

# **ASSESSING CONSTRUCTION PROJECTS KNOWLEDGE MANAGEMENT IN OMAN:A QUALITATIVE STUDY**

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**Abstract-** This paper intends to discover the reality of understanding project knowledge management and its application in the area of construction projects. In addition, to assess the acceptance of a framework addressing construction projects knowledge management and to identify the impeding factors stopping the implementation of a successful project knowledge management framework. In order to examine the above-mentioned areas a quantitative approach will be used. The data will be generated from both primary data (collected through interviews with project managers from different organizations) and secondary data (collected through existing literature on project management).

The results of the study revealed that the misalignment to the objective of the project, changes, errors and omissions and wrong competencies are influencing the project knowledge management. In addition, the study presented and discussed the implications of the findings and conclusions on the optimization of Knowledge management.

**Keywords:** Knowledge Management, Project, Construction, Project Management

## **1. INTRODUCTION**

Projects are the ultimate way of accomplishing and managing the business in the construction industry. Projects –in general– are defined differently by their applications such as construction projects, information technology projects, quality improvement projects, etc. However, all projects (construction and non-construction) share comparable characteristics, which in most cases are used to define a project. First, a project addresses a need and it is the way out from a problem. Second, a project is temporary with a known start date and finish date. Third, within these known dates, a project is about delivering specific deliverables through specific tasks. These deliverables and tasks are linked to financial benefits, where it might be generating or saving capital. Finally, projects must have a clear, definitive goal or objective. The same must be specific and can be accomplished normally via project management.

In an initial attempt to explore the need for studying the project management within the arts and social sciences and other related areas to humanities, specifically to information studies, searched via Scopus for "Project management" for the period 2014-2017 and retrieved 29,387 articles distributed among 16 subject areas. Five major subject areas share a large percentage of the literature, among them the social sciences, business, engineering, environmental science and medicine. 20% of these articles are within the arts and social sciences (5892 articles). The analysis of the social sciences articles reveals interdisciplinarity between other subject areas, in specific, business, environmental studies, engineering and medicine. Another search was done to explore the relationship between project management and information studies during the same period and it retrieved 6332 articles distributed in many fields, which confirms the interdisciplinarity of project management topic among other related fields.

The projects in the construction industry are associated with a high level of uncertainty. Therefore, having one project knowledge management framework that will work in all circumstances is not practical. There is a need for a framework that can address external influence, unexpected events, evolving requirements and fluctuating resource movements.

The review of the project management is very important for studying project, project success and project knowledge management. Passenheim (2009) draws a conceptual framework for managing projects emphasizing that projects naturally have recognizable phases and each phase has a set of challenges facing the project manager. "If we view the project from the highest level, these basic projects can be also identified as major factors influencing the project success. If one of these phases is planned or executed wrongly, the project will have a high probability of failure." (Passenheim 2009)

Academics and researchers address projects and project management in many ways. Some view projects from a business perspective. "Everything in business is a project or is project-related" (Dinsmore, 1999). Others view it as a management discipline (Cleland, 2006). The project management is addressed in number of scholarly papers and books. Some of these are about how to successfully manage projects. This is to include identifying, understanding and implementing the tools and techniques needed to successfully manage projects. Others are about providing the tools and techniques to achieve this success. It is more about managerial and integrated approach focusing on context of the situation, how decisions are made and much more emphasis on the knowledge.

A project is normally characterized by having start and end dates, objectivity, deliverables, stakeholders, schedule, risk and others. Project management is planning, organizing, directing and controlling resources for a relatively short-term objective

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that has been established to complete specific goals and objectives. Furthermore, project management evolves along the project life-cycle starting from the initiating stage, then planning stage, followed by monitoring and finally, at the closing stage. In project management, success is measured mainly by three criteria (time, cost and quality) or what is known as “Golden Triangle”. If a project is completed as per the needed quality and within the agreed cost and time, then it is a successful project. This triangle is insufficient in determining project success.

Currently, the project success measurement criteria are set at the initiating stage. This is subject to the outlook of the project stakeholders. Project success can be identified at the macro viewpoints and at the micro viewpoints. The macro viewpoint of project success is about stakeholders' satisfaction. The micro viewpoint of project success is about the day-to-day projects' smaller achievements and need not to wait for the closing stage of the project. “Project management success has three key components: (1) meeting time, cost, and quality objectives (project outputs and inputs); (2) quality of the project management process; and (3) satisfying project stakeholders' needs where they relate to the project management process.” (Baccarini, 1999)

Many scholars argue that industry type needs different project management (for example Cooke Davies 2004 and Ibbs and Kwak, 2000;). Therefore, project knowledge areas might influence the success of the project differently as and when they are applied in different industry types. Trying to address the project management success factors without linking the same to the objective of the project is futile. In fact, some factors will have different implications at a different stage of the project life cycle.

