Industrial Engineering & Management
ISSN: 2169-0316

Imran et al., Ind Eng Manage 2018, 7:3
DOI: 10.4172/2169-0316.1000260

Review Article Open Access

Determinants of Overhauling Failures: Evidence from OEM Intensive Maritime Capital Projects

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Abstract

The purpose of this research is to find delay causing factors and gaps in standard project management, supply chain and resource management practices in maritime refit projects of Pakistan. In this study, outcome of literature review has been used to kick start the qualitative research. The primary data collection was based on thirty interviews from professionals to establish delay causing factors of capital refit projects of maritime sector. The data collected from interviews was analysed due to four major reasons. First, to highlight the grey areas in standard project management, supply chain and resource management practices. Second, identify new delay causing factors apart from delay factors identified during literature review. Third, crosscheck the authenticity of causes extracted from literature, and lastly to converge the number of causes to major contributors, and establish a framework based on maximum delay causing factors as more number of factors will dilute the efforts put in by the organisation to complete the major refit projects on time. The results of the study reveals that the most delay causing factors in OEM dependent capital refit projects of Pakistan maritime sector identified in the research are obsolescence, supply chain, resource management and project management. However, research also revealed that the effects of obsolescence can be greatly reduced if practices related to supply chain and project management are improved during the planning and execution phase of the project.

Keywords: Determinants; Maritime platforms; Original Equipment Manufacturer (OEM); Supply Chain Management (SCM); Obsolescence; Capital projects

Introduction

Rapid globalization and massive advancement in electronics during last few decades have drastically changed the design and principle of electrical and mechanical systems [1]. Solomon et al. [2] in their research have highlighted that new elecrtrical and electronis systems have a short life span as the manufacturer incessantly working to introduce modified system which process large data in less time and are more user friendly. In order to ensure quick market saturation for the product, manufacturers stop the technical support of their previous product and thus leaves no option for the user other than to buy the modified version. However, in case of military equipment the product life is more compare to commercial products, therefore, the electronics used in military hardware faces an acute problem of obsoloscence due to change in market startegy from repair-use to use and throw principle [1,2].

The sea going platforms of maritime sector in particular and hybrid systems of public sector in particular are fitted with very expensive electrical, electronic and mechanical systems. The replacement of these complete systems due change in technology is not a cost effective option especially for the developing Nations like Pakistan [3]. Therefore, these platforms are given refit to ensure operational readiness for deployment. Therefore, refit project can be define as a project in which all the system and machinery fitted on these platforms are dismantled and disembarked for defect rectification and overhauling. This activity needs timely availability of required spares from OEM and requisite resources to undertake this job on time. These systems undergo defect rectification and overhauling process and then checked for correct operations in workshop environment before embarkation on board. Upon embarkation the system is connected, energized and check for its correct operation in harbor and then at sea. Therefore timely completion of these major refits of sea going platforms is very important to reduce supply-demand gap and maintain the competitiveness of maritime sector of Pakistan.

The delay in completion of refit projects of OEM dependent maritime capital assets often results in cost overrun and makes the project very complicated and risky [4]. Since there are number of stake holders envolved in such projects which have varing acuity due to difference in their work experience and lack of communication. Further, timely availability of implicit and explicit resources along with required set of spares and infrastructure significantly reduces delay in OEM dependent refit projects of capitl maritime assets [5,6]. Despit the aforesaid, timely completion of these projects remains a quest for managers due to issues like cost over run, obsoloscence and numerous associated risks of large scale projects. The capital refit projects of Pakistan maritime sector, apart from aforesaid reasons also faces unprecedented delays in their completion due to change of project manager, project sponsors as well as organizational strategy to meet the operational requirements. Such changes during the execution phase becomes detrimental for capital refit projects of maritime assets and make it impossible to meet the gap between supply and demand of maritime platforms. The combine effect of these issues make the project execution extremely difficult and impracticable.

