A Comprehensive Study on the Reality of Knowledge Management and Lessons Learned in the Projects

A Case Study in Iran Oil and Gas projects

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Abstract—**The concept of Lessons Learned (LL) in projects refers to the knowledge and experiences have been gained during the execution of the projects. These can be very vital in improvement of management style of current and future projects, to prevent the potential problems such as cost and time overruns. However, despite the importance of LL, it is usually ignored or not considered properly in the projects. The aim of this research is to study the current status of the LL practices in "Iran Oil and Gas Projects" (IOGP). First, a comprehensive literature review on the concept and approaches used to include LL in project management is conducted. Then, the major barriers for implementation of LL management in IOGP are identified, using interview method and investigation of the current states of LL processes in IOGP. Finally, in order to suggest solutions, in-depth analysis of the problems is carried out, using project management tools and techniques. According to the findings of this research, there is not a formal and systematic process for LL management in IOGP. Moreover, the main barriers for KM and LL Process consist of strategic and management barriers, organizational barriers, communication barriers and staff barriers. The proposed solution to improve the LL documentation consists of organizational issues, open communication culture, training & learning environment and formal LL process.**

Keywords-Project management; Lessons learned; Knowledge Management; Oil and Gas Projects

I. INTRODUCTION

Completed projects are terrific sources of information [3], which bring some new experiences on the table. Such information can help to prevent similar problems in future and make considerable time and cost savings on the projects. The concept of Lessons learned (LL) in projects refers to the knowledge gained from the process of performing the project. It can be documented at any time of project life cycle, particularly during the execution of the projects, in order to catalogue significant information that has evolved as a result of the implementation of the projects. The gathered information is used to build up a knowledge base of an organization and to establish a database of the best and worst experiences in project implementation [1]. LL has a significant role in knowledge development and improvement, particularly in uncertain problems. It provides the possibility of recording the knowledge gained by professional bodies who have worked thousands of hours in the projects. So even if they leave the organization, it can be documented and reported as the LL knowledge base, which is a database of historical information, gained experiences and issues related to the outcomes of previous projects [2].

Despite the importance of KM & LL, they are usually ignored or not considered properly. This deficiency is common not only in many of the projects in the world but also in the "Iran Oil and Gas Projects" (IOGP). So, the aim of this paper is to study the current status of LL documentation in IOGP with concentration on its barriers. According to this aim, through a comprehensive literature survey on the concept of LL and KM, the processes, tools and requirements for developing a successful LL process is introduced. Then the barriers for KM and LL process are identified. Finally, through some interviews and documents analysis, the status and the barriers for implementation of LL process in IOGP is investigated and some solutions are proposed.

II. LITERATURE REVIEW

A. KM and LL Reality in the Projects

Lessons learned are the experiences gained from the process of performing the projects. It is an ongoing process with great knowledge creation. It may be considered as a project record, which is classified as a lessons learned knowledge data base [2]. The project team may learn lessons which can be useful in similar future projects, while no one documents them in a systematic way at the end of the projects [11]. Using knowledge gained from implementation, failures or even successes of the projects is vital for the long-term sustainability and competitiveness of businesses [5]. It can be helpful in; reduction of the cost and time needed for problem solving and improvement of the quality of the solutions suggesetd

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during the construction phase of the projects. Morover, it can reduce the probability of repetition of the same problems in projects [12]. So, most of the projects do not need to start from scratching as much as they can utilize existing processes and learn from the experiences acquired from previous projects [5].

According to "integration management" part of PMBOK [2], project close out refers to the process related to the closing of the projects including LL documentation. This document includes *"Historical Information"* which is transferred to the *LL knowledge* base for use by future projects. It can be concluded that LL activities is a major part of the knowledge management in the projects. This information is used to update "Organizational Process Assets".

