existing details; hence, this will be an input to Organization Process Assists (OPA) while taking into consideration that details are captured throughout the project life cycle as these lessons are observed and identified from staff who are handling project implementation or project progress report thus it is not only at the end of the project while each team member as the team may forget later what they need to update so this will give them clear guidance to do their works under consultation of project manager for any concerns and to ensure collected data is stored [27] [30].

In [27] added that after identifying the concern, it has to be recorded in the project Lessons Learned Register before starting to analyze them with the support of the subject matter expert, followed by appropriate corrective action to proceed further. After that, the register will be updated once

the issue is cleared and finalized. It is important to use them correctly based on the right analysis, as per [30]. According to [29], projects should not be closed formally without documenting and reviewing lessons learned along with approval from relevant leadership as this creates governance; hence, this needs formal meetings to close any project along with minutes of meetings that are distributed and followed up.

Furthermore in [27] believes that the process in Etisalat varies among different sections due to the different nature of works and details, but generally, it's almost close to each other's. On the other hand, [30] advised that Project Management structures are independent in each division but supported by the back office for Technical Project Management (TPMO) responsible for unifying the processes of managing projects and having the right tools. The overall process summarized by [32], is identify, document, analyze, store, and retrieve while [31] added some steps as;

- Gather feedback from project team members by way of formal and informal interviews
- Use closed focus groups to develop lessons learned
- Keep an active register for lessons learned
- Share lessons learned with peers in other projects
- Continuous research into new methods for achieving similar projects
- Emails and meetings
- Collaborative tools such as portals, surveys, and data capture forms to gather lessons

Lessons learned process can be improved as per [27], by applying and implementing a Workforce Management system (WFM) as well as risk simulators; hence, there will be an indication of upcoming shortages of resources, time, or other factors and usage of big data and AI would improve the lessons learned process to the most as per [30]. Also, [31] added that ideal unification is required for shared knowledge within an organization; then on completion of every project, lessons learned are recorded, and team meetings are called to discuss various risks encountered, variance from the baseline of the project, and how we can bring about improvement, [32]. Lessons learned as per [29], should be incorporated into the KPIs to ensure that PMs actually look at and show sufficient evidence that they have tried to mitigate future risk based on the lessons learned.

4.5 Tool and Technique

According to [28], the process is done by recording the lessons in an Excel file with a template which includes a record of events, successes, failures, risks encountered, mitigation steps taken, and recommendations or improvements; thus data collection, data analysis and data storage is done based on this. [27] added that this is done by having a shared folder for each project as well as having a single database for project risk and stopper that is updated by the back office team, with respect to their observation, staff reporting from the field, or subject matter expert. He added such experience and correction action shared by different communication methods such as email, share folder, or verbal communication (call, meeting, etc.) with all

concerned members. Furthermore, [31] added the use of collaborative tools such as portals, surveys, and data capture forms to gather lessons.

According to [27], there are different systems used but do not integrate all project parts and lack end-to-end solutions as each system has some portion of data, and the same is shared by [28]. Furthermore, [29] mentioned that ADCCI does not use Project Management Information Systems PMIS but they have developed a governance to provide data and analytics regarding project management to leadership as this is mainly in the form of manual reports that are based on MS Project schedules and weekly meetings.

Also [27] added that improvement can be obtained by having a PMIS system that can capture and provide an indication for abnormality, which also provides a guideline to overcome issues that were added from previous experience. In [30] is mentioned that Etisalat is in the process of procuring PMIS to support project managers to have smart and mobile access to multiple projects and program documents while [31] advised that this section already has PMIS which is fed by multiple projects' owners, allowing project managers to avoid similar mistakes made by others already.