In order to start the research, a comprehensive literature review was done to find out the existing delay factors which are making the projects unfeasible. Further, the scope and definition of overhauling failures is strictly restricted to the delays[1] in overhauling operations

[1]A delay is defined as a significant time over run as compared to initially approved overhauling schedule. Such time over runs may have strategic bearing.

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Received June 10, 2018; **Accepted** September 12, 2018; **Published** September 17, 2018

Citation: Imran M, Kureshi N, Mairaj T, Nisar S, Shah A (2018) Determinants of Overhauling Failures: Evidence from OEM Intensive Maritime Capital Projects. Ind Eng Manage 7: 260. doi:10.4172/2169-0316.1000260

of capital projects arising out of issues in (i) project management (ii) supply chain (iii) human resource capabilities and (iv) Technical obsolescence.

Literature Review

Supply chain

The maritime platforms are the backbone of maritime sector and their timely availability whether it be for cargo transfer or to exert sovereign control at sea is considered mandatory for maintaining the requisite competitiveness of the sector [7]. However, these platforms require schedule maintenance and timely defect rectification to avoid a major break down at sea. Therefore, timely availability of required set of spares and resources is necessary to complete the defect rectification and maintenance as per the OEM defined schedule. Further, to reduce the supply-demand gap of OEM dependent maritime platforms, additional investment is required to increase repair capacity and maintain large spare parts inventory [8].

Supply chains in OEM intensive capital overhauling projects of maritime platforms are generally global in nature, i.e., putting the organizations in a position where they have to consider the overall performance of the global supply chain and not just the performance of their supply chain. Cachon [9] indicated similar findings and indicated that two main strategies in capital project supply chain include the balancing order intervals and flexible quantity strategy. The author indicated that supply demand variance for inventory, such as raw materials acts imperfect proxy of the supply chain. The author pointed out that even small changes in any portion of supply chain, such as demand variability, visibility or flexibility problems could ultimately make the supply chain ineffective in short as well as in long-term. Since, capital projects are long-term, such inefficiencies could lead to major problems in the project. This indicates the importance of project scheduling as well as supply chain scheduling to map the outcomes of various activities, and the impact of any unplanned, or unanticipated incidents, which could inflate the supply chain and project management flaws significantly to reflect the lack in overall strategy of the organization in handling its capital projects. At the same point, even in the most recurrent capital projects, the possibility of eliminating the unanticipated incidents or variations is not possible. However, the crossover between project and supply chain management allows consideration of activities with an additional perspective such as risk management in Project Management and risk management in SCM, to identify activities or events that could happen before hand, and make contingency plans to lessen the impact on project schedule in case of general as well as in capital projects. Industries involving capital projects highly rely on the critical nature of inventory management. Collaborative work scheduling across a variety of stakeholders have been recognized by Cachon and Fisher [10] as an important success factors in construction supply chain. Thus, reviewing inventory policy is critical for success of such projects. In addition to this, Coyle and Gardiner [7] pointed out that information sharing is vital to the capital projects, in terms of integration, and effectiveness of performance. The value of information has been established by a number of other researchers [9-11]. All of these researchers identified the importance of information sharing in supply chain as well as project management perspective to arrive at correct decision. With regard to capital project supply chain, such as those in construction industry, researchers have identified a number of serious management issues. Xue et al. [13] identified intelligent agent based coordination. Xue et al. [13] pointed out that the reasons for the above mentioned managerial issues is the significant difference of construction projects from others like involving different domains of economy such as manufacturing, services and others, fragmentation, one-off production, conflict management, uniqueness of a project and others. the same features could be traced in maritime capital project because mostly the project involve manufacturing as well as services, usually one-off such as overhauling projects, conflicts exist and every capital project is unique, whether it relates to construction or overhaul. In relation to capital projects [14,15].

