**Facilitating Organisational Decision Making: A Change Risk Assessment Model Case Study**

## 1. Introduction

As long as business environments are subject to constant change and risk facilitation processes such as change management and risk management are needed to maintain an up-to-date structured set of specifications for business requirements. Both the current organisational architecture and the architecture at the aftermath of a change can be visualised through models; further, in this way the purpose of change and the associated risks can be comprehended and analysed more easily by the organisation.

The field of modern project management which can facilitate such processes is not new (Cleland, 1994; Chaffey, 1997; Maylor, 2001) and started to emerge in the 1990s. Actually, what seems to have changed over the past decade is the evolution of techniques applying theory into practice. Projects and organisations are subject to change, simply because the business environment changes. One of the aims of structured project management methodologies is to adapt to changes, minimise risk and ultimately ensure project success. Projects have significant differences in terms of plethora of factors, including factors that are the well-established, such as cost, time, scope and quality.

The development and establishment of standards, especially for project management frameworks such as PMBOK®, PRINCE2®, APMBOK, SCRUM, ISO 21500 and others are not simply good practice guidelines, but also legal requirements in complex project environments. The main strength of such frameworks lies in their comprehensive formality, narrative of collective experience and accuracy in describing specific processes for specific purposes. These global project management frameworks and standards have accounted for and are usually coupled with Risk Management quantitative and qualitative techniques; nevertheless, the facilitation of change risk assessment is a critical process which can be further developed.

This research paper proposes a novel modelling approach named Change Risk Assessment Model (CRAM), which will contribute to the development of formal business modelling techniques, especially in the change(s) risk assessment area. Project Change Risks are assessed with the aid of Analytic Hierarchy Process (AHP) so as to define the internal dynamics of change management within project management eliciting also risk cause-and-effect relationships. The proposed model which is mainly described in the methodology and discussion and analysis sections has been tested commercially by means of a case study.

Analytic Hierarchy Process (AHP) is an established and structured multi-criteria hierarchical technique for making complex decisions. It was first conceived in the 1970s by Thomas L. Saaty and addresses decision

making problems involving multiple criteria whose relative importance is determined via pair-wise comparisons. This is achieved by constructing a matrix which exhibits the relative importance of each criterion relative to the others. In short, AHP is "a well defined mathematical structure of consistent matrices and their associated eigenvectors ability to generate true or approximate weights" (Forman and Gass, 2001).

Briefly, the steps using Analytic Hierarchy Process as described by Saaty (2008) are as follows:

1. Definition of the problem and determination of the kind of knowledge sought.

2. Decision structure hierarchy (top; decision goal), followed by the objectives from a broad perspective, from intermediate levels (criteria on which subsequent elements depend) to the lowest level (usually a set of alternatives).

3. Construction of a set of pair-wise comparison matrices. An element in an upper level is used to compare the elements in the level immediately below.

For the utilisation of the Analytic Hierarchy Process (AHP) approach, risks are usually presented in one of the following forms: narrative (descriptive), qualitative or quantitative (Technical Risk Assessment Report, 1986). Effectively, the descriptive way of risks processing, lacks mathematical analysis.

Saaty (2001) argued that "by making paired comparisons of the elements on a level in terms of the elements of the next higher level, it is possible to decide on an appropriate choice of that level. This provides an overall flexibility because hierarchies are flexible as they can be altered and accommodate more criteria".

Apart from the introduction, this paper is organised as follows: the next section presents literature findings in terms of AHP modelling used in various industries. Section 3, provides an insight of the three CRAM's interrelated processes and Section 4 presents the methodology used to assess change risks. Moreover, in this section the "RingTokk Systems" case study is presented. Section 5, analyses and discusses the CRAM's results, section 6 concerns research limitations and finally section 7 presents the conclusions of the paper together with the authors' suggestions ~~intentions~~ for future work.

## 2. Literature Review

Change management and risk management, are usually regarded as separate processes normally implemented during the initial stages of a project. However, what seems critical for an organisation is to adapt to specific customer requirements and concepts such as: strategic business planning, customer satisfaction, market adaptation, flexibility and subsequently efficient and effective business change management (Apostolopoulos and Simpson, 2009). Contemporary structured project management

methodologies currently fail to estimate and address risk in organisational change management in a detailed manner, in contrast to other aspects of the project management processes.

Risk can be defined as "any potential problem that threatens the success of a project" (Taylor, 2006). Focus on project risk management has moved from quantitative methods to structured risk management processes with a view to understanding and embedding risk management throughout the project's life cycle (Artto, 1997). PRINCE2 (2009, p.311) defines risk as "an uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives. A risk is measured by a combination of the probability of a perceived threat or opportunity occurring and the magnitude of its impact on objectives", whereas in PMBOK (2013, p.558) as "an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives (p.558)". A simpler definition of risk in terms of probability of occurrence and its related impact can be given by the formula (Heldman, 2005; Kendrick, 2009, Kerzner, 2000):

Risk = Probability x Impact **Eq. 1**

In effect, risk estimation can address the question of "what can go wrong?" In other words, what is the likelihood of an event deviating from its expected and planned course or occurrence? Business environments are subject to constant change and risks; however, with the aid of CRAM organisational change risks can be assessed effectively.

Not all changes have the same implications (risk impact) for projects as some might be accepted and some others might not. Similarly for risks, changes have an analogous impact. The more changes are accepted during the project's execution phase (Baca, 2005), the better chance are for project delays.

In the literature, there are many different models for managing change. These include Lewin's (1951) three stage model (Unfreezing, Confusion, Refreezing), Bullock and Batten's (1985) planned change phases (Exploration, Planning, Action, Integration) and Bridges (1991) transitional phases management (Ending, Neutral, New Beginning). Overall, these are mainly ~~a~~ descriptive, multi-stage processes which exclude risk-assessment (Apostolopoulos et. al., 2014).

Further to AHP, and as described in section 3.2, other techniques or tools can also be applied to assess risks. For example, Ackermann et. al., (2014) argued that there is a need for new approaches to be considered as far as managing risks in projects are concerned. The new approach can take into account multiple perspectives, like problem structuring with the use of risk maps which can improve risk analysis.

This approach is potentially applicable in association with CRAM, as causal mapping technique captures not only the risks, but also their impacts.

Furthermore, risk management quantitative and qualitative techniques reported in various publications, such as Management of Risk (MoR) by OGC and Practice Standard for Project Risk Management by PMI, indicate the vast opportunities presented in identifying, assessing, counteracting on risks and also measuring organisational tolerance against risk maturity models.

Literature findings indicate that AHP has been used extensively in various sectors and complex decisions such as: US Nuclear Regulatory Commission to allocate $100M portfolio; US Department of Defence to allocate appropriate resources to diverse activities; British Airways in 1998, to choose the entertainment system vendor for its entire fleet of airplanes; Xerox corporation, to allocate $1B for research projects (Saaty, 2008).