Knowledge Management (KM) is the process of creating value from an organization's intangible assets. It refers to sharing and leveraging knowledge within an organization and outward toward customers and stakeholders [5]. KM has such strategic value that organizations should include it as one of the pillars of their human capital strategy. KM can help to capture, share and leverage knowledge before it leaves the organization [5]. KM improves the efficiency of the organizations; it facilitates the access to the knowledge of the employees. The organizations make better decisions, improve their procedures, reduce reworks, increase innovation and reach to high level of integration and cooperation [6].

B. KM and LL Processes and Tools

Several KM cycles are suggested in different references, while the simplest one that meets the purpose of this paper consists of four major steps, Knowledge is identified and captured, shared with others, applied in combination with existing pertinent knowledge, and then created in the form of new knowledge, which is then captured and continues [5].

According to Chin, (2004) [13] There are three parts to the basic LL process. First, develop an environment that supports continual learning. Then, capture key lessons learned and finally, archive, organize, and make these learnings accessible to current and future project teams. So, archiving, organizing, and communicating LL will be a foundation for long-term success of the organizations.
Considering the aim of this approach, it is possible to create major three steps for LL process including; LL capturing approaches which refers to the activities of capturing key lessons learned, LL documenting which refers to the activities of archiving and organizing and LL communicating which refers to the activities of making LL accessible to current and future projects. Comparing the KM cycle as explained previously with the above suggested steps for the LL process, It can be concluded that the concept of the steps is similar but as it mentioned the fourth step of the KM cycle is use of knowledge by people and then it may result in creating the form of new knowledge which is then captured and continues, therefore for completion the cycle of the LL process another step should be added as "LL Feedbacks & Development". So it implies that LL process should include four major steps: Capturing Phase, Documenting Phase, communicating Phase, Feedbacks & Development Phase:

C. Capturing Phase

The purpose of "LL capturing" is to find out key experiences, deviations and any LL regarding the ongoing projects. Key information about achieved experiences including deviations, problems, opportunities, wrong or right actions/ solutions and root causes of any deviations and problems are captured from key projects' team members and Stakeholders. It should be noticed that there are some approaches for capturing of LL, experiences and root causes analysis, as below. It means that LL approaches should not be just a diary report of what happened in the project. Below, different approaches for "LL capturing" are presented [13].

1) Learning Organization Establishment: A learning organization is one in which managers do everything possible to maximize the ability of individuals and groups to think and behave creatively and thus maximize the potential for organizational learning to take place. In order to establish such environment, a learning organization should be built up. The five principles for creating a learning organization are to develop personal mastery, build complex, challenging mental models, promote team learning, build shared vision and encourage system thinking [10]. Organizational Learning (OL) is complementary to KM. An early view of OL was "Encoding inferences from history into routines that guide behaviour"(Levitt and March 1988). So OL has to do with embedding what has been learned into the fabric of the organization [9].

2) Meeting Approaches: There are different techniques to manage LL meetings such as brain storming [13], open discussion [14] and even E-meeting [4], in which all participants can discuss from their point of view in turn. The facilitators of the meetings should try to keep discussions on the road and un-biased. Well documenting and recording of the meetings' results is important [13]. The input data for these meetings include Project Schedule, Bug Reports, Review Reports, and Integrated Project Plan [15].

Generally LL meetings should be held bi-weekly, monthly or at major milestones with participation of the project team and stakeholders, as an information sharing tool of how obstacles were overcome and what could be done better on the next phase or next project. The advantage of regular meetings during the project progress (not just at project completion) is that people can give more accurate information and have better discussion, before forgetting the details of experiences or even leaving the project or organization.

- Brainstorming Technique: In this technique, the facilitator asks the participants to write their answers/ideas to questions such as: "what are the

main LL / experiences in the project", "what could be improved?" and "what went well?" In order to avoid people influence on each other point of views and cause biases on the results, it is recommended to develop the ideas in silence. Then the facilitator leads the discussion to record and publish the results of LL [13].

- Open Discussion: In this approach all participants can present issues including experiances, problems and their solutions. The LL meetings can be held in three levels, including project team members, relevant department managers and senior managers. So, team members feel free for open dialogue. The idea is to transfer the results of lower level meetings to the upper ones [16].

