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RISK FACTORS TAXONOMY IN SOFTWARE DEVELOPMENT PROJECTS: STUDY FROM KUWAIT

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ABSTRACT

The objective of this research is to develop a taxonomy of software development projects risk factors in Kuwait. An intense review of more than 30 papers published in peer review journals in the field of information technology area in the period of 2000-2018. A number of 59 risk factors from the literature were collected. Seven IT experts from Kuwait validated these risk factors in two focus group sessions. The outcome of this research produced taxonomy of 28 risk factors that applies to Kuwait.

Key words: *Software Development Projects, Risk Factor, Risk Management, Risk Taxonomy, Focus Group*

1. INTRODUCTION

Kuwait is an Arab state located in the northeast of the Arabian Peninsula in Western Asia. Oil was discovered in 1934, which transformed the local economy. The Kuwaiti standard of living was among the highest in the world by the early 1980s. Kuwait's Gross Domestic Product (GDP) reached 112.81 billion US dollars in 2015, representing 0.18 percent of the world economy.

In 2017, the government of Kuwait lunched a new national strategic plan, NEW KUWAIT 2035, in which Information communication technology (ICT) sits at the heart of the government's strategy, New Kuwait. According to the new strategy many ICT projects needs to be delivered. However, according to [1] critical success factors in the developed world cannot be adopted in the developing world without alterations and modifications due to cultural and social dissimilarities. Further, with a high failure rate of software development projects [2] and [3], this could involve many challenges for government entities delivering successful projects. [4] Suggests that professionals should concentrate on the factors that contribute most to the failure of IS projects in their organizations. One of the most challenging processes in a software development project is risk management, i.e. risk assessment and mitigation. Further, it is argued that risks exist in every software development project leading to a challenging task recognizing and evaluating risks and uncertainties [5].

This paper focuses on identifying risk factors available in the selected literature and verifying which factors could apply and could affect the success of software development projects included in Kuwait new strategic plan. The objective of this research focuses on surveying the literature to collect available risk factors as an attempt to produce risk taxonomy that could apply to Kuwait environment and can be used as a checklist, which is a common and simple method for IT practitioners to execute at the commencement of software development projects.

2. REASERCH EXPERIMENT

The research design is divided into two steps: addressing the research questions (section

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2.1) then presenting how the research experiment will be executed (section 2.2).

2.1 Research Questions

This research attempt to answer the following questions:

1. What are the software development risk factors that exist in the literature?
2. To what extent do the identified risk factors in the literature apply to Kuwait?

2.2 Research Design

A survey of the literature was carried out as an attempt to identify information system development risk factors. The literature review focused on 25 peer review journals ranked among computer science and information system journals. The papers were selected from the time period of 2000 until 2018, with considerations of certain key words. Key words such as risk, risk factors, critical success factors, and critical failure factors were noted during the exploration of the titles and abstracts. The authors argue that a total of 34 research papers could provide a reasonable representation of the literature. Some of the methodologies used in the recognized papers were based on qualitative and quantitative approaches and were conducted in various parts of the world.

The final finding of the literature review identified 59 risk factors. Seven local experts in the field of IT validated this list and participated in two focus group sessions with the objective of investigating the extent of the applicability of each risk factor to the local environment of Kuwait, as explained in Appendix A.

3. ANALASYS OF LITRATURE REVIEW

The literature survey was conducted in three steps: data collection from peer reviewed journals (section 3.1), review of similar work (section 3.2), and validating the outcome with experts in the field (section 3.3).

3.1 Risk Factors (RF) Taxonomy 59 RF

The authors have conducted an intense literature review to identify software development risk factors. This section describes the collection of risk factors that were collected from 34 research articles/papers and were derived from 25 different Journals from the period of 2000-2018. A total of 59 risk factors were collected from previous studies. The journals were in the discipline of computer science and information systems with a key word search of risk factors, critical factors and failure factors.

The number of references per risk factor was accumulated according to the number of references that appeared in the literature; the most frequent risk factors were ranked accordingly. Table 1 (see Appendix A for more details) presents risk factors collected from previous papers and shows the number of references or frequency of appearance in literature for each risk factor.