4.6 How Managing Project Knowledge Can Support Decision-Making and Risk Management

According to [28] [27], managing project knowledge includes an effective recording of lessons learned and project experiences that will speed the decision-making, help deal with similar situations, anticipate possible risks, previous solutions, and effectively efficiently manage the project. Knowledge management provides a way to treat knowledge as an asset, transfer data, and benefit from lesson learning for future projects, as per [30]. He added this can support in reducing risks and continuous improvement in project performance. In [31] it was stated that the team will avoid issues and support to minimize risk by intelligence from data gathered from lessons learned.

In addition, [27] believes that it supports overcoming issues by being proactive to eliminate issues from occurrence. For cases with multiple occurrences, it provides an indication to verify the root cause and ways to eliminate occurrence. According to [29], a good repository of knowledge is vital to decision-making as proper decisions need to be supported with knowledge of past, present, and forecasting future events as this becomes a norm in an organization if there is Knowledge-Based decision-making and also applicable from a risk perspective as it provides the ability to estimate or foresee what may happen in the future by looking to previous situations, events, and experiences. He added that project knowledge is also important to estimate project budgets and contingency based on previous projects.

5 Analysis

5.1 Knowledge and How to Maximize Its Benefits by Project Manager

Every project creates new knowledge which can be either explicit or tacit, where both are important for lessons learned. It is worth mentioning that both are important as each of them complements each other and supports to cover the knowledge for contexts. This project management is "...is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" [4] as it promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all information, which includes what was unrecorded such as expertise and experience. This is very important for the benefit of the project to avoid mistakes and help the project manager avoid reinventing the wheel every time they initiate a project as it leads to faster and more effective decision-making for the project manager, facilitating him to get needed approval. Subsequently, it makes the project team more competent with a better understanding of project requirements based on knowledge as this knowledge is a mixture of stored documents or data and interactions between people.

Thus, as a first step towards improving existing practices in the future, it is essential for the project manager to increase his understanding of how project management activities are supplemented by knowledge management activities. The knowledge and lesson learned should include both positive and negative experiences of a project as the project manager and his team should learn from project failures and project successes; thus lessons learned has to be captured as an ongoing effort throughout the life of the project and the project manager has an important role her to ensure that however to maximize the benefit, the project manager should look beyond database or record as cultural and processual aspects are very essential to consider to gain massive benefits and proper implementation. Putting attention to Enterprise Environmental Factors (EEFs) provide either opportunities or thread to any project as these details will be added to the Lessons Learned Register with some specification and categories such as type, description, risk level, occurrence, etc.

5.2 Source of Knowledge and Role of Project Manager

There was an alignment of data obtained from literature and interviewers that the project manager is responsible for verifying Manage Project knowledge MPK inputs like project management plan, project documents, Organizational Process Assets OPA, Enterprise Environmental Factors EEF, deliverables to make action to ensure project completed in respect to project constraints. All interviewers agreed that lessons learned can be utilized to minimize the percentage of errors in the future, so this can be obtained by better planning during the initial stage of new projects by eliminating risks and encouraging opportunities to occur. As elaborated by [28], it will help organizations enhance project execution by eliminating mistakes and problems that could occur. The same was echoed by [27], who mentioned by lessons learned we can increase the success rate for upcoming projects. Therefore, [29] considered having knowledge of previous projects to be key to future project success, so highly advise the importance for others to review available lessons learned at the beginning of any project. In [31] is advised the main area for a project manager to focus on while creating and adding inputs for the Lessons Learned Register:

- Mistakes made during projects
- Success factors during projects
- Processes forces towards failure or success of projects
- Alternative solutions generated during projects
- Encountered problems and remedies implemented
- How to avoid future project risks.

Before starting, the project manager can benefit from meeting with SMEs, and other project managers who have experience on the same project and from lessons learned and this could be before or during the kickoff meeting; however, he needs to ensure that managing knowledge is performed throughout the project life cycle help. The project manager should strongly encourage team members to participate and share their knowledge and experience to gain maximum benefit as this can be done via many mechanisms such as meetings, interviews, focus groups, etc. to support the transfer of project knowledge and share information across the team. There are several tools and techniques that the project manager or facilitator can depend on to gather data needed for knowledge management, which contain both explicit and tacit knowledge [10]. Furthermore [33] found that 64% of participants in an experiment reported having learned from the documents filed by their peers; however, only nine percent were willing to contribute to the documentation due to the time and level of effort required.