3) Capturing Tools

- IT Tools -Telecommunications & Media Tools**:** This approach to LL Capturing can be used especially when project members and stakeholders are not in the same place and can not have regular face to face LL meetings. Using IT facilities and media devices, such as e-mail, SharePoint, video conference and other tools, project managers are contacted in a specific time periods to find out if they have encountered similar problems and have knowledge of the solutions.
- Risk Management: According to the risk management part of PMBOK standard, it can have a significant role in LL capturing [2]. The results of risk management processes produce information that can be used in future projects and should be captured in the organizational process assets [2]. One of the organizational process assets that referred here which may be updated is lessons learned from project risk management activities. These documents are updated, during the implementation of the project and the project closure. Risk management plan, risk breakdown structure and the final version of the risk register, all include some issues related to LL documents [2].
    - Project Auditing: Project auditing can be addressed as a capturing tool for the projects' LL. Its report includes LL information. The formal report should contain Information pertinent to other projects, which means, what LL from the project being audited can be applied to other projects being undertaken by the organization [17].

D. Documenting Phase

As it is mentioned before, all efforts to capture LL data through each of the aforementioned methods would have no value if they are not documented in a well-organized knowledge base format. The following approaches are suggested for documenting the LL.

1*) LL Report:* LL data should be distinguished and extracted from resources such as LL meetings, risk management process and project auditing. The context of the LL report includes [1]: description of the LL, sources of LL data, any reference related to the LL, description of root causes of the problems, impacts of the problems on the project, recommended solutions, description of the application of the LL, searchable key words related to the LL documents, list of the necessary data for creation and reporting and approving the LL.

2) *Approving and Encoding the LL Documents:* Considering the main attributes of the LL report, the outcomes of LL reports need to be reviewed and categorized in a final report format, which is an appropriate reposition for the knowledge of informally developed procedures that helps to ease the tasks of execution of the project. Once reported, they can be tested, approved and finally added to the parent organization project management procedures and roles, if generally useful [17].

All generated LL documents should be approved by an entitled person of the organization that should be clarified in the LL procedure in advance. The Project Manager should assign some individuals at the early stages of the project for the task of generating these documents. Moreover, it is very important to enable the LL documents by using some searchable functions such as key words, their application areas, the level of their importance and chronology. So they should have label of encoding which shows these characteristics.

E. Communicating Phase

According to the philosophy of the LL documentation, information should be communicated with the relevant people in the organization in a timely manner and distributed to them. So, the communication process of the organization has a key role to ensure that LL is available to all relevant people, in a timely manner. According to the PMBOK standard [2], communication management process can facilitate LL process in term of gathering and distributing of LL from and to the relevant people. Both LL process and communication process increase the efficiency of each other and their functionality. There are many tools for communication improvement such as team working, communication media and so on.

There are some factors to be considered including Communication network, Communication climate and Trust Building [8]. Moreover, media is the way that information is communicated. Using a combination of some of the media such as Electronic database (information systems), Web Pages, Broadcasting Job Knowledge, email, Inter LL meetings, Journal and newsletters can help to communicate LL of the projects in an organization.

F. Feedbacks and Development Phase

Application of the LL is the main purpose of doing LL process in projects but it is not independent from other steps. LL application in other projects and similar situations, getting feedback and improving LL process are the most important part of a LL process. Feedbacks can be

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reflected in order to update LL database. The mechanism of reflecting feedbacks can be considered as below:

- Risk Monitoring & Control: According to the Risk Management process, risk monitoring & control has a key role in updating the organization LL document. Risk management feedbacks are reflected to update LL data.
- Organization Procedures and Standard Adjustments: Normally, LL outputs could recommend some improvments on the technical and managerial assets of the organization. The recommended revisions will be investigated and will be added to the organization procedures and standards. This approach guarantees useful application of the LL findings which means LL data are communicated and applied in its relevant areas.
- Project Management Office (PMO) Establishment: Establishment of the Project Management Office (PMO) in organizations can be a guarantee to develop a successful LL process. PMO is an office to deal with multiple projects and charged with improving the project management maturity and expertise of the organization, as well as increasing the success rate of projects. PMOs commonly perform many tasks such as initiating and launching new projects, establishment and enforcing project management processes. Most of its functions cover different activities required to perform the four major steps of the LL process in an organization [17].

