

## **RISK MANAGEMENT IN DELIVERING COMPLEX RESEARCH & DEVELOPMENT PROJECTS: A CASE OF THE UNITED ARAB EMIRATES ARMED FORCES RESEARCH & DEVELOPMENT CENTER**

Badr Ahmed Alshehhi<sup>a</sup>, Dr. David Thorpe<sup>b</sup>, Dr. Steven Goh<sup>c</sup>  
University of Southern Queensland ,Abu Dhabi, United Arab Emirates<sup>abc</sup>  
Corresponding Author : w0061492@uq.edu.au

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### **Abstract**

Risk management continues to be a major feature of the project management of large construction, engineering, technological, research and development projects in an attempt to reduce uncertainties and to achieve project success. Working in Research and Development Centre of the United Arab Emirates Armed Forces is challenging as new developments are continues since the tasked projects include high degree of risks which may potentially interfere with successful completion of these projects. Therefore, a scientific approach and developing process improvements for identifying and managing the risks that exist in these projects are needed within the context of the UAE environment. This will fill a void in the literature, although managing risks of R&D environments have been studied for many years, where current studies fall short of studying these risks in the UAE Military. The benefits will yield theoretical framework for managing risks that fits UAE military and similar R&D environments

**Keywords:** Armed Forces, R&D, Complex Project, Risk Management.

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### **1. Introduction**

Risk management continues to be a major feature of the project management of large construction, engineering, technological, research and development projects in an attempt to reduce uncertainties and to achieve project success. Managing risk is an important task in identifying and quantifying the uncertainties inherent in complex research and development projects. Managing such risks better aids minimization of threats and maximization of opportunities in such projects, and therefore better assists such projects to realize their potential while minimizing exposure to potentially adverse outcomes.

Thus, this paper outlines an Engineering Doctorate proposal of *Management of Risk in Delivering Complex Research and Development Projects*. The research is based on a real case study focusing on risk management in Research and Development Center of the United Arab Emirates Armed Forces. Although managing risks of Research and Development (R&D) environments have been studied for many years, researches on risks associated with R&D of military environments are still relatively low and almost scarce in the United Arab Emirates (UAE), giving importance to such a study to fill in the literature.

This proposal will highlight the research purpose, objectives, and motivation together with statement of the problem and the current status of the proposed research organization. This will be followed by brief literature review and theoretical background of risk management in general as well as in R&D, military, and UAE, and, consequently, the significance of the proposed research. Then, the research question and brief of methodology aspects along with the research timeline and ethics are presented.

In summary, the aim of this paper is to provide a research proposal at an engineering doctorate level to construct a theoretical framework for Research and Development Center of the United Arab Emirates Armed Forces in order to manage the potential risks of their complex R&D projects.

## **1.1 Focus of the Study**

### **1.1.1 Research Scope and Purpose**

The scope of this study is to develop a framework for managing risks of complex Research and Development (R&D) projects of the United Arab Emirates Armed Forces (UAEAF). The purpose of this research is to analyse, based on a real case study of the Research and Development Center of the United Arab Emirates Armed Forces (RDCUAEAF), the risks that are associated with complex research and development projects in a military working environment. The Intent is to identify and construct an R&D risk framework that reflects impact of risks on large scale R&D projects in the United Arab Emirates (UAE) environment. Understanding stakeholder's perception on the type of risk identified in their development work is at the core of the study in order to construct the convenient risk framework. The UAE is a unique environment where culture, tradition, religion and socio-economic factors engulf work environments. The impact of these elements, through the eyes of the stakeholders, as well as any elements arising from their views, will be of importance in the construction of the risk framework for the study. Based on this analysis, confirmation of this framework will lead to generalization of the results to the intended population.

### **1.1.2 Study Motivation**

Military research and development no longer remains the privilege of a handful of industrialized, wealthy nations, and its belief that military's R&D will release and persist a new wave of proliferation (SIPRI 2014). R&D activities can be characterized as complex, interdependent, responsive to sudden research environment changes, and heavily reliant on expert judgment to maintain quality, relevance, and performance (Energy Facility 2010). Process improvement is historically considered as a critical element to the success of an organization or business.