One of the project managers' main difficulties is managing lessons learned during the project. While 62.4% of organizations have formal procedures to document lessons learned, 89.3% of organizations are not doing it [15]. In [34] it was found that the main causes of the lack of documentation of lessons learned on projects are time, motivation, discipline, and skills. The project manager should ensure motivating the team members and build a trustworthy environment; hence, in order to create this environment, the project manager must know about team members, their positions and responsibilities, stakeholders, their level of expertise, and their ability to influence, about organizational policies around knowledge/information sharing, and his own authority to take necessary actions to create the environment in the team in addition to knowing if the sponsor has a dedicated team or department that help in knowledge management. These incrementally added to project knowledge and supported the continuous improvement of project management processes.

This is critical as project managers can't force people to share everything they know as even the best knowledge management tools will not help unless people feel motivated to share their knowledge. The ability to manage will reduce the burden on the project manager's role as the job becomes easier if he understands how to transfer project knowledge and share information across team members. He needs to focus more on face-to-face interaction as it is usually the most effective way to build the trusting relationships that are needed to manage knowledge as this supported practice in agile projects as the culture and method in agile projects lie in leveraging team knowledge and producing deliverables which show that some of the practice is inbuilt knowledge-sharing mechanisms.

5.3 Knowledge Process and Project Manager Role

The project manager has to focus on three levels for lessons learned which are;

- Level-1 is lessons learned process
- Level-2 is evaluation of lessons learned repository
- Level-3 is related to lessons learned metrics

In Level 1, there are five steps: identify, document, analyze, store, and retrieve as represented in figure 1 as this has to be a continuous cycle involved by all teams. The project manager should ensure governance of the participation of all concerned team members.

In Level 2, the project manager should ensure that there is an analysis of stored lessons learned and ensure to utilize them in order to provide action to raise project knowledge and implementation. Adding to this, the project manager needs to ensure the integration of existing knowledge with new knowledge and the removal of obsolete knowledge. Also, he needs to empower the person who is doing the analysis with a kind of power to enable and implement approved solutions or enhance the skill of the team through specific training.

In Level 3, the metric has to be designed and mapped to knowledge since the executive level is mainly interested in metric data for further approval and decision. Therefore, it's essential to convert obtained data from completed analysis to metrics. Overall, achieving an effective metric report depends mainly on the quality and type of data captured in lessons learned, which need to be consistent and maintained in a centralized repository.

The project manager plays a critical role in managing the project using project knowledge, which is very useful; hence if the project team suffers from a lack of efficient knowledge transfer, then this situation leads to wasted activity and poor project performance before and during project execute, the project manager needs to do something in parallel, collect, store and manage knowledge along with project deliverable to gain success. He must also ensure that capturing project lessons learned is part of procedures and an expected deliverable from your project management and product methodologies. They must ensure that project teams work together to document project best practices and areas of improvement for the next project. Then, identifying any concerns that have to be recorded in the project Lessons Learned Register prior to starting analyzing them with the support of a subject matter expert followed with an appropriate correction action to proceed further. After that, the register will be updated once issues are cleared and finalized. It is important to use them correctly based on the right analysis.

It is clearly observed from the interviews that there is no unified concept; hence, the Project Management Structure is independent in each division in Etisalat. For example, [30] elaborated on the need for back office support for Technical Project Management (TPMO), where such processes are core function for TPMO to unify the processes of managing projects and ensure having the right tools and resources.