Capital projects are characterized by supply chains that involve a number of organizations, usually resulting in inter-organizational network. Under this SCM perspective. This was done by focusing on Interpretive Structural Modeling (ISM). This model has been found by authors to help in identification of relationships between antecedents and setting priority for their achievement, giving a hierarchical view. This hierarchical view comprises of 16 procedures divided into macro classes being cross-organizational cooperation, rules and procedures - accessibility and super-ordinate goals. This study is of high relevance to the research topic that the use of ISM was testing in a Yacht-building context, resulting in important insights relating to the implementation process in the maritime industry. Thus, the use of ISM is very important from management's perspective due to its strong conceptual background for SCM adoption, focus proven applicability in projects that are complex and are usually to be carried out in unpredictable setting, being the typical features of maritime capital projects.

Most of the industries where long-term engineering projects dominate such as construction industry, maritime industry, aircraft construction industry, the fragmented nature of the projects are well documented. The resolve of clients, in case of capital projects in maritime industry is based on competitive pricing, which becomes more important factor when it comes to developing countries like Pakistan. Thus, management of a maritime overhauling capital project is dependent upon procurement and supply chain structures. Researchers like Emuze et al., [15] found that traditional procurement methods, which are usually based on lowest price, are preferably used. The authors also found that the performance of a project is dependent upon design and supervision team, and integration of outcomes, balancing short-term as well as long-term relationships. This peculiar thing leads to marginalization of the short-term nature of relationships. The continuous reliance on a procurement method leads to compromise on collaborative working arrangement, threatening the improved performance that would have been possible.

The growing complexity of activities at tactical and operational level in any industry is pivoted at the crossroads of various topics. Supply chain management seems independent topic with reference to project management, especially in maritime industry involving overhaul of Capital Sea going platforms, where each project takes significant time period to complete. However, it is not the case in real. The complexity of supply chain, distribution of suppliers, the growing trend of outsourcing, off-shored activities and the increasing demand for one roof solution, creates supply chain challenges for management of long-term projects. Gaudenzi and Christopher [16] indicated that many forces act collectively to make supply chains complex. Among these forces, increased outsourcing, increased off-shoring and procurement, changes in product requirements, and internationalization creates challenges, which should be addressed to sustain competitiveness. The authors pointed out that the solution for meeting supply chain challenges, especially in capital projects is to develop a hybrid supply chain that incorporate the feature of 'lean' as well as 'agile' supply chain.

The authors focused on telecommunications industry, where most of the projects are long-term, to demonstrate that supply chains adopted by the industry are 'leagile', a term representing lean and agile. In another latest research by Xu et al. [17] indicates that recurrent projects often face problem like random material delays and others. A number of capital projects, especially those in maritime industry related to overhauling are recurrent long-term projects, which present a practical interface between project management and supply chain management, and are prone to random material delay, due to their scheduling and material requirements. The authors indicated that in such projects, a project-driven supply chain (PDSC) is the only solution resulting in optimization of safety stock decisions, as well as the crashing decisions in the projects. Additionally, the authors based optimal crashing policy on convexity properties, and studied the link between underlying inventory decisions and project crashing decision, necessitating the use of PDSC. Moreover, Cohen et al. [18] has pointed out that such a trade-off from OEM is not be so simple in the presence of existing complex supply chain structure for spare parts availability and supply network. However, aspect of supply chain for non-availability material/spares and its effect on timely completion of overhauling projects related to maritime platforms have not been covered in the said study.

Human resource

The refit projects of OEM dependent capital maritime assets have to follow pre-defined schedule maintenance to avoid major break downs at sea. The timely completion of these refit projects heavily depend on the availability of required spares and resources. Peteraf [19] have highlighted two very important aspects to ensure timely availability of maritime platform after a refit project. First, those organizations can enhance their competitive advantages by acquiring valuable resources when they are actually required. Secondly, handle unforeseen activities by controlling implicit and explicit strategic resources.

Capital natured projects in developing countries heavily depend on systems and procedures defined by OEM. Correct implementation of these procedures is possible when the required set of resources are timely available to ensure optimization of efforts in capital projects. Effective application of resources can allow organizations to enhance competitive advantages by acquiring capabilities and resources which are necessary and valuable [19]. Good control of these strategic resources including explicit (systems, equipment and spare parts) as well as implicit (Information, communication etc.) proves out to be a power tool for handling unforeseen events [19].