Table 1: risk factors collected from literature

No of Risk factor	Risk factor	No of ref
RF1	Budget related risk	21
RF2	Miscommunication	19
RF3	Poor understanding of user requirements	17
RF4	Unrealistic schedules	17
RF5	Complexity of a project	17
RF6	Lack of top management commitment to project	15
RF7	No planning or inadequate planning	15
RF8	Inadequate project management	14
RF9	Project manager may have no control	14
RF10	Inadequate requirements	13
RF11	Technological newness	13
RF12	Lack of expertise	13
RF13	Team related risk	12
RF14	People and personality failures	12
RF15	Conflicts of people	12
RF16	Ineffective communications with users	12
RF17	Poor or nonexistent control	12
RF18	Insufficient training	11
RF19	User resistance to change	11
RF20	Organizational environment risk	10
RF21	Lack of definition of roles and responsibilities in software projects	10
RF22	Lack of knowledge	10
RF23	Schedule pressure	10
RF24	Lack of senior management commitment and technical leadership	10
RF25	Lack of agreement on project goals	10

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RF26	Changing scope/objectives	10
RF27	Inappropriate staffing	10
RF28	Lack of adequate user involvement	10
RF29	Lack of adequate technology infrastructure	9
RF30	Resource insufficiency	9
RF31	Application complexity	9
RF32	Inadequate user participation	9
RF33	Team Turnover	9
RF34	Choosing the wrong development strategy	9
RF35	A climate of change	8
RF36	Unclear Description of the real environment	8
RF37	Lack of strategy alignment	8
RF38	Poor quality deliverables	8
RF39	Ignoring the Non-functional requirements	7
RF40	Lack of frozen requirements	7
RF41	Technology shortfalls	7
RF42	Failure of technology to meet specifications	7
RF43	Task complexity	7
RF44	Inability to test in the operational environment	6
RF45	Mismatch between company culture and required business process changes	6
RF46	Data Loss	6
RF47	Continually changing scope and system requirements	5
RF48	Conflicting User Requirements	5
RF49	Lack of data integration	5
RF50	Budget not enough for maintenance activities	5
RF51	Not thoroughly defining the scope of the new system	5
RF52	Trying new development method/technology during important project	5
RF53	Low quality of testing	5
RF54	Scope Risk	4
RF55	Failure to follow an enterprise-wide design that supports data integration	4
RF56	Lack of architecture and quality software project	4
RF57	Failure to get project plan approval from all parties	4
RF58	Un acceptance of the Plan in time by client	3
RF59	Lack of knowledge needed for component integration	2

3.2 Validation of Risk Factors through Focus Group

The focus group method was used to reveal individual opinions through prepared group session. The focus group method has become a primary qualitative method in social science research and is increasingly used across numerous academic disciplines [8], [9], but it is rarely applied in the information system development discipline.

The Focus Group study was divided into two sessions (see figure 1) to validate the risk factors from Table1. The sessions were applied in this research with seven IT experts from Kuwait forming a group for validating risk factors, which were collected from the literature. The seven IT experts have more than 20 years of experience managing IT projects in different sectors (private and government). The experts hold different roles in the IT discipline. Three are directors of an IT center and one as head of the decision support department in a government entity, and three are from academia acting as IT consultants in private and government sectors. Each one of these experts has managed or participated in more than ten software development projects with a budget for each project ranging from 100,000$ US and up to ten million US dollars. The aim of the focus group is to validate each risk factor from Table 1 and investigate to what extent it applies to the Kuwait environment.

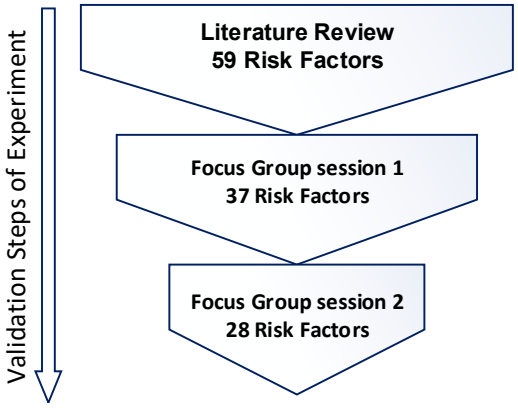

Figure 1: Experiment validation steps with IT experts

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The focus group method allows the collection of multiple individual opinions simultaneously [10] and helps in establishing agreement or disagreement on explanations and or understandings of the study [11].