5.4 Knowledge Tool and Project Manager Role

The interview report showed that different processes, tools, and techniques are being used for different sections in Etisalat and ADCCI. An agreement was observed to start lessons learned throughout the project life cycle and capture concerns related to threats and opportunities. Tools or techniques to capture and record the lessons learned included basic office document applications to specialized Project Management Information systems as this depends on project size and complexity and the company's maturity for project management practices. However, even using the basic method, the project manager must ensure a standard template for capturing lessons learned and predefined fields to record attributes to ensure ease of later retrieving and analyzing. Interviewees advised that all record is stored in shared folders to which the project team has access, which is very important to ensure knowledge transfer; however, this keeps data at risk of change without approval or lack of confidentiality of data. Also, it has been found that common major tools and techniques are:-

1. Gather feedback from project team members by way of formal and informal interviews
2. Use closed focus groups to develop lessons learned
3. Keep an active register for lessons learned
4. Share lessons learned with peers in other projects using Emails and meetings

The interview report showed that Etisalat and ADCCI are not using any PMIS system. On the other hand, they are using different systems but not integrating all project parts or providing end-to-end solutions. As per [35] [36] the use of technologies and applications provide better support to project manager in daily tasks and processes. Thus, if a company uses PMIS, then this would be a tool to manage valuable content and categorization. It will be available anytime for staff and benefit project managers as it is useful to store and organize enormous amounts of data. PMIS could also be utilized to create risk registers, implement an earned value management that focuses mainly on evaluating the actual performance against the planned one, and provide a technical support during project planning so it is recommended to use it by the project manager and organization. This is supported by the results obtained from the literature, which showed that the level of satisfaction with the current project management information systems was above 60% in Western Europe and the Middle East and 72% in Africa. The level of satisfaction per industry from the highest to the lowest: information system (79%), manufacturing (77%), construction and government (71%), energy (55%), and defense (45%).

In addition, it is very important to integrate all systems and tools for knowledge management to maximize the benefits [26]. This supports overcoming issues by being proactive to eliminate issues from occurrence and use the correlated data in the best form to support decisions. For cases with multiple occurrences, it provides an indication to verify the root cause and ways to eliminate occurrence. Also [29] provides insight into how big data and AI can support improvements. Big data and AI are improving the lessons learned process by utilizing as much data as possible and using them correctly based on the right analysis.

5.5 Benefits to Decision-Making and Risk Management

Past recorded experiences will support the PM in making fast decisions since they helps in dealing with similar situations, anticipating possible risks, and effectively and efficiently managing the project so that teams do not make the same mistakes. General feedback obtained as managing project knowledge includes the effective recording of lessons learned and project experiences that will speed up decision-making by better dealing with similar situations, anticipating possible risks & previous solutions, and effectively managing the project in an efficient way.

For example, if an issue occurred while the project was implemented and already included in the register, then fast response and proper action will take place to put the project back on track, which will take longer if it was not registered and correction actions were not identified. Only two interviewees linked lessons learned as an assist; [27] [30] elaborated more about how OPA can have better progress that will support PM to make a plan for eliminating risks or encouraging opportunities. Two candidates talked about how effective recording and managing project knowledge, including effective recording of lessons learned and project experiences will speed the decision-making, help in dealing with similar situations, anticipate possible risks and previous solutions, and effectively efficiently manage the project [27] [28].

6 Conclusions

Managing project knowledge is a vital cyclic process; hence, it helps use available data or create new knowledge. It stitches together project manager knowledge and experience acquired from the past, present, and future. This knowledge acts as a framework and is very powerful for decision-making and risk management. Knowledge can be obtained as explicit or tacit, but the project manager needs to ensure that tacit knowledge is converted as explicit to have it in codified matter for further utilization or analysis. Such knowledge provides a way to treat knowledge as an asset to transfer data, noting that a good knowledge repository is vital for better decision-making, reduced risks, and continuous improvement in project performance. So, we can say having knowledge of previous projects is key to future project success. Therefore, the project manager needs to review available lessons learned at the beginning of any project and transfer such knowledge to the project team either by eliminating threats or encouraging opportunities.