Despite the fact that project management success is one of the most frequently discussed subjects, there is still huge disagreement about the definition of success. Therefore, the research intends to reveal the benefit of the successful implementation of project knowledge management in construction projects.

The research questions are examining construction projects' knowledge management and the contributory factors of the implementation of a successful framework. Hence, the research is primarily conducted to answer the following research questions incorporated into the semi-structured interview accordingly:

What is the reality of project knowledge management?

How project managers in Oman understand project knowledge management?

How far introducing a project knowledge management framework is accepted by the project managers in Oman?

What are the impeding factors stopping project managers in Oman from accepting project knowledge management frameworks?

## 2. METHODOLOGY

In order to examine the research questions and ultimately attain the objectives of the study, a qualitative approach was used. The data was generated from both primary data (collected through interviews with project managers) and secondary data (collected through existing literature on project management).

Due to the different objectives and different research questions, a comprehensive and detailed methodology was developed to enhance the understanding of the data collected and increasing its reliability and validity.

The methodology will begin with a case study for developing an understanding of the different dimensions of project knowledge management. This was done by utilizing semi-structured interviews with project managers in Oman. The purpose of these interviews was of threefolds. First, contextual settings of construction projects in Oman will be specified. Second, applicability of the developed project knowledge management framework will be examined as well as the ranking of the importance of project knowledge management. Third, the interview questions will aim to unravel the influence of other project knowledge management (if any) specific to Oman construction projects which received no attention in prior literature such as the influence of project team specific skills and competencies as well as impediments to success.

The sequence of the sample coding of the Interviewees of the semi-structured interviews (Table 1) is not linked to the organizations for protecting their privacy and give them the opportunity to reflect openly and be transparent. It was randomly applied to the list of Interviewees.

Organization Type	Coding
Client:	DEV 1
	DEV 2
	DEV 3
	DEV 4
	DEV 5
	DEV 6
	DEV 7
	DEV 8
	DEV 9
Consultancy:	CNS 1
	CNS 2
	CNS 3
Sub-Consultancy:	SCNS 1
	SCNS 2
Contractor:	CNT 1
	CNT 2
	CNT 3
	CNT 4
Sub-Contractor:	SCNT 1
	SCNT 2
	SCNT 3

Table 1 Interviewees Coding

### 3. DATA ANALYSIS AND DISCUSSION

The collected data will be analyzed to respond to the research question, started with a summarized descriptive analysis of the interviewees' characteristics as following:

#### 3.1 Interviewees Characteristics

Interviewees are from the different parties that might be involved in any construction project. They are from clients, contractors, consultants, subcontractors and sub-consultants. Interviewees from subcontractors and sub-consultants have worked almost in all the listed types of projects (Residential Buildings, High-rise Buildings, Hotels, Infrastructure, Highways and others). They have developed their experiences from different types of construction projects. However, most of the interviewees are doing or did the project manager role.

The descriptive analysis shows that interviewees having experiences in different construction project types. However, the majority (90%) have worked in projects related to residential buildings and 81% have worked in hotels projects. More than half (57%) of the Interviewees have worked in projects related to high-rise buildings and 33% have worked in infrastructure projects. Only 19% have worked in highways projects and another 19% have worked in other types of construction projects. These percentages show that many have the experience in residential building, hotels projects and high-rise buildings, but it was fundamental that all of them worked in construction projects.

The below figure (Figure 1) is summarizing the relationship between the different organizations involved in the semi-structured interviews. This is to indicate that the client is the originator of the project and client is having a relationship with both consultant and contractor. Then there is the relation between the consultant and contractor. Where the consultant's role is to ensure that the contractor is executing the project as per the intent of the design. Finally, it is showing the line between the consultant and subconsultant as well as the line between the contractor and subcontractor.