Shiau et. al., (2002) used a survey (400 respondents) and AHP for the selection of subcontractor in construction projects. Other case studies can be found in the paper of Forman and Gass (2001) such as General Motors, which used AHP for car designers to evaluate alternatives, perform risk management, and to arrive at the best and most cost-effective automobile designs.

In relation to project management and associated risks assessment, Mustafa and Al-Bahar (1991) used AHP to analyse project risks. Specifically, they developed a series of rules-of-thumb on construction management projects. According to their views, many construction projects failed due to inconsistency of time, cost quality goals and project requirements.

Dey (2002) analysed the risk management in terms of cost achievement and concluded that it should be carried out before implementing work. More recently, Palcic and Lalic (2009) used AHP as a tool for evaluation and selection of projects. In addition, Pakseresh and Asgari (2012) used AHP to determine the critical success factors in construction projects.

From the above case studies, it is evident that AHP is an established method for decision making, deployed extensively in project management and in industry domains where critical decision making is required. Actually, the main idea for CRAM research originated from the fact that project changes incur risks which have to be assessed and controlled. The above case studies take into account business project factors which were considered for the design of CRAM.

In this context, contemporary project management frameworks, such as PRINCE2® (2009) explain that projects bring about change and consequently change incurs risk; more specifically, risk taking in projects is inevitable. On the other hand, PMBOK® (2013) argues that risk and uncertainty are high during the beginning of the project. In effect, the 'cost' of changes is also high since results cannot be determined as yet. As time progresses these variables have increasingly less impact as decisions are reached and during the projects' closure phase, project deliverables are more likely to be accepted among stakeholders.

It is the aim of this work to identify and examine different attributes beyond the constraints which are extensively referenced in PMBOK® and PRINCE2®, showing that the four major ones (time, cost, quality and scope) are just the peak of the iceberg. What lies beneath are factors related, for example, to leadership, communication, culture, project management team characteristics and others (Apostolopoulos et. al., 2014). However, risks cannot be eliminated; Stoelsnes (2007) expressed the view that events or conditions will appear in projects that are difficult or even impossible to predict prior to an activity.

Even though the scope of presented references mainly applies to project-oriented environments, it is the purpose of this paper to extrapolate on these results by indicating the validity of the effectiveness of CRAM approach to change risk management in other industry domains as well. The constituents of CRAM and its ~~the~~ effectiveness in addressing challenges identified in this section are described in section 3.

## 3. Defining the Change Risk Assessment Model

Business environments and associated decisions are complex. Furthermore, as more changes occur the more complicated project management becomes. Changes and the processes related to managing risks differ among organisations as there is no one-size-fits-all or all-you-can-eat model.

CRAM's aim is to propose an integration of change management within contemporary project management frameworks, alongside ~~with~~ a risk assessment mechanism in the form of a hierarchical model. The end-result is a novel model approach for assessing management risk in business changes. It can be easily integrated with contemporary project management frameworks, as the factors (and related attributes) are widely applicable to ~~in~~ the broader landscape of business environments. For the assessment of change risks in terms of mathematical formulae and results validity, AHP will be deployed.

This is a novel approach, both theoretically and practically, which adds the notion of risk assessment for change management within project management methodologies. CRAM attempts to take into account various environmental risk factors which influence project success. These risk factors are modelled, and

can be assessed numerically in a top-down hierarchical model approach. Nevertheless, not all risks are the same or have the same priorities. A useful application of the model will, for example, assist a project manager to comprehend the relationships between the different factors of the model and enhance his/her ability to judge, evaluate and assess risks. As a result, the modelling community can benefit from the proposed approach by applying similar modelling practices to other industries as well. Figure 1 shows a high level diagram of the research model approach:

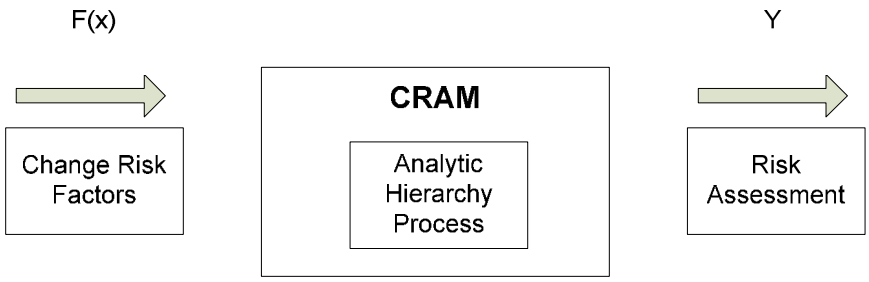



**Figure 1: CRAM High Level Diagram**

The inputs of the model include risk factors which are related to project or organisational change and in a wider context to change management. Respondents can appoint proportional weights (qualitative analysis) after completing a respective risk questionnaire using a linear rating scale, which will be discussed in section 4. With the aid of AHP, the outputs of the model (risks) are prioritised and assessed for further decision analysis.

The proposed model is a novel modelling approach for assessing business change management risk. The authors reflect on prior research and elicit collective knowledge from contemporary project management frameworks. CRAM's approach can be relevant to business problems without having project management framework inputs as a prerequisite, as the factors and related attributes identified are widely applicable in the broader scope of project business environments and operational research (Apostolopoulos et.al., 2014).

Overall, the aim is to fit to project business scenarios as a repeatable process enhancing business decisions. The model is flexible enough, so as to allow potential users to decide upon their own risk attributes (add/delete) and test the sensitivity of the solution or result to new information.

The three interrelated processes that construct the elements of CRAM are as follows:

- Risk Identification;
- Risk Assessment; and

- Risk Monitoring & Control.

### 3.1 Risk Identification

The step towards defining CRAM's risk factors concerns the identification process. Risks can be practically identified in numerous environments and, in fact, the difficult part is not only to identify them, but to also control them. The primary goal of *Risk Identification* process is to identify the threats and opportunities which may affect the projects' objectives and consequently deliverables.

In any business case and irrespective of risk categorisation, the proposed tools and techniques to identify change risks can include but are not limited to the following:

- SWOT analysis
- Change/risk surveys
- Delphi technique
- PESTEL analysis
- Risk Breakdown Structure (RBS)
- Interviews
- Brainstorming sessions

### 3.2 Risk Assessment

The second step towards defining CRAM's risk factors concerns the assessment process. This step involves the *Risk Estimation* and *Evaluation* phases of change risks. Change, if uncontrolled, can be associated with activities of uncertain outcome(s) which would be deemed unwanted deliverables from the viewpoint of project stakeholders. However, when change management and risk management are coupled, risk impact can be reduced. This is because risk is estimated at the planning stage of a project and consequently there is time to develop a risk mitigation plan and take necessary preventive actions.

The majority of quantitative methodologies based on probabilities carry less ambiguity and imprecision, meaning that they have increased accuracy as far as the assessment of gathered information on identified risks is concerned. Quantitative methods interpret results more formally compared to narrative descriptions or qualitative measurements.