III. LL AND KM BARRIERS

According to the aim of this paper, in this section the general berries of KM and LL activities is reviewed. Considering the relevant literature, the main barriers of KM can be classified as below [7]. These barriers are valid in LL process and can affect its process as well.

A. Strategic and Management Barriers

- Strategy Alignment**:** The problem will occur due to the lack of alignment between the KM strategy and the business strategy of the organization.
- Management Support**:** Without the active and visible support from top managers in organization, KM will not get the support of employees. So, where leaders clearly communicate and enforce the value of sharing knowledge, the KM will have better results. One of the main management barriers is that managers do not use positional and social power to facilitate open communication channels in an informal way.
- Resource Allocation**:** The cost of capturing, processing and transferring knowledge can be a barrier to KM. When companies fail to allocate sufficient resource to the KM activities in most instances they will fail in their KM venture [18] [19].

B. Organizational Barriers

- Organizational Structure**:** Informal connections keep communication channels open and nobody needs to wait for next official meeting to initiate information. So, organizational hierarchy could have a direct impact on the KM success. In some organizations hierarchical structure negates any KM activities, which means organizations should be aware of that.
- Organizational Culture**:** The Company's culture can influence the perceived usefulness, importance and validity of KM. It influences the process of creation and adoption of new knowledge, determines the knowledge belongs to organization or individuals and creates a content of social interaction which influence**s** the organizational maturity on KM. Factors such as creating a supportive and open communication climate, fair rewarding and building trust in an organization can encourage people to state their beliefs and focus on opinions and problem solving rather than negative evaluations or criticizing others [8]. Where the organizational culture is not aligned with the drive for knowledge it will act as a barrier toward KM [7].

C. Communicational Barriers

- Communication and Information Systems**:** If the organization's information system is a kind of overloaded system (including useful and useless information) people will be confused [20]. People simply like to directly access to the required knowledge in an appropriate time scale with less confusion about the accuracy of the system. One of the major barriers to LL utilization is inefficient access to the relevant information. The communication process of the organization has a key role to ensure that LL is available to all relevant people.
- Rewarding and Recognition System**:** when the organization doesn't have a rewarding system to recognize the valuable knowledge shared by the employee, people do not encourage sharing valuable knowledge.

D. Staff Barriers

- Trust**:** Tacit knowledge is the type of knowledge that lies with the experience of employees, so in order to share this type of knowledge employees should trust the organization. Otherwise they will feel that they lose their own knowledge and its value, so they avoid making it available to others.
- Competition: If the competition internally in an organization or externally between divisions is not healthy, people will not want to share knowledge.
- Knowledge Value**:** The value and benefit of existing knowledge is often not realized by the owners, so

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they don't try to capture and store it in an appropriate format.

- Language: Due to communication barriers, knowledge may not be transferred to the relevant people. This problem particularly can occur in multi-national projects which are implemented by many people from different countries [21].
- Staff Turnover**:** As discussed before, it is difficult to capture and manage tacit knowledge. This type of knowledge is also lost when employees leave the organization.

IV. LL CONCEPTUAL MODEL

Considering the above discussion about the LL elements and their relation with KM, a conceptual model is developed. The Model shows the barriers to KM and LL process in the organizations. Moreover, it presents the relationships between KM and LL process and their interactions with the projects (Figure 1). According to this model, the LL process is conducted during the implementation of the projects. The adopted data from LL are transferred to the knowledge base of the organization in an appropriate format, which can be used to support new projects. The model shows two main parts of LL and KM process in an organization and their relation with projects.