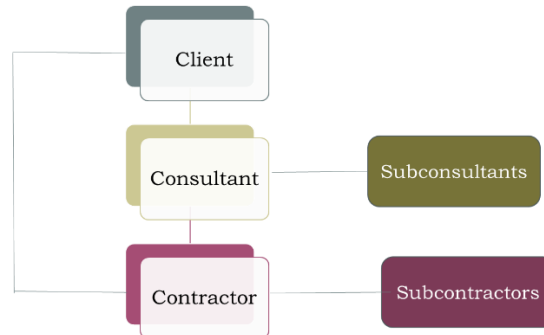


Figure 1 Relationships between organizations

#### 3.2 Reality of Project Knowledge Management

The findings presented here are based on the first part of the interview. It is about the reality of project knowledge management. There was almost an agreement that knowledge management can have a positive influence on the success of projects. However, none of the interviewees have worked in a project with a structured knowledge management process and

system. This jeopardized the ability to determine the positive influence of knowledge management and or to track this influence on projects. Interviewee DEV5 stated that “the first step is to manage it –knowledge- within the project, then and only then we might be able to measure its contribution to project success or otherwise...”. From interviewees’ responses data for this part of the interview, the patterns that emerged are: 1) Changes, 2) Errors and omissions, 3) Wrong competences and 4) Misalignment to the objective of the project.

### 3.2.1 Changes

Knowledge management is critical for containing the changes throughout project different phases. Even with the common view of interviewees about the certainty of changes in projects, they also shared the belief about the importance of knowledge management in reducing these changes. It was a collective conclusion by most interviewees that knowledge management early adoption in the project is having a positive relationship with reducing the changes during the project different phases and the associated additional cost time with these changes.

Interviewee CNS1 mentioned that: “we came later to the project, we inherited the design. As we did not know the answers to some of our “why” questions due to the nonexistence of information/knowledge management, we started to introduce changes. This was an expensive exercise. After many sessions with the technical team, they (client technical team) involved their leadership team to attend the final presentation of the proposed changes. They all challenged the proposal and killed most of these changes, but after we charge them a good amount of man-hours. We all agreed that we have to involve as many as we can from the stakeholders –especially- those with answers to the “why” questions. By introducing some knowledge management parameters, we almost needed no changes at this stage.....”.

Changes might be triggered by any stakeholder and during any phase of the project. The changes could be for improvements, modifications and or fixing design shortfalls. Changes are normally tolerated at the design phase and before freezing the project concept. However, most of the changes during the construction phase are associated with additional costs. These changes might also result in rework, which is -in most cases- amplifying the additional cost.

During the construction phase, changes are normally introduced by the clients, but all other stakeholders might be a source of change. The client request changes to improve project delivery time, to deliver the project on budget and or to redefine project scope and quality. Interviewees illustrated their experiences with these changes.

Interviewee CNS3 reflected that “at the design phase, the client did not have the right team to challenge the design. In the middle of the construction, the client appointed a senior technical advisor, who started to question the design and started to propose value engineering initiatives. Where he thought all of this will result in cost savings, the project faced many disputes and suspensions”.

“The Board of Directors for the client organization changed and the new chairman wanted to descope the big tickets items from the scope of the main contract and to contract directly with the subcontractors for these items. The assumption was, the direct relationship with the subcontractors will result in fast-tracking the project. In fact, the time and efforts to manage the interfacing between the main contractor and the subcontractors did not justify the change” – interviewee CNT3

Some of the changes are out of all stakeholders' control. For example, these changes might be to address constructability problems or supply chain problems. According to interviewee CNT4: “when a selected item at the design phase is not available at the construction phase due to discontinued by the manufacturer or prohibited in the country, then a change is a must. For example, after we started the construction of (project name), we came to know that the selected (item) is not in production anymore. We had to change and we had to consider the time and cost related to this change”.

Another example is unforeseen site conditions, which might cause serious changes, which are in most of the case associated with additional costs to the project. There are many examples of these conditions: infrastructures and utilities beneath the site, the water table and the type of rocks in the subsurface. This can be avoided by conducting the right and adequate site investigations.

“My classic example is about a project where the site is next to the sea and the designer depending on the very old investigation and neglected the fact that the water table is an active and changing element. When we started the excavation we know something is not right we request further investigations and experimental bits. All the results confirmed our concerns and they have to go back and reassess the design” affirmed the interviewee DEV3

Other changes can come from the authorities. According to interviewee DEV8, “...changes to the project came from the (authority name) as they did not approve the design and did not issue the needed permits for construction. We could not do much about these changes. We worked closely with the client and the main contractors to minimize the exposure to all of us”.