Two session were conducted with a quest to answer the following four questions:

a. Does each risk factor apply to the Kuwait environment?
b. How often did each risk factor exist in any project you have participated in?
b. Do we need to reliable the risk factor?
c. Do we need to combine one risk factor with another/others?

The authors played the role of facilitator to administer the focus group session, which is an important part of conducting a successful session. Prior to the session, an explanation of the purpose of the sessions was passed to the participants along with a complete set of information covering a) risk factor list (Table 1), b) description of each risk factor, c) explanation of the questions above.

3.2.1 Session 1

In session one the experts/participants started to validate each risk factor in the list (Table 1), comparing each risk factor with the others, looking for similarities of meaning. Risk factors with a similar meaning were combined. Risk factors that do not apply or rarely applied to Kuwait were dropped from the list.

Session one took four hours to complete the list and produced a new list as seen in Table 2 (listed below) which consists of 37 risk factors.

Table 2: Risk Factor List Post Session One

Risk factor NO	Risk factor
R1	Miscommunication
R2	Insufficient control of Project manager
R3	Team capability
R4	Poor understanding of user requirements
R5	Complexity of a project
R6	Unrealistic schedules
R7	Team Conflict
R8	Innovative Technology
R9	Lack of top management commitment to project
R10	No planning or inadequate planning
R11	Changing scope/objectives
R12	Inadequate project management
R13	Inadequate requirements
R14	Lack of expertise
R15	Lack of agreement on project goals
R16	resistance to change
R17	Insufficient training
R18	Organizational environment risk
R19	Lack of definition of roles and responsibilities
R20	Lack of knowledge
R21	Schedule pressure
R22	Lack of senior management technical leadership
R23	Resource insufficiency
R24	Team Turnover
R25	Choosing the wrong development strategy
R26	A climate of change
R27	Lack of strategy alignment
R28	Poor quality deliverables
R29	Insufficient enterprise-wide design and data integration
R30	Lack of frozen requirements
R31	Technology shortfalls
R32	Failure of technology to meet specifications
R33	Inability to test in the operational environment
R34	Data Loss
R35	Budget not enough for maintenance activities
R36	Low quality of testing
R37	Lack of architecture and quality software project

3.2.2 Session 2

In session two, which was conducted after two days, the participants were asked to go through each risk factor from Table 2 and apply the same approach that was conducted in session one. More insights and remarks were raised by the participants about the existence of each risk factor in the environment of Kuwait. The experts/participants relate the discussions with real examples from projects they executed. The session ended with a number of 28 risk factors as seen in Table 3 and took more than three hours.

Table 3: Final Risk Factor List Post Session2

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Risk factor number	Risk factor
R1	Miscommunication
R2	Insufficient control of Project manager
R3	Team capability
R4	Poor understanding of user requirements
R5	Complexity of a project
R6	Unrealistic schedules
R7	Team Conflict
R8	Lack of top management commitment to project
R9	No planning or inadequate planning
R10	Changing scope/objectives
R11	Inadequate project management
R12	Inadequate requirements
R13	Lack of expertise
R14	Resistance to change
R15	Insufficient training
R16	Lack of definition of roles and responsibilities
R17	Lack of knowledge
R18	Schedule pressure
R19	Lack of senior management technical leadership
R20	Resource insufficiency
R21	Team Turnover
R22	Choosing the wrong development strategy
R23	Lack of strategy alignment
R24	Poor quality deliverables
R25	Lack of frozen requirements
R26	Technology shortfalls
R27	Budget not enough for maintenance activities
R28	Low quality of testing

4. DISCUSSION AND LIMITATION

This research undertook an intense literature review of the risk factors in software development projects. The outcome of the review produced 59 risk factors available in the literature. This taxonomy was filtered at a later stage by experts from Kuwait in the field of Information Technology and produced 28 risk factors to present risk factors taxonomy more common to the Kuwait environment according to experts' judgment. However, this produced taxonomy needs to be updated frequently due to rapidly changing technology. This produced taxonomy could be considered as a generic list to be used in software development projects, however its not specific to the nature of different project, i.e., ERP, agile, e-Government. This limitation could be resolved by categorization into different types of software development projects, then emphasizing/categorizing the risk factors by the type of project. On the level of risk factor, it might be more descriptive to categorize each risk factor by its relative dimension/environment, i.e. personnel, project, technology and organization. The taxonomy lacks the degree of severity of each risk factor that could help in providing a ranked list. This could present each risk factor with its degree of severity which calls for a survey instrument among experts in the field to reach a general view of the severity of each risk factor.