Therefore, the motive for this research, based on data collection and analysis, is the researcher's quest to discover and develop process improvements for identifying and managing the risks that exist in these Research and Development Centre (RDC) projects in which it can be applied to similar complex projects in this environment and other related environments and organizations. The researcher, being part of this organization, has witnessed a need for such inquiry, that will not only lead to an improved risk management process, but also to save precious resources, expertise and expenditures by minimizing risks and maximizing success of such projects. It is important to have experts in managing risks at this level of complex projects in a country with scarce human resources that lack the proper specialization in the field.

### **1.1.3 Statement of the Problem**

Working in RDCUAEAF is continuously challenging as new requests and developments are in daily demand and its associated projects require variety of resources and expertise. Further, they include high degrees of uncertainty and risks which may potentially interfere with successful completion of these projects. Therefore, potential risks ascend which threaten the successful completion of the projects and in some cases these projects fail to deliver their basic outputs due to these risks.

One of the typical examples of the RDC complex projects is that UAEAF has purchased a huge fleet of “Mine Resistant Ambush Protected” military vehicles from USA with basic structures without any installed configurations. UAEAF tasked the RDC, through arrangement with the end-users; the Land Forces units, to integrate different types of configurations consisting of different kits and armaments. Specific configurations should be installed for each set of these vehicles. For example, for a predetermined number of these vehicles, the following has been tasked to be installed:

- Four types of communication systems; one from USA and three from France.
- Two types of medium weapon systems; one from USA and one from UAE-German Company.
- Many basic mission related equipment such as display units and munitions which are either local or foreign products.
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As a result, RDC placed in high uncertainty situation with very expensive, special, and complicated type of military vehicles which have multi complicated and secret subsystems, tasked with R&D activities to integrate different system configurations of different standards from different countries, and communicate with end-users, suppliers, subcontractors, licensing and legal authorities, and team each with different countries, cultures and perceptions, to deliver efficient and reliable product that meet the expectation of the UAEAF. Therefore, a further look into improving the process and system of identifying and managing the threats that exist in these projects and project’s environment are required. There is a need for a scientific approach, to uncover user perception of risks associated with such complex endeavour and the elements that impact the management of such processes within the context of the UAE environment. This will fill a void in the literature, where current studies, to the best of the knowledge of the researcher, fall short of studying these risks in the UAE Military. The benefits and recommendations will yield a framework of managing risks that fits UAE and neighbouring Gulf Countries which share culture and traditional values.

## **2. Literature Review**

### **2.1 Theoretical Perspective**

#### **Project Management Plan**

A project is defined by (Berkun 2005) as “a carefully defined set of activities that use resources such as money, people, materials, energy, space, provisions, and communication to meet the predefined objectives”. Complex project, differ from traditional projects if it’s large in scope, cost, and size or includes structural, technical, directional, or temporal complexities (Remington & Pollack 2007). Some professionals believe that R&D projects are always complex since planning and heading of R&D are unclear and revolve around uncertainties (Kerzner & Belack 2010). A complex project typically comprises several different and overlapping phases, includes cultural implications and interactions with several suppliers and team from various cultures, and has many stakeholders with number of customers or end users each with different perceptions and plan for the project (Kerzner & Belack 2010).

Project management is the discipline of organizing and managing resources in such a way that the project is completed within defined scope, quality, time and cost constraints (Gerard 2003). The important thing about project management is that it is a convenient methodology that adapts to any size of project or program. The tools and methodology that are used are similar in all projects (Newell 2005).

A Project Management Plan (PMP) is prepared to develop a source of information that will work as a guideline for how the project will be planned, executed, controlled, and closed (PTR Development 2006). Hence, from authorization to completion, a project goes through

a whole lifecycle that includes the process of defining and initiating the project objectives, planning the work to achieve those objectives, execution the work, monitoring and controlling the progress, and closing the project after receiving the product acceptance (PTR Development 2006).

Furthermore, the development process includes the actions necessary to define, integrate, and coordinate all subsidiary plans into the PMP (Barkley 2006). One of the main purposes for developing a PMP is that not all the projects need all the planning processes, and to the same degree (PTR Development 2006). Therefore, the content of the PMP will depend upon a specific project and its content will vary depending upon the application area and complexity of the project (Barkley 2006).

The PMP is composed of the plans and documents generated by the various processes. Those items are the subsidiary plans and components of the project management plan. The project management knowledge areas as provided by (PMI 2013) include the management of project's integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholders. Each of these areas contains processes and provides details in managing the project.