Change is part of almost all construction projects. Therefore, project management should factor for changes in all project phases. “...as the project evolves the chance of inducing a change increased..... the right project planning is about anticipating these changes along the project life”– Interviewee DEV2

Knowledge management was identified as an important pillar in a successful procurement strategy. This start from the selection of the designer and all the way to the selection of the construction contract type. Interviewee DEV2 declared that “when they do not have detailed information and they decided to go remeasured contract, the contractor can make a fortune from changes. Through time and with the right knowledge transfer and use client might be prevented from selecting the wrong form of contract”.

### 3.2.2 Errors and Omissions

Knowledge management's influence on reducing projects errors and omissions is remarkable. It was found that Knowledge management has positive impact on eliminating or at least reducing the causes of project errors and omissions. This is applicable to the individual, organizational and project levels. A useful example about individual level was given by Interviewee CNT4 "when I joined the project I introduced the weekly lunch and learn. This was new to the team but later it becomes a culture. The theme was simple, you know it then only one person knows, you share it then all of us know it. We exchange knowledge". At the project level, Interviewee DEV2 believed that: "...I know projects failed simply because of the lack of sharing knowledge. This might be because of culture or job security. Yes, job security. If I teach you and you know what I know when you are ready to take my job..."

At the organizational level, it is about protecting the organization. Interviewee DEV2 explained this: "we created knowledge depository. We have a technical index for this depository. We knew that we can not afford to do the same mistake more than once. Types of projects we are involved with may vary, but we can depend on our knowledge management to navigate through each project's success". Interviewee CNT3 believed that: "we ensure that we do business with the same 'GOOD' suppliers in every project we are involved in. This is our first tool to retained supply chain knowledge and most importantly we do not have to educate new players every now and then. They have the needed knowledge, so we trust them. In return, they trust us and share their knowledge with us for a win-win relationship".

At the industry level, it was mentioned by a number of interviewees that knowledge management in construction projects is having big influence design changes and time and cost overrun.

Budget and Time restrictions might be a substantial source of errors and omissions. Trying to cut costs in every corner leads to oversights and omissions, where the time pressure promotes individuals to commit mistakes and errors. Where clients encourage excessive competition, low bidding (contractors, consultants, subcontractors and sub-consultants) might really affect the quality of the project negatively. Hiring the lowest bidder might mean hiring the incompetent bidder.

A related story was given by interviewee DEV2: "the (scope designation) subcontractor got the contract with a very low margin and when the project was delayed they lost that margin, then they started to squeeze. They reduced the resources to do the job and this resulted in losing the good resources and the remaining resources were unable to deliver the scope to the right level and their scope was only errors and omissions".

"While rushing to finish our scope before the summer as the other subcontractors cannot work in the summer if we do not finish, we made an error in the calculations. Even with the huge experience, we claimed to have, under time pressure we commit a mistake ..." – interviewee SCNT2

For interviewee DEV5, "The team from (the client) kept coming after cost savings even when we propose alternatives for the objective of expediting the project delivery. They went far in the price discussion till our proposals were not viable anymore.... We all drifted from the track toward the finish line... now the nastiest part is the subcontractors' maneuvers to cut cost, as for them like (subcontractor) time and quality are never before cost. Once, they delayed the procurement of a long lead item so that we, later on, have to accept their alternative copy of the original design which likes one-tenth in the price of the real item..."

Another big source of errors and omissions in projects is poor communication. This to involve the mix instructions flow from different parties, a different understanding of scopes, and different languages. As the gap increases the costs associated with errors and omissions increase.

In many cases, construction errors are committed due to issues in contracting and procurement strategies. Interviewee DEV5, in his example, clarified that "in a big project like (project name) the main contractor was having his own patching plant at the site and was supplying concrete to some other contractors at the site including us as his subcontractor. As the patching plant was small they did not supply on time. We have to start getting the concrete from a third party, but both of us did not factor this in our contracting strategies. No one agreed to supply concrete to (site location) at the same rate we use to pay to the main contractor. To compromise, we started to get the concrete only at night and most of the time no inspectors or supervisors attended the concrete pouring... need not to say, this resulted in rework, delay and for sure additional cost and lost for all".

At the design phase, the consultant is the one who does the selection of items without agreeing with the sub-consultants. This creates a gap that gets wider when the main contractor does the same with his subcontractors. As there is no involvement from the subs –who in fact we do the procurement processes- the project is set for errors and omissions in many of these selected items.