In the first stage, the LL is captured and documented that can be considered as captured knowledge in KM system. The next stage is LL communicating that is equivalent to the knowledge sharing stage of the KM process. Therefore any communication procedures of LL process can be transferred for utilization in the knowledge sharing step as well. The last stage of LL process is application of LL in other projects and similar situations and their feedbacks which help to improve and update the LL database. This stage corresponds with knowledge application. Finally knowledge creation stage of KM process enhances knowledge capturing stage. During this process many problems and challenges could happen, which are classified as LL and KM barriers

V. INVESTIGATION OF THE LL BARRIERS IN IRAN OIL & GAS PROJECTS

In order to find the current status and the main barriers to documentation and utilization of the lessons learned, in Iran Oil & Gas projects, the actual application of LL in Iranian oil & gas projects is investigated. This case study has been done by conducting several in- depth interviews and document reviews. In this regard eight interviews with the relevant experts and managers of different projects have been done and some organizational documents have been reviewed.

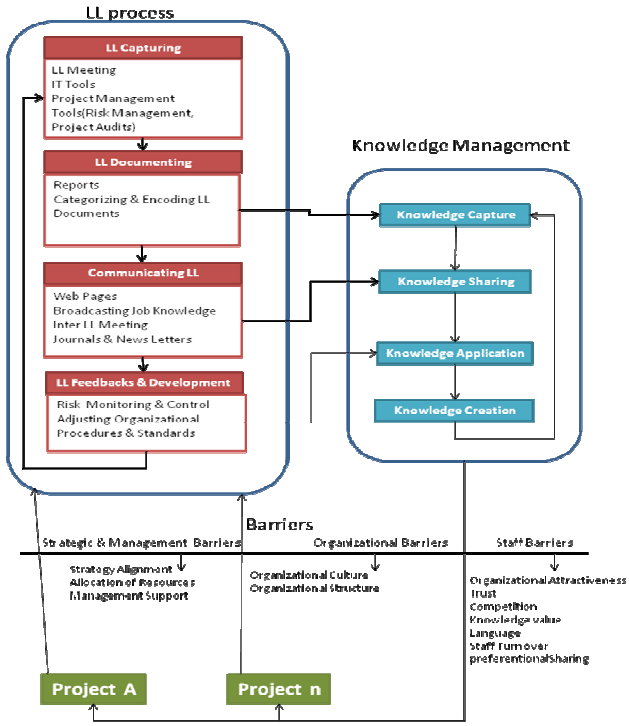

Figure 1: Conceptual Model of LL process and its barriers in project based organizations

In order to study the current status of the LL activities in projects, several questions related to the application of the LL in the organizations, their approaches toward LL as well as the reasons for negative attitude toward the LL were asked. These questions were: If the organization has any LL process. If the organization has any systematic approach for LL process. In case of negative answers, what is the reason? What are the problems and barriers to implementation of LL practices in the organization? The reasons are classified in categories of barriers to KM. Details of the findings are as below.

A. Strategic and Management Barriers

- Top Management Support- No Formal LL process: In most organizations, LL activities are ignored because they are not defined in the organizations' procedures and there is not a formal management support**.**
- Allocation of Resources for LL Processes: A quick look at the four steps of LL process presented in section 2.2 shows that implementation of LL process needs enormous effort including time and cost, which requires additional cost and expenses from the parent organizations.

B. Organizational Barriers

- Organizational Culture- Lack of Supportive Climate and Open Communication**:** As it is explained, supportive climate and managers'

power could create warm culture, trust, open communication system and fair rewarding system. These are important factors to implement a successful LL process. In the observed organizations these factors are not considered so much and leaders do not support and encourage people for collecting, sharing, and using lessons learned. Moreover, in this type of organizations, due to the political, accountability and organizational reasons, People may not like to participate in LL meetings.