#### Risk Management Plan

Risk can be referred to as an uncertain event or condition that if it occurs has a positive or negative impact on project objectives (PMI 2013). Many practitioners and researchers in project management consider risk to be more related to adverse effects on project performance (Wang 2010). The definition mostly used in the literature of R&D risk management defines the risk as an event having a negative impact on project outcomes (Wageman 2010).

Risk Management Plan (RMP) is one of the important plans of project management knowledge areas. It is a key business process within both the private and public sector around the world. Sound and effective implementation of risk management is part of best business practice at a corporate and strategic level as well as a means of improving operational activities (Australian Standard HB 436 2013). Furthermore, the risk management process should be an integral part of management, embedded in the culture and practices, and tailored to the business processes of the organization (ISO 31000:2009). Therefore, risk management includes the processes, concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on project in addition to the update of these processes (PMI 2013).

## **2.2 Review of the Related Literature**

#### R&D Risk Management

Risk management is rapidly gaining recognition as fundamental to proactive and responsible project management. R&D projects introduce unique challenges to project management generally and to risk management specifically (Wageman 2010).

Managing risks of R&D environments have been studied for many years. Risk management is one of the approaches that have been widely applied in practice (Wang 2010). In the literature of R&D risk management, several studies have found that applying risk management techniques to innovative R&D projects can improve their success rates (Wageman 2010; Wang 2010). Some researchers performed empirical studies and reported that risk management practice can lead to success of higher risk projects (Wageman, 2010; Wang, 2010).

Some of the professionals who engaged in the conception of new knowledge, processes, or methods in the project management field also participated in the R&D management

researching (The World Bank Group 2014). Several of these researchers have developed risk management methodologies to improve success rates of R&D projects. (Epstein 2002), for instance, developed a systematic approach for the early detection of complex problems in R&D projects in order to increase the organization success. Other proposed methodologies include using knowledge management systems and collaboration tools that capture practitioner experience for reducing R&D risks, risk frameworks for analysing risks in technological projects, and methodologies that quantify technical performance risks to control the identified risks throughout the projects (Wageman, 2010; Wang, 2010).

Furthermore, some researchers suggested integrating customers into the innovation process to reduce the risks of unmet customer needs (Wang 2010). Others suggested that managers should adopt different quantitative approaches for different levels of uncertainty in addition to using qualitative tools and rely on judgment and experience as uncertainty increases (Alessandri, 2004). The key success factors identified in these studies are planned to be taken in consideration for managing R&D potential risks of the UAEAF.

### Military R&D

The studies that discuss organizational risks in relation to military's applications, and especially their R&D projects, are relatively few. (Keat, 2012), for instance, developed a theoretical framework for defense R&D investments under uncertainty.

The reasons behind the low number of studies in these kinds of environments are because of the special nature of the defence sector in addition to the secrecy involved in the defence field. As a result, more researches were encouraged in these fields. For instance, The National Institute of Standards and Technology Advanced Technology Program in USA offered sponsoring proposals for High-Risk R&D Projects (Management & Technology, 2002). Department of Energy in USA launched budget and rewards for R&D Projects researchers (Management & Technology, 2002).

### Literature in UAE

(UIS 2014) conducted and published statistical study about the number of R&D researchers per million people for each year in most countries, and has shown either few numbers of researchers or no information in most of Middle East Countries including UAE; perhaps due to lack of available data. However, there are some researching efforts exist in R&D civilian sector in most of Middle East countries including postgraduate PhD students. For example, Centre Suisse d'Electronique et Microtechnique-UAE (CSEM-UAE) Innovation Center in UAE offered proposals at masters and PhD levels to continue the research program between the Department of Energy Technology KTH Sweden and CSEM-UAE Innovation Center-UAE in field of renewable energy and environment (Martin 2012). Also, UAE is the home of over 70 accredited institutions of higher learning which include large public and international research universities. Therefore, well-known international institutions partner with UAE universities on initiatives for R&D, science and technology, innovation, and entrepreneurship. Conversely, there is no single study or specific research have been accomplished regarding management of risks in R&D fields, especially Military's R&D, or at least there is no available information about it.