Focus group methodology used in the two sessions assisted in revealing insights from the experts. For example, one expert revealed that "in government organizations, there is a need to provide more training programs on Project Management to all team personal because it was apparent that most lack proper knowledge in this important area". Focus group method was successful method to be used to extract the opinion and insight from experts. however, it consumes some time and needs prior preparation and precise control to achieve a successful outcome.

5. CONCLUSION

This research has used qualitative methods to identify and validate the risk factors that exist in software development projects in Kuwait. An intense literature review was conducted to collect 59 different risk factors from a number of peer reviewed journals in the field of information technology from the period of 2000-2018. Focus group methodology which is rarely used in the field of information technology was applied as a mean for a) validating 59 risk factors that could be applicable to the Kuwait environment, and b) filtering, combining, and or renaming each risk factor. A final list of 28 was produced in this research providing more contemporary risk factors taxonomy that can be used by IT practitioners in Kuwait. It was noted that IT practitioners in government organizations needs more training in the field of Project Management in order to achieve successful outcome.

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Appendix-A

No of Risk factor	Risk factor	References	No of references
RF1	Budget related risk	[6],[14],[15],[17], [18],[19] ,[20],[21],[25],[26],[28],[29] ,[30],[31],[32],[35],[36],[40],[42], [47],[50]	21
RF2	Miscommunication	[14],[15],[16],[17], [18] ,[20] , [22],[27] ,[28] , [29] , [30],[56],[26],[21] , [31],[32],[33]	19
RF3	Poor understanding of user requirements	[6], [15] , [16], [17], [18], [19] ,[21],[22],[23] ,[24],[26] [29],[30],[51],[52], [56] , [64]	17
RF4	Unrealistic schedules	[6],[14],[15],[16],[17],[18],[19],[22],[28],[64], [56] ,[26],[25] ,[30] ,[21]	15
RF5	Complexity of a project	[12],[13], [14],[15],[16],[17], [18],[20],[61] , [22] , [26], [27] ,[29],[51],[30] ,[21] ,[52]	17
RF6	Lack of top management commitment to project	[12], [15], [24], [25],[18],[19],[20],[22], [14], [28], [29], [30],[56], [26], [61]	15
RF7	No planning or inadequate planning	[6],[12],[15],[18], [19], [20],[22] , [23],[14] , [52],[56] ,[26], [27],[30], [31]	15
RF8	Inadequate project management	[12],[13], [15],[24], [18],[19],[20],[26], [27],[25],[21],[51],[52],[64]	14
RF9	Project manager may have no control	[12],[20] , [21],[22] ,[14],[15],[27],[28] , [29] ,[21] , [16],[18],[23],[24]	14
RF10	Inadequate requirements	[14],[15],[16] , [17],[18],[27],[28] , [29],[30],[40],[51],[52],[53]	13
RF11	Technological newness	[18] , [19],[20],[22] , [14] ,[15],[56],[25],[26],[51],[30],[32],[21]	13
RF12	Lack of expertise	[18],[15],[16], [22] , [14] , [13],[15],[18],[20],[22],[30],[55]	12
RF13	Team related risk	[15], [22] , [14],[28] , [29] ,[26],[30] ,[21] , [16],[17],[18],[12]	12
RF14	People and personality failures	[15], [24], [18] ,[19],[20],[21],[22], ,[26],[25],[30] ,[21]	11
RF15	Conflicts of people	[13], [24], [18] ,[19],[22] ,[25],[28] , [30],[55],[56] ,[26],[21]	12
RF16	Ineffective communications with users	[12], [16],[14],[15],[16],[29] ,[26],[25], ,[21] ,[22],[30],[32]	12
RF17	Poor or nonexistent control	[12],[14],[15],[28],[51] ,[30] ,[21] , [22],[25],[26],[32],[64]	12
RF18	Insufficient training	[12],[15],[16],[17],[19],[20] ,[28] , [56] , [27],[21],[24]	11
RF19	User resistance to change	[22] , [14],[15],[16],[28] ,[29] ,[26], [27],[28],[29],[30]	11
RF20	Organizational environment risk	[15], [13] , [14],[20],[21],[22],[23],[25],[26],[30]	10
RF21	Lack of definition of roles and responsibilities in software projects	[16[,[18] ,[19],[22],[29] , [30],[56] ,[26],[20],[21]	10
RF22	Lack of knowledge	[14],[15],[16], [29] ,[26],[25] ,[20],[21] , [30]	10
RF23	Schedule pressure	[6],[12],[15], [18], [28],[29],[25] ,[26], [27],[30]	10
RF24	Lack of senior management commitment and technical leadership	[24], [18] , [22] , [14] ,[28] , [29] , [6],[12],[15],[16]	10
RF25	Lack of agreement on project goals	[24], [18] , [22] , [14] ,[28], [56] ,[26],[21], [14],[15]	10
RF26	Changing scope/objectives	[14],[28] , [56] ,[26], [16], [12],[17],[18],[27],[28]	10
RF27	Inappropriate staffing	[24], [18] , [22] ,[14] , [56] ,[26], [27],[21],[15],[12]	10
RF28	Lack of adequate user involvement	[14] ,[15],[16],[20] ,[28] , [29] ,[30],[31],[32],[56]	10
RF29	Lack of adequate technology infrastructure	[14] ,[15],[16],[20] ,[21],[22] , [29] , [56] ,[26]	9
RF30	Resource insufficiency	[14] ,[15],[16],[17] , [22] ,[28],[27],[21] , [16]	9
RF31	Application complexity	[20] , [14],[26], [27],[21],[15],[12],[6],[30]	9
RF32	Inadequate user participation	[13] , [22], [56] ,[51], [14] ,[15],[16], [17] ,[20]	9
RF33	Team Turnover	[15],[22] ,[28] ,[26], [27] ,[21] , [16],[17],[18]	9
RF34	Choosing the wrong development strategy	[14] ,[15],[16], [17] ,[20] ,[26],[30],[21] , [22]	9
RF35	A climate of change	[14] ,[28] ,[26],[21],[15],[16], [17] , [22]	8
RF36	Unclear Description of the real environment	[14] ,[15],[19],[28] ,[26],[51]	6
RF37	Lack of strategy alignment	[13] , [22] , [14] , [56] ,[26],[21], [17] , [22]	8
RF38	Poor quality deliverables	[14] ,[15],[16], [17] ,[20] ,[22] ,[28] ,[26]	8