The project manager plays an important role in the lessons learned process since it starts from day one, so corrective actions must be taken immediately. These lessons are observed and identified by staff handling project implementation or any stakeholders. After identifying the concern, it will be documented under the project lessons learned template, and the project manager will start the analysis with the support of a subject matter expert. After that, it is very important that corrective actions take place to proceed further, and once the concern is cleared and

finalized, the register will be updated for upcoming projects. Furthermore, the project manager should encourage the improvement culture and ensure the team members are motivated to add their values and input for further improvement. The project manager can also take management support to create such a culture and to move the organization towards improvement and a trustworthy culture.

It is important for a project manager to initiate and conduct lessons learned sessions during the project life cycle, not only at the end, to obtain the following outcome: New and improved ways to achieve/implement similar projects, new processes or frameworks of improvement, becoming as a reference for upcoming similar projects and set benchmarks for future projects. Additionally, continuous improvement is essential for better work practices. For lessons learned processes, tools, and techniques can be utilized using project management information systems (PMIS), which can be used effectively for project planning and monitoring of phases. Also, PMIS system can capture and provide an indication for abnormality, which also provides a guideline to overcome issues added from previous experiences.

Primavera is one of the good examples of PMIS, that can increase satisfaction; hence, results showed that the level of satisfaction for project management information systems was above 60% in Western Europe and the Middle East and 72% in Africa and the highest recorded industry satisfaction found within information system (79%). Finally, it must be emphasized that it is very important to integrate all systems and tools for knowledge management to maximize the benefit.

7 Research Limitations

One of the primary limitations of cross-sectional designs is that they cannot establish causality or infer the direction of relationships between variables. They only provide a snapshot of associations at one point in time. Additionally, they may not capture changes that occur over time. Furthermore, due to time constraints only sis subject matter experts were interviewed and this might limit the views, opinions, and suggestions offered. Moreover, another limitation lies in the geographical scope of the sample, which was exclusively drawn from the United Arab Emirates (U.A.E.). As a result, the findings may not be generalizable to broader or more diverse populations outside the U.A.E.

8 Future Research Recommendations

Researchers may want to consider expanding the scope of their study in future research efforts to encompass a more diverse range of geographical locations and cultural contexts for a more comprehensive understanding of the topic. It is also recommended that future research should capture a wider range of industries.

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Appendix

Lesson Learn Register Real Example

Source: Interview with MR. Yusuf Samir

Section: Transport and Backbone Projects

Lessons Learned Register								
Project Name		Data Center Modernaization			Project Manager Name		Yusuf Samir	
Project Description		Data Center Modernaization project to meet 5G requirement of Buisness customers						
Lessons Learned		Resources			Severity Levels		Meduim	
		Cost					High	
ID	Situation			Identified On	Highlighted By	Severity	Impacts	Recommendations	Remarks
	Category	Project Phase	Description						
1	Resources	Implementation	Process of spare handover to maintenance team (part of project handover) intend to accept first by project in their store and then they need to handover to maintenance.	03/01/2019	Ali	Medium	1. Duplication of resources allocation, for 2 days 2. Duplication of works, like verification of Delivery note	1. Process to be changed to have direct delivery to maintenance with presence of project team. 2. To be agreed with all stake holders and then process to be modified.	Closed- 25/03/2019
2	Cost	Implementation	Existing spares process leading for un necessarily cost, by allocating staff for same task in 2 days instead of 1 as well as there could be a need for helpers to shift these spares from project to maintenance store	03/01/2019	Ali	High	1. Duplication of resources allocation, for 2 days 2. Un necessarily cost for helper charges and other cost encountered to shift the items	As mentioned above, such extra time can be eliminated by direct delivery since no cost will be encountered on project team.	Closed- 25/03/2019
3	Resources	Implementation	Missing installation materials	15/05/2019	Salem	High	Affecting project completion as per given time and scope.	BOQ to be verified during planning phase and to be compared with design doc.	Updated for upcoming projects