Creating competitive advantage is vital in organizational settings that involve unique skills such as those engaged in capital projects of maritime industry. Thus, any organization operating in such an industry requires valuable, rate, inimitable resources and organization to create competitive advantage. It is often argued that the organization must endeavors a framework referring to the firm's practices, activities and processes necessary to develop dynamic capability. Further, the role of human resources (HR) in resource management of an entity, whether commercial or otherwise has been widely established by researches like Batt [20], Beardwell [21], Boxall and Purcell [22], Burke [23] and others. The researches converge on the findings that competitive advantage of an entity, keeping focus on internal and external environments, and growing challenges like internationalization, global market expansion, and emergence of new technologies are dependent upon highly productive, efficient and effective workforce. This is a major addition to resource theory, indicating that generating and sustaining a competitive advantage depends upon the organizational ability to possess, and effectively manage unique, efficient, and valuable human resource.

Kazlauskaite and Bucinniene [24] indicate that human resource are central to the resource management and suggesting that this particular resource act as a long-term foundation for any organization. The authors indicated that both distinctive and generalist approach in resource theory indicates the importance of HR, as a key resource for organizational strategy, sustainability, scalability and success. Under distinctive approach, the human resource possess unique skills, knowledge, abilities, experience, attitudes and wisdom that an organization capitalizes through productive services, high-end reasoning and decision-making abilities, knowledge accumulated through time, judgment, propensity to take risks and identifiable expertise, identified and found respectively by Grant [25], Kamoche [26] and Barney [27]. Additionally, the generalist approach indicates that HR is a resource that is under control of a firm as human capital resulting from employment relationship, representing people working in the organization or working for it, pivoting the findings of Wright [28], Gomez-Mejia et al. [29] and Fisher et al. [30]. The centrality and criticality of human resources originate from the complex system in organizational representing interplay between mechanism and value generation and its path dependency. The importance and criticality of human resources is established by Barney [27,31], Grant [25,32], and Kamoche [26]; competency-based view by Lado and Wilson [33] knowledge-based view by Grant [25,32], business-network view by Strandskov [34], and other approaches.

Louisot [35] identified that intangible assets have become critical for most of the organizations and business across the globe, contributing towards the overall 'reputation' of the business. Such intangible significantly affect the total value, efficiency and effectiveness of physical assets of the company. Although, these findings seem irrelevant to the capital overhauling projects, but technically the capital overhauling projects such as those in maritime industry, the composite reputation matters significantly. The nature and involvement of specialized equipment such as navigation, combat, SCADA's, communications, command and control and global positioning system, drive impact of long-term reputational image of a company, and in OEM intensive maritime platform overhauling capital projects of capital nature such as maritime platform overhauling. in this regard, the author pointed out that entities that are significantly dependent upon their composite reputation of intangible that determine the performance of their physical assets, shall adopt a holistic systemic approach, taking into account the risks, variation and uncertainties, whether positive or negative to manage their reputation. The author found that in reality, there is no reputational risk, rather these above listed things i.e., intangible and tangible assets determine the reputation. Further, capital projects, related to overhauling are characterized by a unique feature i.e., being multi-stage production processes where a number of resources, including inventory are used. This necessitates the use of operations sequencing to manage lead times and predict deterministic yield losses and random demand. Bilal and Malik [36] indicated that operations sequencing is integral because it supports pre-operation and post-operation cost structures under various cost criteria such as total discounted or average cost.

In addition to human resources, knowledge (implicit as well as explicit) is an important resource that plays vital role in organizational performance and its capability to meet operational, tactical and strategic needs. In a research focusing on the role of implicit and explicit knowledge, Smith, indicated that the importance of labor and other factors of production has been overstated in history, undermining the importance of creating and applying knowledge. The author indicated that the ability of an organization to acquire and manage knowledge

not only measures the managerial success, but also indicates presence of strong knowledge-related capabilities. Said studies mostly covers benefits of resources related to business environment and it slightly touches the advantages of intangible implicit resources because same are deeply imbedded in management system and difficult to replace [37]. However, their impact on the performance of OEM dependent projects have not been elaborated in aforesaid research.