"the designer selected doors hinges to be made only for this project. It is coming from Poland. As a door supplier (subcontractor) we faced a very hard time to source the same. It was an unnecessary selected item that causes many disputes and a delay to the project... only if they have asked us at the design phase we could have told them the right a practical solution and we all could save time and cost" –interviewee DEV5

### 3.2.3 Wrong Competences

Interviewee CNT1 stated that: "... the more you know the more you dare. Once you dare you will aim for a better job, position, project and employer. When you leave the project you take your knowledge with you. So this is the dilemma, we encourage knowledge management and this in many cases increases project team turnover nevertheless this risk mitigates itself as knowledge management decrease the knowledge void created by project team turnover".

It was noticed that the construction projects are team projects in nature. One task will be done in a group in most cases. In each discipline, a number of employees is doing the same thing. However, those employees' knowledge, skills and attitude will differ. Therefore, not every employee leaving the project will affect the project and take the knowledge away from the project. Interviewee CNT2 commented that: "... losing someone will not always result in knowledge loss. For example, we have a number of employees in the paving section. Some of them are more seniors than others and for sure with different levels of experience. We only retain the good ones and keep hiring project by project. In most cases, this is working well. But there are projects –especially the very big- where we do face a hard time trying to hire the right paving team and when we start accepting any level of paving knowledge this cost us a lot...."

In the construction industry, each project differs from other projects. The stakeholder may differ. The project team may differ. At least the location of the project differs. Therefore, the influence of individual knowledge is less compared to the right organization and industry knowledge management. Interviewee SCNT1 said: "in our industry, we deal with each project as a new startup. We have to think about everything at each project. The right team, the offices, the utilities and many others. Because of this if we think one can do it right and we do not rely on the experience we built through the years we will never deliver projects".

It was found that knowledge management has less influence on personnel over time. Interviewee DEV2 gave an example related to that: "...we were told that a new project director with 20 years of experience will be joining. From his first day, he challenged the way we do business. He wanted to introduce a different process and forms. There was never a winner in the debate about the knowledge we have from the previous projects and his 20 years of experience. He was good, but he delayed the project. He never appreciated the project knowledge management as he did projects differently for long...."

Wrong competence might be also in the form of intentionally or unintentionally avoiding or changing step(s) in the process of executing the work. For example, when an individual tries to perform the way he or she uses to perform in the past where the project is very new.

Another source of wrong competences is not applying the learning from previous similar projects and trying to re-invent the wheel. The absence of lessons learned is a contributing factor to maintaining the wrong competencies. As per interviewee DEV6: "the project was having more the (package name) all with similar design and to be built after each other.... Could not understand how the issue of leveling was repeated more than twice".

Some of the wrong competencies are developed from habits or the repeated way of doing the tasks or sometimes even doing the job unconsciously. This is a serious source of noncompliance behaviors. These dangerous behaviors can get more serious when developed to be a culture. Then individuals start to carry them from project to project. "... (sub-consultant name) assumed everything and prepared the information before even visiting the site, let alone doing the investigation.... Only because they used to do this and nothing happened. It was not the same in our project. We faced a number of issues with the design...the dispute was never easy to resolve as the accountability of the design was with the consultant and the client did not want to meet the sub-consultant who cause all of this...." – interviewee DEV2

The wrong design or wrong materials can be addressed much easier than the wrong competencies. The first two can be fixed very fast by either paying more or by involving authority to instruct the right party to fix them. In comparison, wrong competencies are taking time and involved many aspects to be fixed. "Sometimes this situation is not related to the lack of knowledge, but the job to be done is different. We hired the subcontractor to do the flooring based on our experience with them from other projects. We did not factor (accounted) for the wooden flooring scope in this project. We both faced a hard time. Their team could not do it. We have a lot of wasted material. We had to import more. The delay and overrun in the cost was huge. We have to walk away from the whole project" – interviewee CNT1.

#### *3.2.4 Misalignment To The Objective Of The Project*

Misalignment to the objective of the project is associated with the numerous number of parties and individuals involved in the project activities. As per interviewee DEV 7: "The void mainly started at the construction and enlarged as the progress of the project". Interviewee SCNT 1 believed that in most cases the main contractor is the cause of the misalignment. This misalignment may be the result of the incorrect solution to a problem. As per an interviewee: "... we applied the human capital outsourcing strategy that we normally use in our country but we ended up blacklisted in the ministry of manpower and paid huge fines... where we wanted to solve the problem of human capital shortage we applied the wrong solution... now we know using old solutions for new problems in new projects can be a big mistake".