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RF39	Ignoring the Non-functional requirements	[17],[29] ,[26],[25],[30],[21],[15]	7
RF40	Lack of frozen requirements	[18], [19], [22] , [14] , [56], ,[15],[16]	7
RF41	Technology shortfalls	[13], [19], [22] , [14] ,[15],[30], [32]	7
RF42	Failure of technology to meet specifications	[24], [19],[28] , [56] ,[26], [14],[15]	7
RF43	Task complexity	[14] ,[15],[16], [17] ,[18] ,[26],[21]	7
RF44	Inability to test in the operational environment	[14] ,[15], [19],[28] ,[26],[51]	6
RF45	Mismatch between company culture and required business process changes	[18], [22] , [14] ,[15],[16],[26]	6
RF46	Data Loss	[14],[15],[20] ,[26], [16],[30]	6
RF47	Continually changing scope and system requirements	[14],[15],[22] ,[21] , [16]	5
RF48	Conflicting User Requirements	[17] , [22] ,[26],[21] , [16]	5
RF49	Lack of data integration	[24] ,[28] ,[26],[14],[15]	5
RF50	Budget not enough for maintenance activities	[17], [18] , [14] , [56] ,[21]	5
RF51	Not thoroughly defining the scope of the new system	[22] ,[26],[25],[14],[15]	5
RF52	Trying new development method/technology during important project	[18] , [22] , [14] ,[15],[16]	5
RF53	Low quality of testing	[14] ,[15],[16],[29] ,[21]	5
RF54	Scope Risk	[14],[15], [17] ,[26]	4
RF55	Failure to follow an enterprise-wide design that supports data integration	[24] ,[26],[30],[32]	4
RF56	Lack of architecture and quality software project	[26],[28],[29],[30]	4
RF57	Failure to get project plan approval from all parties	[18], [19], [14] ,[15]	4
RF58	Un acceptance of the Plan in time by client	[19], [29],[30]	3
RF59	Lack of knowledge needed for component integration	[14] ,[15]	2