## **2.3 Contribution and Significance of the Proposed Research**

### Contribution to Theory

To the best knowledge of the researcher, there are scarce researches that have been undertaken on the area of risk management of Armed Forces R&D's projects and within UAE especially. There is a need to fill the void in this field of body of knowledge as R&D's projects of UAEAF are special in their nature from the points of importance, challenges, secrecy, and most often timely-critical. Therefore, the need exists to understand the special nature of risk management practices that are associated with this type of highly complex projects. Hence,

unlike other projects, organizations, and sectors, require risk management which may differ than the other existing researches. The development of systematic process to manage the risks in complex R&D projects of the Armed Forces is an important contribution to the risk management body of knowledge that may be useful for both management professionals in organizations as well as researchers in the field of risk management.

#### Contribution to Practice

The researcher hopes that the finding of this focused research will provide more perception and practical solution for the stakeholders of complex R&D projects in the domain of risk management as following:

- Benefits in the UAE:
  - It will assist the RDC higher management to integrate and align the risk management methodologies within the organization's strategies, policies, and practices.
  - It will enable RDCs' project managers to identify, at an early stage, and manage risks through the project lifecycle.
  - It will enhance customer's awareness and participation into the innovation to reduce the risks of unmet customer needs.
  - It will assist other organizations in UAE, both in government and private sectors, to identify and manage risks associated with their projects and environments.
- Benefits for the Arab Gulf Region:
  - Considering that the UAE shares the same cultural background with the rest of the GCC countries, this study will give other Armed Forces personnel in the Gulf Cooperation Council countries a picture of the factors impacting complex Armed Forces projects and best practices and procedures to manage such risks.
- Benefits for International Organizations and countries:
  - It will assist multinational private or state-sponsored organizations in the army and defence industry to understand the nature of risks associated with R&D projects carried in the Armed Forces within the UAE.

## 2.4 Theoretical Framework

The framework for this research plans to adopt the overall philosophy of risk management from literature and its logical interpretation along with analysis and synthesis as the basis of theory development (Ariful & Haemmerle, 2006). It will take in consideration the nature of the researched organization, the risks associated with its projects, the sharing knowledge and experience practices, and the features of the available tools and techniques. A range of techniques shall be used since single approach to risk management is not appropriate in most cases (Bowers & Khorakian, 2014).

## 3. Research Methodology

### 3.1 Philosophy

The study at hand focuses on both social issues related to the UAE-Armed Forces-technical culture and physical issues related to theoretical achievement. To be able to understand what drives or inhibits theoretical achievement, an integrated knowledge is at core of the researcher's interest, and the researcher will take into consideration the views of Piers, James and Dewey, the three founders of pragmatism philosophy, that the inner world of one's experience is as important as reality (Talisie & Aikin, 2008). Pragmatic philosophy finds "a middle ground between philosophical dualism" (Johnson & Christensen, 2012). Therefore, the researcher is interested in a moderate common sense of combining different philosophies. That is the perception of the participants in this research along with theoretical achievements will be taken into consideration in developing the framework.

### **3.2 Approach**

The research methodology planned to be used in this study will be a research action and single case study using mixed methods design (Schensul, 2008), which is a procedure for collecting, analyzing, and mixing both qualitative and quantitative data within a single study, to understand the research problem more completely (Schensul, 2008). The basis for the mixing is that using both qualitative and quantitative methods aid in wider analysis of the topic since none of the either methods are sufficient by themselves to detail the situation (Greene, Caracelli, & Graham, 1989). Prior to designing the research tools, some elements shall be determined with detailed attention. Such of these elements are research objectives, the required research information, the population and sampling technique (Nardi, 2003).

### **3.3 Design**

The first phase of this study will be a qualitative approach in order to gain a better understanding of what social issues affect theoretical achievement, and to be able to acquire first-hand knowledge. The factors that will emerge from the themes and analysis of results from this phase will feed into the second phase of the framework of the study; the quantitative phase. In this phase, the research design will incorporate data collection and statistical analysis to confirm the impact of the factors at hand and including results from the qualitative phase. In the quantitative part of this research, the researcher intends to test a measurement instrument that has been developed by integrating themes collected from the qualitative phase of the study.

### **3.4 Design Consideration**

Mixed methods research involves integrating quantitative and qualitative approaches to generating new knowledge and can involve either concurrent or sequential use of these two classes of methods to follow a line of inquiry (Bulsara, 2014). The use of this approach involves multiple stages and leads to greater validity of data collection, answers the question from a number of perspectives, and effectively allows populations with limited language skills or trust issues to participate (Bulsara, 2014).