Misalignment can be a result of insufficient communication between the project team. As an outcome of the insufficient communication, what the client wants and the consultant design might not match the final result. Insufficient communication might include a wrong flow of information, unclear messages, no proper documents controlling and different languages. "...it is all started from stopping us (subcontractor) from attending the progress meetings with the client. The information about the importance of some parts of the project over others was never communicated to us. How could we deliver that scope of the project first and fast if we do not know in the first place the importance of it" – interviewee SCNT2

Figure 2 is a summary of the previous discussion about the reality of project knowledge management the first part of the interview.

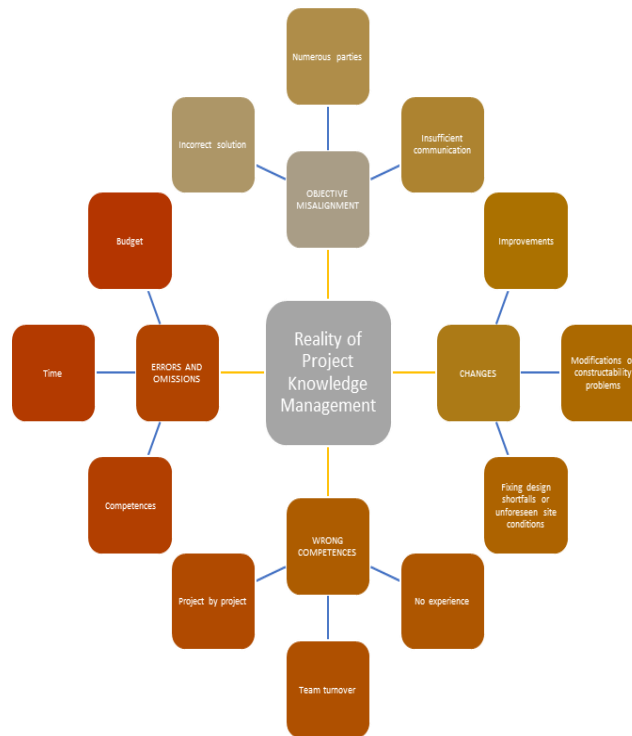


Figure2 Discussion summary

3.3 Projects Managers and Project Knowledge Management

The findings presented here are based on the second part of the interview. It is about the understanding of project managers in Oman to project knowledge management. Remarkably, most of the interviewees knew or mentioned the concept of project knowledge management, but all of them do not know how to cost it or how to determine the return on investment and this limited them from considering it. The patterns that emerged are: 1) Project knowledge management cost and 2) Return on investment.

3.3.1 Projects Knowledge Management Cost

In terms of costing and assessing the investment return from applying knowledge management, it appears, generally that most of the interviewees accept the notion that projects are a complex issue, as they involved a number of stakeholders, yet no one equation been applied to calculate the cost of knowledge management was given by any of the interviewees. Interviewee CNT2 emphasized that "... we do not cost it, but we have to invest in it. How much it cost; we do not know. That is why it is not the contractor cup of tea...."

3.3.2 Return On Investment

We (Interview CNT2 Company) are using Aconex: a virtual tool for project information management. Then Interviewee CNT2 proposed the idea of analyzing the return on investment related to using Aconex. Another proposal came from Interviewee DEV5:"...as we are sharing knowledge and reducing the organization cost on training and on employees development that might be the cost of knowledge management". The last proposal is a summary of a few insights from the interviews. It is about the requirement of an App, a web-based or any other electronic platform allowing the tracking of the influence of knowledge management in terms of return on investment.

Part 2 of the interview	Patterns	From the interviews
Projects Managers and Project Knowledge Management	Cost	Interviewee CNT2 emphasized that "... we do not cost it, but we have to invest in it. How much it cost; we do not know. That is why it is not the contractor cup of tea...."
	Return on Investment	Interviewee DEV5:"...as we are sharing knowledge and reducing the organization cost on training and on employees development that might be the cost of knowledge management".