Project management

The field of project management has emerged as a combination of other disciplines namely, quality management, risk management etc. This peculiar aspect was identified by Mottram and Sam [38] who pointed out that traditional project management perspective is getting outdated and needs latest skills, techniques and theory to meet modern industries requirement. In this regard, the emergence of a cross-functional inter-professional teams for capital projects like overhauling of maritime platforms requires an integrated approach towards project management by combining other fields like SCM, quality management and risk management etc. Thus, the project management is a combination of procurement, quality management and risk management activities; therefore, it is important that industries should train their workforce by abandoning the traditional project management approach while dealing capital overhauling projects related to maritime platforms. Xu and Wei [39] have indicated that factors like consumer needs and production cost, in capital projects related to overhauling of maritime assets are sometimes difficult to estimate, and hence historical data is used to kick start the project.

In capital projects, another project management problem is the existence of random as well as fuzzy variables that interplay with decision making system. In this case the decision makers have a limited access to accurate information and have to depend greatly on partially estimated variables. For example, replacement of an overhauling facility with new one in maritime industry involves a number of fuzzy variables, where a variety of random and fuzzy front activities interplay and making the decision making process difficult [39]. Further, no guidance from PMBOK is available on pre-project preparation and handling of issues arising due change of project manager, project sponsor and organizational strategy in case of capital projects. Therefore, in most of the cases these capital refit projects of maritime assets become unviable and their subsequent usage remain mired with reliability issues. The capital refit projects of maritime sector are governed by standard project management practices across the world. However, most of the countries like Spain, Canada, India, Pakistan...etc. are facing the problems of time and cost overrun in maritime projects.

Technical obsolescence

The problem of technical obsolescence arises when OEM discontinue the technical support of their electronic systems for which modified versions have already been launched in the market. Since maritime platforms are fitted with very expensive state of the art electronic suits which are kept operational through repairs and maintenance for long time. These types of electronic system have been hit the most due technical obsolescence and short product life cycle and contributing maximum towards late delivery of maritime platform after major refit. In the course of literature review it was came to light that because of obsolescence Canada had to pay 11 million dollars over and above the refit cost of submarine along with another submarine of same class for cannibalizing the electronic suit with a time overrun of 3 years [3]. Similar incident was happened with Indian Navy when three plotting tables were purchased from UK for three submarines. The refit of first submarine got so delayed that only one table was made operational by sacrificing the electronic modules from the remaining tables.

Research Methodology

Academically, little has been done to theorize and conceptualize the theory of time efficiency of the overhauling operations of capital projects. The scope of this study is not generic and restricted to test hypothesis, rather it aims to formulate evidence based theory in context of potential determinants of failures in overhauling operations of capital intensive projects. The paper uses exploratory approach to identify gaps in existing project management practices along with key determinants by analysing various refit projects undertaken by the organisation. The base line for the research was established using the frame-work concluded during the course of literature review. The research is focus to examine gaps in standard project management practices, various determinants causing delays in timely completion of refit projects. The research methodology used to arrive at conclusion is as follows.

Research design

The nature of study is exploratory, therefore, a qualitative approach was adopted and interview method was used to collect the primary data. For this purpose thirty three professionals engaged at various level of the project were selected. To make sample representative the potential respondents were randomly selected from a core of highly specialized experts presently engaged in overhauling operations of capital projects or have been assigned such task in past. Since potential interviewees have specialized background of specified benchmark[2] in context of this study, therefore a sample size of 30 is optimistic.

Data collection

In this case interview was used as a tool to collect data to find out determinants of overhauling failures. The potential interviewees are individuals with highest degrees of professional expertise and exposure on OEM intensive capital projects in Pakistan. Moreover, the refit projects undertaken by the organisation during last twenty years were selected to broaden the data collection base for correct identification determinants caused delay in completion of refit project as per the OEM defined timeline. The interviews were carried between first quarter of 2015 to first quarter of 2016 with an average time of one hour and 30 minutes for each interview. The interviews of key informants were structured and outlined to identify the project specific determinants of delays and failures in refit operations. The interviews were conducted using an interview guide focusing on individual perception regarding determinants causing delays in completion of refit projects related to maritime assets. Voice recorder and hand written notes were used as a tool to collect data during the interview. The collected data was then converted in to MS-Excel file for data analysis using Nvivo software to make the results conclusive [40-45].