The placement of both qualitative and quantitative phases of this research depends on the guidelines of (Greene et al., 1989) together with the Mixed Method Design Matrix of (Johnson & Christensen, 2012).

### **3.5 Data collection**

#### **Qualitative Data Collection**

As successful and effective risk management requires a clear understanding of the risks faced by the project and business (Hillson, Grimaldi, & Rafele, 2006), the first phase of the study will consist of identifying the difficulties and risks encounter within RDCUAEAF projects. Following the adopted model of (Yin, 2003), this will be done through analysing several of previous and current projects in the RDC, in addition to reviewing remarks from observation and these projects' documents such as plans, technical specifications, test programs, reports, minutes of meeting ...etc., identify threads, and detect deviations and their possible causes. Focus group is one of the techniques which will be adopted by the researcher for the purpose of obtaining general background information (Stewart et al., 2007) about perceptions of RDC employees regarding risk management of their projects.

Since interviews enrich the quantitative and qualitative responses (Wageman, 2010), thus, one approach will involve face-to-face interviews with a number of key personnel including defense authorities, who could provide a broad range of perspectives in management issues.

Based on the sections and specialties, the main personnel will be involved in these interviews, will include, but not limited to:

- RDC's Directors, senior managers, and managers
- Project Managers
- Project's team including Engineers and System engineers

Once the data is collected, the initial analysis will make a preliminary understanding of the current state of the organization, that will be called "as-is status" analysis. The "as-is status" analysis will help to create identification of strengths and weaknesses of processes, measurement of corrective actions effectiveness and evaluation of necessary process improvement investments. From that analysis, the plan activities can be defined to reach the aim.

#### Quantitative Data Collection

In order to confirm the generalization of the results collected during the qualitative phase to the targeted population, suitable survey and questionnaires will be developed for the purpose of this research and will involve the appropriate personnel in the Armed Forces. The research survey will utilize standard questionnaires as data collection instrument forms (Greasley, 2008). The questionnaires will be based on the literature that addresses risks, their impact on R&D projects, related to the research question and objectives, and will focus on factual matters and perceptual viewpoints including those collected during the qualitative phase.

The pencil-and-paper survey is the most common survey method, for it is familiar to the respondents and allows them more time to think before they write their answers (Muijs, 2004). Although an online questionnaire would be less time consuming in normal cases, the physical presence of the researcher is perhaps needed since the Armed forces culture still sees that emails are inferior to face-to-face interaction for security reasons.

### 3.5 Data analysis

The collected data will be subjected to further analysis and interpretation using methods and tools such as risk matrix and absolute risk graphs, which arrange the risk events in combinations of consequence of failure and probability, in addition to descriptive analysis such as bar chart pie chart and line charts and using available commercial risk analysis software. The collected data will also be relating it to the research question, assessing the limitations of the study, and propose recommendations.

As literature review is a major contribution to research progress (Colicchia & Strozzi, 2012), and as there are wide of theoretical and practical approaches which applied to the desired research, an update of the literature review of the topic will continuously be performed during the study in order to ensure that recent and updated researches are included (University of York, 2009).

### 3.6 Population

A research population is a well-defined collection of individuals or objects known to have similar characteristics (Explorable, 2014). This research will focus at the risk management in the RDCUAEAF. Therefore, the targeted population of this study will be the RDC employees and mainly the management personnel at all levels. The customers of the RDC or the end user of the RDC products; the armed forces units, will also participate in this research as they are one of the key risk contribute elements.

### 3.7 Sample



Since the research is more based on qualitative method, a judgmental sampling design, from the researcher and other experts' viewpoint, is the primary sampling design which will involve in this research as this type is most useful for describing an existing reality during qualitative phase where only little information is known (Kumar, 2014). Moreover, this judgmental sampling design is also useful during quantitative phase as it aid in selecting a predetermined number of appropriate people who are best to provide information needed for this study (Kumar, 2014). Therefore, the sample is considered achievable when reaching the saturation point where no new or insignificant information is started to be gathered during the data collection phase (Kumar, 2014).

Hence, the sample for this study is divided into qualitative and quantitative samples. For the qualitative phase, the sample will be drawn from the RDC project managers' population. The quantitative sample will be of random sample type (Kumar, 2014) and drawn from the RDC and RDC's customer population which is 100 people. The sample for this population, thus, will be 80 people (Resolution Research, 2014).

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