*Estimation* can facilitate project risks in terms of the probability of occurrence and impact numerically. The next phase, *Evaluation,* assesses the overall effect of all identified aggregated risks. Certain risk types, such as financial risks, can be evaluated in numerical terms. Overall, risk assessment can be accomplished with the aid of a variety of methods and techniques, such as the following:

- Simulations
- Monte Carlo Analysis
- CPM (Critical Path Method)
- AHP (Analytic Hierarchy Process)
- Risk maps
- Bayesian probability and statistics
- Probability trees

As for the *Evaluation* activities and results, these can be recorded by a change controller by means of benchmark questions, such as:

- Were all implemented non-standard changes assessed?
- Did the approved changes meet the intended goal?
- Concerning result; does it satisfy stakeholders and more specifically conform to customer's requirements?
- Were there any unplanned changes found and what were the associated risks?
- Concerning the implementation phase; did it exceed the project's constraints?
- Are the results documented for example in the change/risk log?

The main reason why AHP approach was selected and integrated with CRAM as a risk assessment process is because business environments are complex in a way that the more changes complicate project management further. This can be justified by the fact that there is significant interaction among multiple factors affecting complex decisions concerning change. The theory of AHP relies on a strong proof of concept, an established decision making technique (35+ years of extensive research and usage) and proven applicability to a broad set of domains.

Overall, AHP is a systematic method for prioritising a list of objectives leading to a decision. The same is also true for risk taking; in this case decisions involve which risks are 'affordable to take on'. Risks which cannot be estimated or even controlled may have a severe impact on outcome of a project.

In effect, it is important to determine the degree (impact) and the priority that each attribute has, address complex situations, identify criteria and measure overall change risks, in a hierarchical way, based on priorities and overall risk tolerance.

### 3.3 Risk Monitoring and Control

The third and final step towards defining CRAM's risk factors concerns the monitoring and control process. The *Risk Monitoring and Control* process mainly intends to identify, analyse, plan and track new risks, constant and periodic testing and review of initially identified risks, monitor and control existing or residual risks. Moreover, the process is concerned with the review of proper execution of risk responses while evaluating their overall effectiveness.

*Risk monitoring and Control* can be accomplished with the aid of a variety of methods and techniques, such as:

- Risk Reassessment
- Meetings
- Variance Analysis
- Trend Analysis
- Risk Auditing

Significant contribution to the evaluation of outcomes ~~out~~ of CRAM processes can be provided by a Subject Matter Expert (SME). An expert can be a person who is an authority in a particular research or topic, such as an individual (project manager, change manager, risk manager) or a group of people (Project Steering Committee, Change Advisory Board) which can influence and advise further to CRAM's results.

Specifically for PMBOK®, the term "Expert Judgment" is used as a qualitative technique in almost all processes, as advice and guidance received from knowledgeable and experienced stakeholders. For example, risks may be identified, assessed (in terms of probability and impact) by experts with relevant experience in similar projects or business areas PMBOK (2013; p. 327, 332, 345). Moreover, these experts can assist in the risk management plan by suggesting the appropriate risk strategies to be followed either for threats (avoid, transfer, mitigate, accept) or opportunities (exploit, share, enhance, accept). To this frame Render et. al., (2012) define "Jury of Executive Opinion" as a qualitative or judgemental approach. Specifically, and similarly to SME, this method collects opinions of a small group of high-level managers, often in combination with statistical models.

Besides the SME technique for testing and reviewing purposes, the use of case studies can help to extend experience, and compare what is known through earlier research. A database of case studies can be created to assist to the overall contextual analysis.

## 4. Methodology

Initially, a change(s) risks(s) hierarchy tree was constructed (see Figure 2) to decompose and populate the parent/child nodes with more detailed attributes rationally. The only restriction in the hierarchical

arrangement of elements (factors) is that any element in one level must be capable of being related to some elements in the next higher level; this serves as a criterion for assessing the relative impact of elements in the level below.

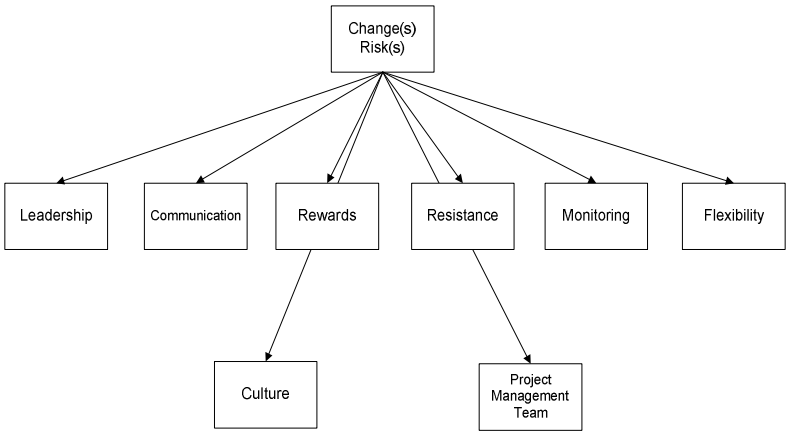



**Figure 2: CRAM Prototype Model**

A tree model structure can be defined as a collection of tree elements (the nodes), where each node can be assigned a relative value together with a list of references to nodes named the "children". A parent node, being the converse notion of a child, is positioned at a higher level.

The lines connecting elements are called "branches". The root is the starting node (highest node in the hierarchy). A node's "parent" is a node one step higher in the hierarchy (i.e. closer to the root node) and lying on the same branch. A node has at most one parent and finally an attribute is a characteristic of the options being evaluated. Saaty (1987, p.166) argued that a hierarchy "is a simple structure used to represent the simplest type of functional dependence of one level or component of a system, in a sequential manner; a convenient way to decompose a complex problem in search of cause-effect explanations which form a linear chain". CRAM's node hierarchy is indicated in Table 1, which consists of one core (root) node, eight parent nodes, and five child nodes.

| Leve1(Root Node) | Level 2 (Parent Nodes) | Level3 (Child Nodes) |
|---|---|---|
| Change Risk | Leadership | Performance |
| | Communication | Motivation |
| | Culture | Appraisal |
| | Resistance | Rewards |
| | Requirements | Training |
| | Monitoring | |
| | Flexibility | |
| | Project Management Team | |

**Table 1: CRAM's Node Hierarchy**

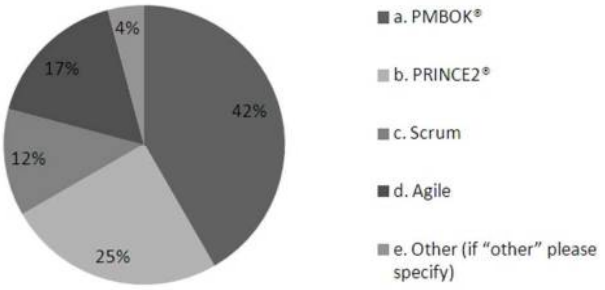
However, the root node is affected by the three risk processes described in section 3:

- Risk Identification;
- Risk Assessment; and
- Risk Monitoring & Control

This means that level 2 and level 3 risk attributes are affected from outputs of CRAM's interrelated processes.