C. *Communicational Barriers*

- Poor Knowledge Management & Communication Infrastructure**:** In most of the organizations there are no sign of integrated knowledge management information systems. In the exceptional cases, organizations have their isolated data, without any communications and exchange**s** of information between them. These deficiencies would be significant barrier**s** to implement LL process**.**

D. *Staff Barriers*

- Knowledge Value- Perceived importance of LL**.** Most of the senior and project managers do not know about potential benefits and real value of the systematic approach for LL. According the research findings, there are some traditional approaches in the LL activities, applied personally by some of the project managers, using the experiences of pervious projects. However. They do not know how much a systematic LL process can help to improve different aspects of their project and the parent organization's performance.
- Poor Attitude toward the Application of the LL: The common problem of the organizations is that there is not any hope and guarantees for application of the LL in other projects.
- Trust**:** From job security point of view, people prefer not to share their knowledge, they are afraid to lose their competitive advantages and their situation in the organization. Moreover**,** some managers believe that they are too busy to spend time looking back.

VI. PROPOSED SOLUTIONS

A. *Organizational Issues*

According to the case study findings, the most important problem**s** in our organizations are related to cultural issues. Below, there are solutions linked to different cultural factors.

- Open Communication Culture: Supportive climate and open communication can encourage people to share their knowledge and participate in LL activities [8]. A long period plan is needed to break the existing culture. The leaders have key roles to create trust (paired with staff barriers-trust) by a fair rewarding system and considering team building points as a major part of this strategy.
- Training & Learning Environment: Continual learning environment is the first principle for the LL process [13], this environment encourages people to share their knowledge and be active and creative in LL meetings [10]. Training is the first step to create learning environment. Lack of knowledge about Project Management and LL value (paired with staff barriers) can be solved by training. Theses programs also can help to remove the belief that LL process is costly or waste of time. When an organization decides to establish a formal LL process, some specific training courses can be helpful for better understanding of their tasks and implementing the process.
- Formal LL Process**:** With respect to the case study's findings, there is not any organizational obligation for LL activities, so establishing a formal LL process can be helpful. The process should be unified and consistence with all organizational sections. It should include codification and standardization activities, clarified tasks and responsibilities and considering incentive and feedbacks [22].

B. *Project Management Issues*

According to the case study's findings, below, there are the solutions linked to the project management techniques.

- Project Management Information System (PMIS): Developing an Integrated Project Management Information System (PMIS) has a significant role in development of LL & KM. In this regard, there are some recommended features in development of PMIS, from LL point of view, such as being user friendly and easy to use, having root cause analysis and searchable key word related to the LL data base. Additionally, having possibility for knowledge sharing and broadcasting of job knowledge which means producing a common language of unified data for dealing with problems from multiple locations and having a communication capability that automatically places information directly into the hands of the persons throughout the network of organizations.
- Risk Management Process: There are important interactions between three processes of Lessons learned, risk management, and communication management. Sharing knowledge in a systematic format, documenting LL, and ensuring frequent communication will maximize project success factors [4]. Risk management process can have a

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significant role in the capturing and communicating project problems and pitfalls from LL point of view. Risk management helps to capture LL data as well as communicating them. On the other hand information related to the LL is used to risk identification and improve communication process. In addition project communication facilitates risk monitoring and control, and more communications about problems and risk factors would occur at LL meetings. Thus implementing these three processes can enhance each other during the project life cycle.

- Project Management Office (PMO): For development of the LL activities in the IOGP, there are some solutions, which are classified in organizational and managerial groups. These can be implemented by establishing of PMOs in the organizations. Establishing PMOs in organizations is a comprehensive solution that can include aforementioned solutions because the functionality of the PMOs can cover most of the requirements of the above solutions.

VII. CONCLUSION

In this paper, the main barriers of KM and LL in projects were investigated. Based on the research findings these can be classified in four major groups including strategic and managerial barriers, organizational barriers, communicational barriers and staff–related barriers. Investigation of the maturity and application of the LL in Iran Oil & Gas projects show that there is not a formal and systematic process for LL management. Moreover, there are many problems related to these barriers such as lack of supportive climate and open communication infrastructure, poor knowledge management & communication, poor attitude toward the application of the LL and perceived value of LL and trust. The proposed solution to improve the LL documentation consists of 1) organizational issues including creating open communication culture, training & learning environment and defining formal LL process 2) project management issues including developing project management information system (PMIS), risk management process and project management office (PMO).

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