3.4 Accepting Construction Projects Knowledge Management Framework

The findings presented here are based on the third part of the interview. It is about the acceptance of a framework addressing construction project knowledge management. Consultants and Clients are not always experts in construction. Therefore when

the consultant design the clients' wishes without involving experts in construction, in many cases they end up with issues and problems in the project at the post-design phases. Employees representing Clients sometimes do not have the right competencies to challenge the design nor to completely comprehend the construction scope. The issue is greater when the consultant (Architect) does not have the needed construction experience. As then they may produce an impracticable design resulting in time and cost implications. The patterns from this are: 1) A framework addressing construction projects knowledge management is the last thing clients and consultant will think about and 2) Contractors and subcontractors might also avoid such framework under the impression of the additional cost this framework will introduce.

A number of the interviewees experienced this issue, below are some examples:

"...part of the master planning the client included a lagoon. When we tendered the different packages, we included the lagoon in the enabling work scope. The contractor bid for it, but they never been able to deliver it. They did not have the know-how. Then they requested to descope the rest of the lagoon work from their contract. We instructed them to do the civil works and agreed to descope the rest of the work including the special paint. That was a mistake....this element of the project never been delivered right.." – interviewee CNT4. If a framework addressing construction projects knowledge management was in place this element of the project could have been delivered.

"We divided the scope of (package name) to more than one subcontractors. This package is all about quality and sequence of work. The local subcontractor never did something this big. The lack of a framework addressing construction projects knowledge management and controlling the sequence of work resulted in local subcontractor were late and this led to delaying the other subcontractors and then project delays and additional costs" – interviewee CNT4.

The high workforce turnover in the construction industry is diminishing the discussion about introducing a framework addressing construction projects knowledge management. A quick solution is temporary workers. This is resulting in the wrong team as the nature of construction work experience is developed over time. "...subcontractors' workers come and go regularly for many reasons. This is affecting the quality of work, which is the least they care about. They do this for cutting costs. They do it for not having long term commitment. They do not consider the development of experience or human capital, it is only more jobs more inflow..." – interviewee CNT1 As the long term personal development is not an objective. Therefore, they do not invest much in developing or maintaining a framework addressing construction projects knowledge management.

### *3.5 The Main Barriers to Project Knowledge Management Successful Implementation*

The findings from this section are based on the interview questions related to the main barriers to project knowledge management successful implantation in the construction projects in Oman. As per the outcome of the interviews, the patterns that emerged are: 1) Intangible return on investment, 2) Deficiency of stakeholders commitment, 3) Multidisciplinary nature of projects, 4) Long process and 5) Budget and cost assessment.

#### *3.5.1 Intangible Return on Investment*

As the knowledge management in projects needs is considered as an investment, the first barrier for implanting, then, it is the absence of calculating method to identify the return on investing in project knowledge management. Despite the fact that most of the interviewees responded that knowledge management positively influencing the project's success, they can not propose how to evaluate this influence. According to Interviewee DEV6: "... before we present new initiatives to our investment committee we have to illustrate the return on investment. In the case of knowledge management, the return on investment is there. However, it is intangible". Interviewee DEV2 explained that: "While we are practicing knowledge management in different formats, yet we do not scientifically calculate these practices influence." Measuring knowledge management's impact on projects will theoretically impact project performance. As lastly concluded that projects are characterized by being multidisciplinary in nature, thus, they will involve multi-activities that incidentally will build a kind of awareness and cultural attention to what is known as knowledge sharing. These will cover dramatical changes on team behavior and incentives towards sharing knowledge to manage projects.

#### *3.5.2 Deficiency of Stakeholders Commitment*

As the project is normally having many stakeholders and multi-activities, it is, as mentioned earlier that almost impossible to maintain the commitment toward sharing information in general and specifically toward knowledge management. According to Interviewee DEV7: "In certain cases, all the main parties committed to the knowledge management, but the whole idea faces a deficiency from the lower layer; all the subs". According to Interviewee DEV2: "... if the idea did not get full support of senior management, then the rest of the team never appreciate the process and never committed to adhering".

To ensure the advantages of knowledge management in utilizing and organizing the project activities and process, management as well as other parties are required to commit to sharing their knowledge experiences and skills. That is to provide a positive relationship between project performance and knowledge availability.

#### *3.5.3 Multidisciplinary Nature of Projects*

Regardless of its benefits to share and involve, the multidisciplinary nature of projects is another barrier to project knowledge management implementation and optimization. As in some of these disciplines, individual knowledge is the main capital they



have and for them sharing this knowledge, allowing to manage it and optimizing the use of it, will put their jobs at risk. More than one interviewee highlighted that their unwillingness to share knowledge is common in the industry and as a result, it turns into becoming a barrier to knowledge management implementation. Even if one discipline is ready to share knowledge and to be part of the knowledge management implementation, there are other disciplines that discouraging this idea and will make barriers to implementing it.