The initial design of the CRAM nodes hierarchy involved a set of arranged semi-structured interviews and focused group discussions (Delphi Technique) with 23 high level executives from various industries in a three-month period. The intension of the semi-structured interviews approach that was followed, was not an attempt to establish consensus (large sample and time consuming analysis); instead the authors' goal was to record the widest possible range of perspectives (risks). In such a way, respondents provided analytical answers to questions, in as much detail as they wished, in an open-ended discussion.

Effectively, the interviews also focused on extended open discussion analysis (details about respondents' background, special interests in change and risk management, related case studies in terms of professional experience) in an effort to grasp key information and end up with a complete possible model. Overall, interviews were proven very helpful in coupling together not only professional experience, but also the personal reflexion of the participants, increasing the validity of replies. Figures 3 and 4 show participant's key information on differing industry backgrounds and experience level:



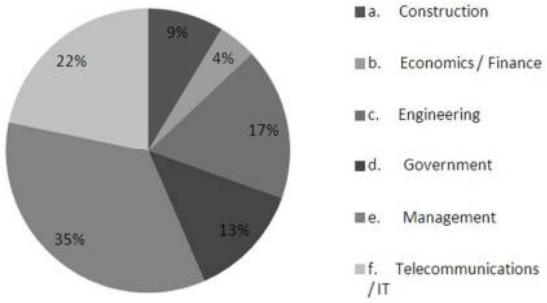




**Figure 3: Respondent's Frameworks Knowledge/Use** **Figure 4: Respondent's Background**

Based on literature research, personal experience and interviews sixty-one attributes of CRAM hierarchy tree were identified as shown in Figure 5.

The survey and detailed definitions of each *Node Element* in terms of a *Risk Attribute's Glossary* can be found at: http://www.changemodel.net and are not included in this paper. In such a way, all respondents will share knowledge of similar definitions of terms and gain a common understanding.

Figure 5 shows an exhaustive extension of Table 1 where, all 61 attributes of CRAM hierarchy tree are depicted.

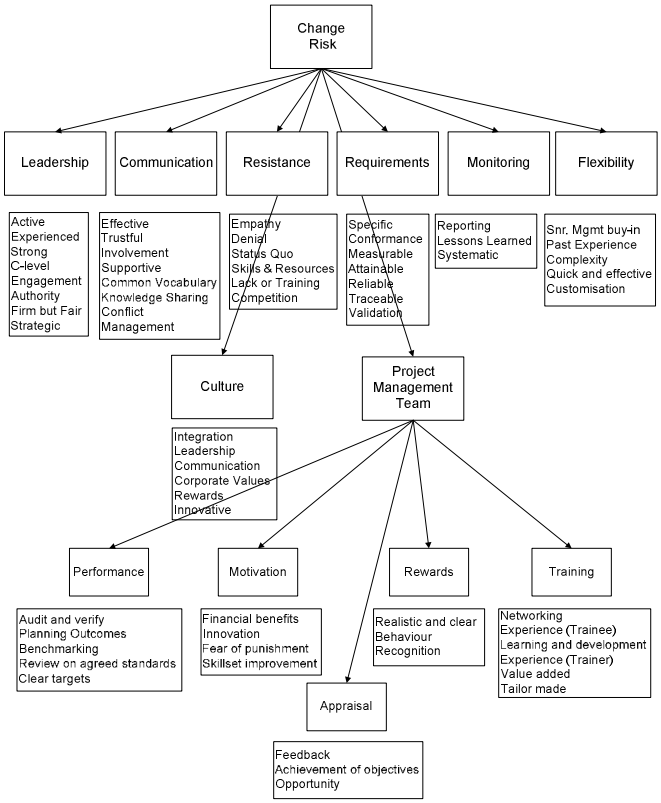



**Figure 5: Change Risk Hierarchy Tree**

In order for risk attributes to be assessed numerically a pair-wise comparison method is adopted. A detailed example can be found in the instructions of the CRAM survey. One major characteristic of CRAM's risk survey is the rating scale. This paper's survey uses AHP linear rating scale, as risk attributes are weighted by integer numbers (1, 3, 5, 7 and 9) depending on the respondent's preference as seen in Table 2.

| Intensity | Definition | Explanation |
|---|---|---|
| 1 | Equal Importance | The two activities contribute equally |
| 3 | Moderate Importance | Slightly favours one over another |
| 5 | Essential or Strong Importance | Strongly favours one over another |
| 7 | Demonstrated Importance | Dominance of the demonstrated importance in practice |
| 9 | Extreme Importance | Evidence favouring one over another of highest possible order of affirmation |

**Table 2: Saaty's Linear Scale**

Johnson and Christensen (2008) explained that by using rating scales researchers can obtain data by providing statements and corresponding rating scales to respondents. Usually, instructions are used to help

respondents make judgements. More specifically, the numerical rating scale consists of set of numbers and anchored (written description for a point on a rating scale) end points.

In addition to the rating scale, the phrasing of the questions is important since it must reflect the proper relationship between the elements in one level with the property on the next higher level (Saaty, 2008). When using AHP, special care should be taken on the formation of the questions since by asking the wrong questions, nonsensical feedback may be obtained which could lead to decreased accuracy of results.

In general, questions should be phrased so that preferences elicited from responses can be easily ranked in order of importance. In the survey responders are asked to rank and qualify risk attributes with respect to a specific element in the immediately higher level of the hierarchy. For example: Q) For "Communication" attribute, which is more important, being trustful or having common vocabulary?

The Saaty's scale described by Eq. 2 below is linear and represents the relative importance of one element over another with respect to attributes:

$$c = x,\ x = \{1, 3, 5, 7, 9\} \qquad \textbf{Eq. 2}$$

Furthermore, the approach attempts to develop a novel systematic methodology (model) for assigning probabilities in attributes (criteria) by pair-wise comparison and more specifically, modelling and assessing change management risks, adding a different perspective and technique to the research area.

Risk estimates of a given change provides essential information in deciding whether to accept the change or not and in specifying the range of risks and implications that this change will introduce. Project managers, implement and monitor change with a view to success, even though the majority of actions are governed by time, cost and quality. Consequently, they describe the processes to be followed in a very detailed way, so as to make the project successful; nevertheless, processes can be further extended when analysing the risk introduced by changes.

### 4.1 CRAM's Validity of Results

This section describes the validity of results based on AHP. In order to evaluate the validity of the estimated weights, Saaty (1980, 1983) proposed using eigenvector information which is considered to be a theoretically and practically proven method for evaluating the validity of the weights (Golden et al. 1989). This involves the calculation of a list of related weights of the chosen initial factors which are, in turn, relevant to the problem in question.