Research design

The potential organizations engaged in overhauling operations of OEM intensive capital projects in Pakistan which can best serve the objectives of this study are Pakistan International Airlines, Pakistan Railways, Pakistan Army, Pakistan Air force and Pakistan Navy. Due to limitation of time, cost out of the above mentioned five organizations,

[2]Potential respondents should be engaged in overhauling operations of OEM intensive marine capital projects or have been assigned such tasks during their career.

only the overhauling operations in capital intensive maritime projects were selected for further investigations in purview of scope of this research as defined in introduction.

Out of OEM intensive highly specialized capital project, the overhauling operations of five different projects were selected as a sample design for this study. Though this study is specifically restricted to overhauling operations of sea going platforms, however, this is equally useful for rest of the organizations mentioned above. This study's predisposition and academic discourse is most relevant for engineering managers engaged in OEM dependent capital refit projects of maritime assets.

It is an exploratory research and the area of study is presently under explored not only in Pakistan but in regional context. The research reported in the literature available provides a useful initial set of noticeable determinants. A mixed method approach has been adopted in which the framework based on determinants derived from literature review was used as a starting point for the research. The primary data collection was based on thirty interviews from professionals to ascertain delay causing determinants of capital refit projects. The data collected from interviews was analysed to accrue four major benefits. First, to highlight the grey areas in standard project management practices on which there are no clear guide lines available in PMBOK. Secondly, identifies new delay causing determinants apart from delay determinants spotted during literature review. Third, crosscheck the authenticity of determinants extracted from literature, and lastly to converge the number of determinants to major contributors, and establish a framework based on maximum delay causing determinants as more number of determinants will dilute the efforts put in by the organisation to complete the major refit projects on time [46-49].

In our sample size of 30, the hierarchy of potential interviewees and key informants include 15% from top management, 20% from middle management, 55% from middle-lower and 10% from lower management. On the basis of interview based on qualitative research design, we identified and put in ascending order the key factors responsible for overhauling delays and failures. Then we corroborate our evidence and investigations from literature and finally devised a theoretical framework for mitigation of delaying factors with highest degree of risk involved.

Data Analysis

Since it is an exploratory research, therefore, the most appropriate and widely used method of thematic analysis was used for data analysis [40]. In this analysis the occurrence and frequency of determinant and sub-determinants called themes and sub-themes are extracted from MS-Excel data file using commercially available Nvivo software. The purpose of this software is to increase counting consistency and decrease coding irregularities significantly by doing the process of counting, weighing and theme identification process with the help of a computer. The result of Nvivo is a theoretical plot of substantial themes obtained by drawing their relevance and relationship within the data by counting occurrence and frequencies of each determinant and sub-determinant. The output from Nvivo is shown in Figure 1 in which major themes and sub-themes causing delays in completion of OEM dependent maritime refit projects are shown alphabetical words. The size of the alphabet shows the frequency with which the word was repeated during the interview.

Results and Discussion

The interviewees were selected from an even distribution of experience ranging from 3 to 8 years so that a true picture of delay determinants related to refit projects of OEM intensive capital maritime assets can be obtained. Since the research was done on a public sector where the leadership was not cost drive but was focused more on stake holder satisfaction. Therefore, most of the interviewees had no idea about the cost involved in the overall project but were more focused on completing the project under prescribed time with given quality standards. In order to ensure accuracy of primary data collection, special emphasis was given towards the education and work experience of the respondents. Selection was done in such a way that more that 60% were having a project handling experience of fifteen years. Further, the education level was selected in such a way that more than 15% were having a graduate degree and rest of them were having diploma in associate engineering from a reputed organisation. The collected primary data revealed that a wide range of determinants perception was prevailing among the respondents which are causing delays in completion of maritime refit projects. The result of thematic analysis based on primary data revealed major determinants and sub-determinants causing delays in timely completion of refit projects. The output indicates that there are seven major themes with numerous sub-themes causing delays in refit projects related to OEM dependent capital maritime assets of Pakistan. The significant of them are as follows:

- Spares and material

Figure 1: Result of Qualitative Analysis.