#### 3.5.4 Long Process

A number of interviewees have a negative perspective towards knowledge management, they believe that knowledge management means a long process in a way that might delay the implementation of the project. Therefore, they think that the long process requires more time to adhere to it, they ensure that the process of knowledge management is actually a barrier for the implementation. As per interviewee, CNT3 underlined that “as we are always competing with time, we fight anything that may delay us. We only want to finish the project and move to the next one.... yes we might be able to save time in the future if we really manage the knowledge we develop with time project by project, yet we do not see that as a justification to do additional long process related to knowledge management”. Even with no evidence that implementing knowledge management means long process, still many of the interviewees refer to this as a barrier. They used to perform in a routine way the regardless of what type of projects they are involved in. Copy and past actions are a much easier and faster way of performing.

#### 3.5.5 Budget and Costing Assessment

Preliminarily, budgeting the project differ for the client, consultant and contractor. While client is using the project estimate or budget to manage its costs during the accomplishment stages, contractor first use of budgeting is to put the right bid (competitive and profitable). Therefore, including a cost for project knowledge management by contractor –when client does not budget for the same and other bidders do not include these costs when bidding- might result in disqualifying this contractor commercially. This notion is clearly described by the interviewee CNT1 as professed that “if we do budget for it we might be the only bidder doing this and we might be bidding more than others and will not get the job. If we do not budget for it then, as a result, we will not be able to implement due to the budget barrier”. Consequently, the cost-effectiveness value of budgeting the project is of the least issues been considered while implementing knowledge management at the project.

#### 3.6 Enablers to Project Knowledge Management Successful Implementation

Overcoming barriers to successful implementation take into consideration: understanding and assessing the current situation, asking and listening to the professionals, and finally, developing enablers to overcome the barriers. The table below summarizes the barriers and the enablers.

Barriers	Enablers
Intangible return on investment	A metrics measuring the influence of implementing the Knowledge Management on projects
Long process	Factor the needed time for knowledge management implementation in planning each activity on projects
Deficiency of stakeholders Commitment	Create a culture of knowledge sharing. Link it to KPI, awards for example.
Multidisciplinary nature of projects	Build people awareness of the importance of Knowledge sharing. Encourage the culture of Knowledge sharing whereby each one could share or benefit from the knowledge provided.
Budget and costing assessment	Factor the needed cost for knowledge management implementation in planning each activity on projects

#### 3.7 Study Insights And Conclusion Of The Analytical Results

The study discussed the discoveries on the influential reasons to the projects overrun in time and cost and to the project not right scope in practice which includes the misalignment to the objective of the project, changes, cost of errors and omissions, cost of design changes and the cost of wrong competencies. Then it was about the influence of knowledge management on the project. Finally, it was about barriers and enablers for implementing knowledge management the same is summarized in the below Figure3.

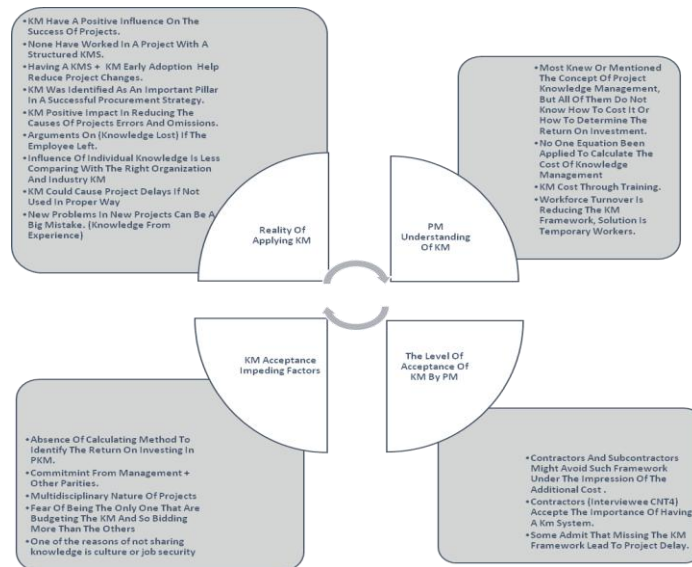


Figure3 Insight and conclusion of the analytical results

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