In summary, the algorithm implementing the AHP method and the way factors are prioritised is summarised below:

1. Calculate the maximum eigenvalue, $\lambda_{max}$ , of the pair-wise comparison matrix *A*. This is defined as:

$\lambda_{max}$ = Sum of Priority Row **Eq. 3**

where

Priority Row = (sum of the row value) x Priority Vector.

2. Compute the consistency index (C.I.) defined by Saaty as:

$$C.I = \frac{\lambda_{max} - n}{n-1} \quad \textbf{Eq. 4}$$

The weights (w1,...,wn), obtained by using the eigenvectors, should be positive and normalised; in effect they should satisfy the reciprocity property.

Provided that there is no absolute consistency, $\lambda_{max} > n$. To define the level of inconsistency Saaty defined the consistency ratio (CR).

3. Calculate the consistency ratio (C.R.)

$$C\ R = \frac{CI}{RI} \quad \textbf{Eq. 5}$$

where the random index (R.I.) for different n can be obtained from Golden et. al., (1989).

| **n** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Random Index (RI)** | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 | 1.51 | 1.48 | 1.56 | 1.57 | 1.59 |

**Table 3: Random CI table**

Random Index (RI) is the average of (CI) for random matrices using the Saaty scale. More precisely, the above table represents a composite of two different experiments performed by Saaty and his colleagues at the Oak Ridge National Laboratory and at the Wharton School of the University of Pennsylvania. In these

experiments, 500 random reciprocal [n x n] matrices were generated for n = 3 to n = 15 using the 1 to 9 scale. CR normalised value is divided by the arithmetic mean of random consistency indexes (RI).

After many of experiments Alonso & Lamata (2006) were led to the following calculation of consistency ratio (CR), which is also the formula used in our research paper.

$$CR = \frac{\lambda_{max} - n}{2.7699n - 4.3513 - n} \qquad \textbf{Eq. 6}$$

The maximum eigenvalue, based on Saaty, can be determined by raising each random matrix to increasing integer powers and normalising the result until the process is converged. The consistency index was then computed on each matrix for n = 1 through n = 15. As a rule of thumb, a value of **C.R. ⩽ 0.1** is typically considered acceptable.

In other words, inconsistency is permitted in AHP as long as it does not exceed the ratio of 0.1. If CR equals 0, then this means that the judgments are perfectly consistent.

To give a simple numerical example, and based on the formulae described above, suppose four criteria have to compared.

| | Criterion 1 | Criterion 2 | Criterion 3 | Criterion 4 | **Weights** | **Ranking** |
|---|---|---|---|---|---|---|
| Criterion 1 | 1 | 2 | 3 | 5 | 0.4709 | 1 |
| Criterion 2 | 1/2 | 1 | 2 | 3 | 0.2672 | 2 |
| Criterion 3 | 1/3 | ½ | 1 | 4 | 0.1880 | 3 |
| Criterion 4 | 1/5 | 1/3 | ¼ | 1 | 0.0739 | 4 |

**Table 4: An example of pair-wise comparison matrix and weights**

The numerical values in table 4 and based on Saaty's linear scale (Table 2), represent the relative importance between the criteria. For example: the relative importance of 'criterion 1' versus 'criterion 3' is 3 and between 'criterion 3' and 'criterion 1' is 1/3. This indicates that criterion 1 is moderately important (see table 2) compared to criterion 3. The numbers in the weights column show the relative weights of the corresponding criteria. Following the steps described in section 4.1, the eigenvalue $\lambda = 4.117$ and CR = 4.3% are calculated. Detailed CRAM case study results, are listed in Tables, 5, 6, and 7, which indicate consistent results in terms of eigenvalues $\lambda_{max}$ and consistency ratios CR.

### 4.2 Case Study Overview

"RingTokk Systems" (www.ringtokk.com) registered in UAE in 2012, is where leading Telecommunication carriers, Cable companies, ISP's, Original Equipment Manufacturers (OEM's), Original Device Manufacturer's (ODM's) and Enterprises join innovations to provide the widest choice of

independent soft phone solutions. “RingTokk Systems” integrates Voice, Data, Video into the most compelling, innovative and leading edge technologies to offer creative Soft phone solutions available on the market today.

RingTokk had severe problems entering the market and beating competition. Overall the mission and vision messages of the company were not clear enough, and the company was facing problems mainly in operations and project planning. It was mutually agreed with Ringtokk’s CEO, that the utilisation of CRAM’s targeted analysis of results and recommendations will be considered and handled as a project. Moreover, it was decided and agreed that CRAM will be utilised for the “RingTokk” case study without any changes in the prototype’s attributes, as it was not necessary to identify new attributes or omit any existing ones.



Prior to deploying CRAM, and after the kick-off discussions with the executives’ board, it became obvious that communications in a multicultural business environment together with the increasing rate or technical unsolved requirements were two identified risks with the highest impact. Something had to change drastically, as it is vital for every organisation to enter the market with the minimum entry barriers.

However, it is also imperative for stakeholders to keep risk exposure at a minimum. In other words, to identify and control known risks the soonest possible and be able to locate in a timely manner, the root cause should a risk materialise. As far as changes are concerned, frequent and uncontrolled changes for example in project plans, company policies, technical requirements and procedures affect severely the key business operations of an organisation.

Leadership, authority, conflicts and deliverables’ delays were issues that the board had to resolve. Effectively, in order to find the root-cause of the problems “RingTokk” was facing, many business issues which had to be changed and decided upon. CRAM was deployed in an effort to elicit and provide business recommendations concerning organisational change risks, results of which are discussed in section 5.

## 5. Discussion and Analysis

Further to the above analysis in terms of the methodology used, section five discusses the results of “RingTokk” respondents’. The twelve (12) Ringtokk executives who participated in the risk analysis process were from various departments such as: the Directors’ board, Marketing, Legal, Technical, Strategy, Procurement and Human Resources departments. For the analysis of the consolidated results, the

weighted geometric mean of replies is used, due to its higher accuracy than the respective arithmetic mean.