- Short product life cycle
- Pre-project preparation
- Planning phase
- Execution phase
- Human resources
- Infrastructure and yard capacity.

Spares and material

The respondents while interview have highlighted the non-availability of requisite spare when they actually needed. Since, these refit projects are related to capital maritime assets which are fitted with state of the art electronics, equipment and machinery designed and manufactured by various OEMs around the world. Therefore, to repair and maintain such machinery timely OEM technical support with respect to correct provisioning of spares plays a vital role in timely completion of refit projects of such maritime platforms. It was highlighted during the interview that there are no guidelines available in PMBOK for planning pre-project activities during which required spares are identified and demanded from OEM. Due to lack guidance, communication and coordination among various tiers of supply chain between repair yard and the OEM nonconforming spares are received. It was also highlighted that if the at all the correct spares are provided by OEM but these spares arrive quite late which adds in to overall delay in completion of major refit project related to maritime assets. It has also been observed that these causes are also being faced by all those public sector organisations engaged in similar type of refit projects.

Short product life cycle

It was came to light during literature review as well that rapid advancement in the field of electronics is facing a peculiar problem of short product life cycle. The maritime platforms fitted with state of the art electronic system is the most affected with short product life cycle in platforms of maritime sector. It was reported by the respondent during the interview that short product life cycle is causing obsolescence which is contributing the maximum towards delay in completion of refit projects. It was also highlighted during the interview that no system is in place which can identify potential electronic circuits and modules which can face obsolescence and timely initiate local or off-shore development of such electronics to make them available when needed during repairs and maintenance. It was also came to light through interview that during technology acquisition OEM should be consulted to identity areas which can be affected due obsolescence in the light of their five year plan and be asked to provide extra spares to ensure through-life-supportability of affected systems.

Pre-planning phase

The respondents repeatedly highlighted the problems being faced during pre-planning phase of the project. The most significant issues highlighted include correct anticipation and planning of fizzy front activities. A dire need was highlighted for timely identification and placing of order for required spares and to establish effective communication among all tiers of supply chain till the required spares are not received. Further, it was also reported during the interview that no well before time action is being taken to cater issues arising from obsolescence. It was also highlighted by one of the senior management during the interview that there are no formal guidelines available in PMBOK to conduct pre-planning phase activities due to which no standard sequence is being followed in this regard.

Planning phase

The next major determinant emphasized during interview and thematic analysis was mismanagement of planning phase. It was reported that proper PM principles particularly absence of analysis for previously completed similar projects were not applied during planning phase of the projects. Therefore, there is a common tendency prevailing in the system where similar errors and mistakes are repeated in every project resulting in growth work extra time and cost. It was reported by a senior manager that there is complete mismanagement in resources allocation and there is no concept of planning project activities using advance computer software commercially available in the market. Therefore, while handling multiple refit projects the track of resource allocation is lost and accurate time of completion for major activities cannot be anticipated.

Execution phase

The deficiencies in project execution also came to light during the interview process. It was reported that the work force involved in project execution was never given any formal training during last 20 years and those trained before were never given any refresher course to brush up their previous knowledge and keep them abreast with latest trends being followed during execution phase of the project. It was found that work is being done in isolated compartments and there is a gap in communication between upper and lower management. Further, growth work due change of scope and errors with respect to resource allocation could not be anticipated correctly and therefore un-rational refit completion dates are usually agreed while revising the schedule during execution phase of the project.