The consolidated results decision matrix [c] combines all k participants' inputs to get the aggregated group result. The weighted geometric mean of the decision matrices elements $a_{ij(k)}$ using the individual decision maker's weight $w_k$ is described by equation 7 below:

$$c_{ij} = \exp \frac{\sum_{k=1}^{N} w_k \ln a_{ij(k)}}{\sum_{k=1}^{N} w_k} \qquad \textbf{Eq. 7}$$

Table five shows the consolidated matrix results:

| | Leadership | Com/cation | Culture | Resistance | Req/ments | Mon/ring | Flex/lity | PMT | **%Likelihood** |
|---|---|---|---|---|---|---|---|---|---|
| Leadership | **1** | 3 | 1 | 7 | 5 | 5 | 3 | 3 | 27.99 |
| Com/cation | 1/3 | **1** | 3 | 5 | 3 | 5 | 7 | 3 | 24.28 |
| Culture | 1 | 1/3 | **1** | 5 | 3 | 5 | 3 | 1/3 | 14.32 |
| Resistance | 1/7 | 1/5 | 1/5 | **1** | ½ | 1/3 | 1 | 1/3 | 3.35 |
| Req/ments | 1/5 | 1/3 | 1/3 | 2 | **1** | 1 | 1 | 1/3 | 5.12 |
| Mon/ring | 1/5 | 1/5 | 1/5 | 3 | 1 | **1** | 1/3 | 1/3 | 4.49 |
| Flex/lity | 1/3 | 1/7 | 1/3 | 1 | 1 | 3 | **1** | 1/3 | 5.66 |
| Project Management Team | 1/3 | 1/3 | 3 | 3 | 3 | 3 | 3 | **1** | 14.79 |
| | | | | | | | | **λ = 8.861** | **CR = 8.8%** |

**Table 5: Consolidated Change Risk Assessment Matrix**

In greater detail:

| **Factors** | **Likelihood** | **Attributes** | **Likelihood** |
|---|---|---|---|
| Leadership<br><br>λ = 7.737<br>CR = 9.2% | 0.28 | Active | 0.235 |
| | | Experienced | 0.081 |
| | | Strong | 0.034 |
| | | C-level engagement | 0.092 |
| | | Authority | 0.277 |
| | | Firm but Fair | 0.036 |
| | | Strategic | 0.245 |
| Communication<br><br>λ = 7.695<br>CR = 8.7% | 0.243 | Effective | 0.115 |
| | | Trustful | 0.104 |
| | | Involvement | 0.21 |
| | | Supportive | 0.123 |
| | | Common Vocabulary | 0.04 |
| | | Knowledge sharing | 0.24 |
| | | Conflict Management | 0.167 |
| Culture<br><br>λ = 5.338<br>CR = 7.5% | 0.143 | Integration | 0.17 |
| | | Leadership | 0.379 |
| | | Communication | 0.317 |
| | | Corporate values | 0.086 |
| | | Rewards Innovative | 0.048 |
| Resistance | 0.034 | Empathy | 0.034 |

| | | | |
|---|---|---|---|
| λ = 6.629<br>CR = 10% | | Denial | 0.096 |
| | | Status Quo | 0.191 |
| | | Considerations of Skills and Resources | 0.055 |
| | | Lack of Training | 0.421 |
| | | Competition | 0.203 |
| Requirements<br><br>λ = 7.649<br>CR = 8.1% | 0.051 | Specific | 0.123 |
| | | Conform to customers expectations | 0.12 |
| | | Measurable | 0.036 |
| | | Attainable | 0.107 |
| | | Reliable | 0.07 |
| | | Traceable | 0.338 |
| | | Validation | 0.206 |
| Monitoring<br><br>λ = 3.018<br>CR = 1.9% | 0.045 | Reporting | 0.238 |
| | | Improve from lessons learned | 0.136 |
| | | Systematic | 0.625 |
| Flexibility<br><br>λ = 5.263<br>CR = 5.8% | 0.057 | Snr. Management Buy-in | 0.28 |
| | | Past Experience | 0.325 |
| | | Complexity | 0.089 |
| | | Quick and effective | 0.059 |
| | | Customisation | 0.246 |
| Project Management Team<br><br>λ = 5.387<br>CR = 8.6% | 0.148 | Performance | 0.072 |
| | | Motivation | 0.369 |
| | | Appraisal | 0.275 |
| | | Rewards | 0.164 |
| | | Training | 0.121 |

**Table 6: Likelihood of Change Risk (Parent Nodes)**

| Factors | Likelihood | Attributes | Likelihood | Attributes | Likelihood |
|---|---|---|---|---|---|
| Project Management Team<br><br>λ = 5.387<br>CR = 8.6% | 0.148 | Performance<br><br>λ = 5.329<br>CR = 7.3% | 0.072 | Audit and Verify | 0.16 |
| | | | | Planning Outcomes | 0.30 |
| | | | | Benchmarking | 0.077 |
| | | | | Review on agreed standards | 0.05 |
| | | | | Clear Targets | 0.413 |
| | | Motivation<br><br>λ = 4.198<br>CR = 7.3% | 0.369 | Financial Benefits | 0.508 |
| | | | | Innovation | 0.151 |
| | | | | Fear of punishment | 0.075 |
| | | | | Skillset Improvement | 0.265 |
| | | Appraisal<br><br>λ = 3.065<br>CR = 6.8% | 0.275 | Feedback | 0.081 |
| | | | | Achievement of objectives | 0.731 |
| | | | | Opportunity | 0.188 |
| | | Rewards<br>λ = 3.025<br>CR = 2.6% | 0.164 | Realistic and clear | 0.333 |
| | | | | Behaviour | 0.57 |
| | | | | Recognition | 0.097 |
| | | Training<br><br>λ = 6.614<br>CR = 9.8% | 0.121 | Networking | 0.287 |
| | | | | Experience (Trainee) | 0.271 |
| | | | | Learning and | 0.061 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | development | |
| | | | | Experience (Trainer) | 0.038 |
| | | | | Value added | 0.25 |
| | | | | Tailor made | 0.093 |

**Table 7: Likelihood of Change Risk Project Management Team (Child Nodes)**

Due to the fact that the research's results are extensive, it is the authors' intention to provide comments on the majority of the parent nodes (risk factors). Complete recommendations were reported and discussed extensively with the RingTokk's CEO. The respondents' results (top four) influential change risk factors based on CRAM ranking are as follows:

1. Leadership (27.99%)
2. Communication (24.28%)
3. Project Management Team (14.79%)
4. Culture (14.32%)

The risk analysis presented in the following paragraphs goes a step further from the conventional approach of project management in terms of time, budget and quality constraints. It is concluded that leadership, culture and communication are the most important change risk factors. Prior to further discussion and analysis, it has to be noted that results are within the limits of consistency (CR<10%) which is prerequisite for AHP validity using Saaty's linear scale.

### 5.1 Leadership Parent Node

Although risk and uncertainty affect all projects, leadership is the key factor for success. For successful project management one of the roles that the project manager has to play is that of the leader. The project manager serves as the 'glue' between the project and the team members, ensuring that stakeholders remain focused on the project goals. In relation to change management, the project manager acting as leader has to make sure that team members understand and respond to the change management processes. In terms of change management, the project manager is the one with the authority to approve changes based on what is included in the projects' scope. In effect, the project manager can handle the change requests accordingly, by analysing the impact the changes will have on the project plan or the requirements.

Change leaders can help stakeholders by encouragement and focus on change. Their active involvement is dynamic; learning is based on the initial recognition that there is a problem, followed by exploring possible solutions and, lastly providing helpful directions. Consequently, learning is the best route to lower resistance to changes. Concerning the RingTokk project, it was rather obvious that the lack of a long term and clear strategy was causing additional problems to the operation of the company. Even though each

departmental head, had the authority to engage people to work together, conflict at lower levels of the hierarchy was something that had to be addressed.

With reference to CRAM, 'Leadership' as a risk factor was ranked as the most influential with 27.99%. Moreover, related attributes with high influence were assessed *authority* (27.7%), *strategic* (24.5%) and *active* (23.5%). Actually, APM® (2012) linked authority with influence. This is because success is related in turn with acceptance, support and agreement to the influencer's proposals or objectives. Successful influencing is related with understanding groups or individuals pattern of attitude, behaviour, emotion and decision making. "A pragmatic project manager must balance the theories of leadership with the practical need to deliver the project objectives and the limits on their authority to lead" (APM®, 2012, p.69).

### 5.2 Communication Parent Node

Results revealed that the three most important risk factors which have to be controlled and perhaps changed in order for the project to be successful are: *knowledge sharing* (24%), *involvement* (21%), and *conflict management* (16.7%). Regarding knowledge sharing, Dingyong et. al., (2009) examined the differences between R&D enterprises and other organisations, reaching the conclusion that a knowledge sharing culture by using documents, templates or that, in general shared information systems is necessary.

APM® (2012) explained that various factors exist which affect the effectiveness of communications, such as: cultural background and transient features, current environment and team dynamics. Indeed, in the RingTokk case study, the cultural background together with the professional background mix was conflicting and problematic.

Further to the results, as far as change management is concerned, the high importance of communication was pointed out by Baca (2005); Helman (2005); Mulcahy (2013), by stressing that communication is 90% of the project's manager job. Moreover, Heldman (2005) argued that risk management and project management are both iterative processes which position communication at its core.

As far as 'Communication' is concerned, another key issue is the language, which needs to be understandable by all stakeholders and convey the communicator's meaning as accurately as possible (APM®, 2012; Robertson and Robertson, 2008). For example, Ringtokk was facing severe problems in cross department communication. Most of the problems were recorded between technical and marketing departments. Moreover, the Human Resources department did not clearly document the job descriptions of business analysts, engineers, designers, suppliers, testers or anyone whose input is necessary. Irrespective of the fact that all the above named professionals have different skills, they also have different views of what is important to communicate or share. Nevertheless, common vocabulary was ranked as the last

attribute with 4% for which particular note has to be taken to ensure a common understating of terminology is present within Ringtokk. In fact, Corvellec (2009) explored organisational risk management in a context where risk is absent from managerial vocabulary or organisational communication.

Another process that concerns communication is stakeholder management. Within this frame, PRINCE2® (2013, p. 41) defines stakeholder engagement (involvement) as "the process of identifying and communicating effectively with those people or groups who have an interest or influence on the project's outcome". The communication process can be managed by the Communication Management Strategy as the frequency of communication among stakeholders is controlled and monitored. In greater detail, the 'Plans' theme facilitates the communication control and addresses questions such as, for example: where, how, by whom, when and how much. Taking CRAM's results into account, involvement was ranked as second risk attribute with 21%.

Nonetheless, as organisations become larger and more complex the need for a structured project management methodology arises. At the same time, complexity might mean more management layers that have to be addressed properly. Consequently this may lead to additional communication linkages. PMBOK® (2013, p.292) explains that "the total number of potential communication channels (CC) is given by equation eight, where n represents the number of stakeholders. For example, if the stakeholders are eight (8) then, the potential communication channels are 28. In general

$$CC = n(n-1)/2 \qquad \textbf{Eq. 8}$$

Among other success factors PMBOK® (2013) explains that project management success depends highly on an effective organisational communication style. Sharing these opinions Burns and Stalker (1961) explained that this happens because project teams are composed of members with diverse backgrounds (skills, experience, attitudes, culture) which work together. Even if project managers are at distant locations (which is also true for RingTokk) technology allows them to manage projects successfully.

Nevertheless, managing projects remotely can be associated with complex risks. In view of this, conflict cannot be avoided; however, the project manager has to handle disagreements and solve problems taking into account project success (Mulcahy, 2013; APM® 2012, Gobeli et. al; 1998).

Conflict (16.7%) is also related to communication style being direct or indirect. Usually, conflicts occur when the project manager follows a boss-subordinate relationship: 'I order and you follow'. True leaders aim to say what they mean in an open and constructive way listening to opinions of others. This was another issue which was heavily recorded. Although RingTokk's high level management was trying to be supportive towards lower level employees, information was not shared properly. Ringtokk's culture did impact the speed of working, the decision-making process, and the impulse to act without appropriate

planning. This led to employee conflict and stress thereby, affecting the business performance. As a result, conflict should be resolved in early stages of the project because it strongly affects the collaborative work amongst team members and can lead to uncontrolled situations.

### 5.3 Culture Parent Node

The cultural factor is evident in culturally diverse multinational business environments, where different ways of thinking and behaving sometimes contradict and at other times reinforce successful adaptation. Even though it is difficult to define since it differs among organisations or individuals, Kroeber (1985) indicated that there are more than 160 different definitions of culture.

The most common definition for organisational culture is "the way we do things here" (Lundy and Cowling, 1996). In most definitions, it is related to characteristics and assumptions of the organisation such as: behaviour, values, norms and rules. Robbins (1996) argued that organisational culture forms an integral part of organisational functioning. RingTokk being a worldwide services provider had to adopt international practices of doing business. This was very hard to achieve taking into account the diversity of employees' location; 65% of RingTokk's employees are based in India (mainly software engineers / testers).

The results obtained with reference to the culture's attributes are in total agreement with level 1 results. In fact, the top three risk factors rank as follows:

- *Leadership* (37.9%);
- *Communication* (31.7%);
- *Integration* (17%).

If the culture is strong, the values are shared and everybody is aligned. It offers a shared system of meanings, forming the basis of communication and formal understanding (Furnham and Gunter, 1993). In some other cases what might influence behaviour is whether managers have the right tools, filling the gap between what is formally announced and what actually takes place (Martin, 1992). Douglas et. al., (2013) argued that modern risk management practices stress the importance of connecting risk management policy and practices with organisational culture and values.

Discussing about business environment, Senge (1990) argued that organisational culture, which has a base of commitment to truth, empowers individuals to reflect on their actions, see if these actions can cause problems, recognise the need for change/s and perceive their own roles in the change process.

Especially in project management, problems might occur because the culture of the stakeholders differs in a variety of ways. They might have their own individual culture of work which comes in conflict with others (Ruuska, 1999). Effectively, project culture must consist of a shared organisational culture and professional culture of individuals. Sometimes in order for the organisational culture to change, it is required to rebuild the existing cultural assumptions into the organisational structure. In light of this Bellasi et. al., (2007) associated constructive work environment with strong leadership and new product development project success. Effectively, organisations that enforce strong communication channels amongst project team members and foresee for effective collaboration are expected to have better performance and project success.

However, in many cases, organisational changes are linked to organisational culture. Shein (1985) expressed the view that the implementation of project management is seen as a cultural change rather than a process change. Lastly, organisational culture, even though it is a powerful force, is also resistant to change.