Human resource

Another determinant came to light during the interview was human resource which is an implicit resource which is deeply seated in the system and is difficult to replace. The problem skilled labour retention was the main issue highlighted by the respondents during the interview as the public sector could not offer good packages to their workforce which ultimately force the skilled labour to leave the organisation for greener pasture. Since lot of efforts and time is required to train a person for a specific job therefore, it is necessary to provide conducive enviornment to silled labour to arrest prevailing high attrition rate in the organisation. Further, it was also informed that professional development courses are not being offered to keep the working staff current with new equipments and computer assisted techniques to optimize the work of refit projects.

Yard capacity

The senior respondent during the interview informed that yard was design to handle two maritme platforms at one time. The same was practiced some couple of decade ago but now with the induction of new platforms and technology the refit projects are facing unprecedented delays causing accumulation of more number of platfoms at one time crossing the yard handling capacity. It was also informed that for an interim solution to yard handling capacity, schedule refit of maritime asset was delayed by keeping the platform operational to avoide having more number of platform under major refit. This has resulted in growth work due excessive hull and machinery detrioriation and consumes an extra time in years to complete the refit of such platforms. It was informed by the senior management that at present the only solution to this abject problem of unprecedented delay is to increase the yard handling capacity and the culture to sub-let the work to private sector be promoted.

Proposed Framework

The delay determinants in terms of themes identified during thematic analysis were checked for their accurateness using triangulation method. The most significant determinants causing delays in completion of OEM dependent refit projects of capital maritime assets are timely availability of spares, short product-life-cycle, gaps in standard project management practices in pre-planning, planning and execution phases, acute shortage in skilled set and limited yard capacity. The aim of this analysis was to reduce the number of determinants to an extend where an organisation can easily focus on to improve these delay determinants and deliver the OEM dependent refit projects related to maritime sector of Pakistan on time. Therefore, a model is proposed where the similar sub-themes are combined to form a main theme in order to reduce the number of determinants and making the organisation easy to concentrate on the most delay causing determinants for project optimization. The important and significant feature of the proposed framework is as follows:

a. The sub-themes related to non-availability, non-conforming spares from local and abroad, internal-external customer relation, communication among various procurement tiers and acquisition planning identified during thematic analysis are combined to have a one major theme. The organisation will endeavor to improve all these sub-determinants of delay under one major delay determinant of supply chain.

b. Similarly, short product life cycle, indigenous development, out sourcesing, inventory management and technology management sub-themes into a one bigger theme for ease of concentration. The aforesaid sub-determinants causing delays are combined into management of obsolescence.

c. The outcome of qualitative analysis pertaining to sub-themes like skill set, deficiency in test facilities, test equipment's, test benches, auxiliary systems, support services and infrastructure are all put under the umbrella of resources. The management of required resources as a delay causing determinant will ensure optimization and delivery of refit project on time.

d. The delay sub-determinant highlighted as pre-project preparation, planning and execution mismanagement are combined to form one determinant of project management. It was came to light that delaying effect of determinants like management of supply chain, obsolescence and resource can be alleviated by re-aligning and reducing the gaps in standard project management practices.

Conclusion

The empirical evidence suggests that standard project management practices do not cater for planning of pre-project activities, effects due to change of project manager, project sponsors and organizational strategy during execution phase of the project. Further, there are four potential determinants of overhauling failures which do have bearing on time over runs in overhauling operations of OEM intensive maritime projects. The priority order deduced from empirical evidence attached foremost importance to (i) Effective and efficient supply chain system, followed by (ii) Project management (iii) Resource management and (iv) Obsolescence management. The results obtained from thematic analysis reveals that the most repeated delay determinant mentioned by the respondents during the interview was obsolescence, supply chain and resource. While establishing the robustness of results using triangulation method revealed gaps in standard project management practices. Therefore, if the delay determinant of project management and supply chain are aligned, then the effect of delays due obsolescence and resources will be addressed up to some extent. The outcome of this research is useful for individuals working in academia as well as handling OEM intensive capital refit projects in public sector. The results are also helpful for researchers to understand gaps in standard project management practices for which no guidance is available in PMBOK. The findings are also going to help experts to optimize standard project management practices in projects of similar type anywhere in the world and propose means to extenuate delays in such projects.

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