**5.4 Project Management Team (PMT)**

Projects are managed by different teams of people which have as common goal project success. The project management team has in turn different characteristic such as culture, experience and management level that have to be combined together so as to ensure that the projects' deliverables conform to customer requirements and expectations.

In this light, Senge (1990) explained that the most effective project management processes are those whose team members facilitate innovation and learning as much as possible. Provided that the team works in a spirit of empowerment, this can be overall assistive in fostering greater motivation, thus leading to project success (Peterson, 2007). Moreover, the project team has an important role in the planning phase related to requirements, risk review, and quality plans.

Either way, a project cannot run without team members; to stress this, Baca (2005, p.19) pointed out that team members "are the magic makers who spin straw into gold and create the product". Even though the Project Management Team factor was ranked with a likelihood of 14.8%, the importance of a strong and dedicated team is unquestionable. Taking a closer look at the respective attributes, the most important ones are motivation (36.9%), appraisal (27.5%) and rewards (16.4%).

In order to execute a project and attempt to lead it successfully, conforming to project's requirements, and realising an expected outcome, whether embedding or not change, a project management team is required.

Nelson (1996) argued that "Expectations are like land mines. If you aren't clear about them, they can explode at the worst possible moment and destroy the trust you have worked so hard to develop".

Managers should be prepared for two types of change, change planned (30% of Performance attribute) and change imposed (Evans and Ward, 2004). Especially new managers experience certain pressure because they wish to make a good impression and effectively implement change correctly. On the other hand, if they force the change process they may face resistance from other stakeholders.

White and Fortune (2002), prepared a questionnaire so as to examine the experiences of people in project management. In their study, special focus was given to performance (7.2% of Project Management Team risk factor) as a success factor for managing projects. In a similar study, Chen and Cian (2010) measured the performance of project management by defining six factors which have the greatest impact on the execution phase of the projects. These were: financial constraints, management commitment, rewards system, organisational structure, education and training of project team.

Hashmi et. al., (2010) studied the growth of project management teams specifically for software development projects in terms of expertise, communication skills, working conditions and financial impact. Kerzner (2000) explained that four basic values of project management are: cooperation, teamwork, trust and effective communication. More specifically, the project management team is "an integrated and multifunctional entity to deliver the specified project product" (Kliem et. al, 1997).

Prior to the CRAM results' analysis, RingTokk was not using any specific project management framework. Many department heads were actually the project managers of their department. As it will also be seen in the conclusions section, RingTokk's CEO decided to formally engage with contemporary project management frameworks and related process for the operational benefit of the company.

## 6. Research Limitations

One of the research's aims is to identify risk factors that apply across business domains. Since projects can be different in a variety of factors (quality, scope), an exhaustive list of risk factors cannot be identified. There is a continuous risk identification process throughout the projects' life cycle. For example, many risks can be classified initially as *unknown* and can be refined after the initiation phase of the project.

Another constraint, regards the questionnaire which may lead to bias since the respondents might have differences in terms of business sector, mix of experience, culture etc. With the aid of the glossary provided, all respondents had a common understanding of what is requested to be assessed.

Concerning the adopted format of semi-structured interviews ~~adopted~~ (~~since the~~ interviews were not pre-planned with closed ended questions) the process resulted to a greater bias than respective structured ones (uniform, accurate and more precise).

The authors have been involved with change and risk management in a number of international projects. It was attempted to ensure that any possible bias arising from this involvement was kept to a minimum, as far as this was possible.

## 7. Conclusions and Future Work

With the aid of modelling and especially CRAM, business change risks can be assessed numerically and are prioritised. Several risk factors and related attributes were identified and categorised. This empowers project managers or other stakeholders to make proper decisions about whether to take on or abandon respective organisational or project changes.

Analytic Hierarchy Process (AHP) is an established and structured hierarchical technique in making complex decisions that help users choose the "best" decision in a challenging situation, instead of finding the "correct" one. AHP mainly deals with decision making problems by determining the relative importance or weight criteria though pair-wise comparison of the criteria.

Case study results indicated that RingTokk was facing key operational problems mainly in the areas of leadership, communication and culture. The company has a strong international character with company offices located in various countries, from UAE to India. These two centres end points may function well as standalone entities, but problem may arise when intercommunicating, mainly due to cultural reasons.

Even though, the recommendations report submitted to RingTokk's CEO was confidential, key actions were decided. The company's revised mission and vision was presented to all employees in order to promote the new operational business era. A cultural training program promoting the key messages, goals and aims of the company will be a prerequisite for every new employee joining the company. Concerning requirements analysis and project deliverables, it was agreed that the company will follow an established project management framework. For this reason, the HR manager recruited one dedicated project manager in India and one in UAE. In this way, all operational and planning goals will be monitored closely and requirements will be recorded; any changes will have to be approved by the department's head. In the marketing field, the company will take part in several international exhibitions as a sponsor, so as to advertise its products more efficiently and increase brand awareness.

In December 2013, RingTokk's CEO announced the company's key business figures, after two years of operation. Based on his speech *"...RingTokk has gone under severe organisational changes, results of*

*which I'm more that proud and I wish to express my gratitude to all of you. The accomplishments are impressive but there's still a lot to do. The customer base was increased by 28% and operations efficiency was improved by 16%, overall our net profit was increased by 4.3%...."*

Further to the RingTokk case study, change risk management was thoroughly discussed as an integrated process within project management and as a rational process for exploring decision and behaviour alternatives; selecting the best possible choices among stakeholders in an attempt to accomplish activities in time, on budget, within scope and agreed quality standards thus ensuring project success.

Effectively, one of the best ways to integrate change risk management into successful project management requirements analysis processes is to encourage people to work together in solving business problems and achieving results. However, in order for projects to be successful, and even though communication may be based on vocabulary discrepancies, all stakeholders have to formulate a solution to model the customers' requirements and conform to what is being expected.

One of the values of CRAM is that it can be deemed as a global change risk assessment method that can be applied regardless of project type, size or organisation. Moreover, it has the advantage that it can be used by any project, since the method is designed to be tailored to specific needs, taking significant environmental change risk factors into account.

Since not all projects are the same, and also not all risks can be identified, CRAM provides the user with flexibility and capability to add or delete risk attributes accordingly, on a per case basis. In other words, CRAM is a fully dynamic model that can be changed on-demand and can become applicable to various business domains.

Ultimately, it is the authors' belief that future research efforts will focus on the assessment of risks with various other qualitative/quantitative techniques as noted in section 3. In addition, CRAM outcomes are characterised by environmental factors and attributes which can form the basis of an environment-feature-driven model composition. A framework capable of transforming such a business process model layer to subsequent models of lower abstraction would require a pioneer approach to model-driven initiatives.

Whether such framework can reside in the logic behind the Model Driven Business Engineering (MDBE) framework is currently under investigation. The outcome could be a more attractive solution to model-driven initiatives for corporate entities providing an insight to CRAM and model based engineering.

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