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RISK MANAGEMENT MATURITY MODEL IN CONSTRUCTION INDUSTRY FROM CONTRACTORS PERSPECTIVE IN NEW CAPITAL CAIRO

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ملخص البحث:

نظرا لأهمية بناء المشاريع الضخمة واهمية تحقيق الادارة السليمة للمخاطر، بدأت هذه الدراسة بهدف التوصل الى فهم أفضل لإدارة المخاطر في المشاريع الإنشائية، من منظور المقاول، حيث تم اتخاذ العاصمة الإدارية الجديدة، كحالة دراسية ويتطرق الي أهم هذه المخاطر وتأثيرها وكيفية تجنبها ووضع خطط وطرق لتقليل اثارها وتجنب خطرها على اعمال المشروع.

في هذا البحث، يتم استخدام استبيان مغلق مع مقابلة لجمع البيانات من شركات المقاولات المحلية في العاصمة الإدارية الجديدة، بعد التعرف على المخاطر التي قد تواجه المشاريع. يتم تحديد قائمة شاملة بأهم عوامل الخطر وأكثرها تأثيراً وطرق تجنبها قبل تنفيذ المشروع أو أثنائه وتم إعداد الاستبيانات حول احتمال حدوث خطر.

وشملت الرسالة 4 دراسات (دراسة نظرية، دراسة ميدانيه، دراسة تحليليه ودراسة استدلاليه).

وخلال **الدراسة النظرية**، تم تجميع الدراسات السابقة في مجال إدارة المخاطر في صناعه البناء وتم دراستها وتدقيقها وتصنيفها الى مجموعات.

ومن خلال **الدراسة الميدانية**، تم أعداد نموذج استبيان وتوزيعه على 60 شخصاً في مجال البناء. وتم جمع الرد على استمارات الاستبيان وتجميعها. وخلال **الدراسة التحليلية**، تم تحليل استمارات الاستبيان عن طريق برنامج إحصائي SPSS وطريقة التحليل الهرمي AHP وتم تحليل النتائج؛ كما تم عرضها على رسومات بيانية وتم مناقشتها.

وخلال **الدراسة الاستدلالية**، تم استخلاص الاستنتاجات واقترحت توصيات للبحوث المستقبلية والممارسات الهندسية.

أعطى البحث الأولوية لفهم عوامل الخطر في صناعة البناء وأهميتها وتكرارها. علاوة على ذلك، تمت تسوية إجراءات تخفيف المخاطر. بالإضافة إلى ذلك، أوصي ببعض الإجراءات التي من المرجح أن تحسن ممارسات إدارة المخاطر.

الكلمات المفتاحية: المخاطر، إدارة، التشييد، العاصمة الإدارية الجديدة، المشاريع.

ABSTRACT

In terms of the importance of constructing mega concrete projects and the importance of achieving a proper risk management, this study was initiated with the objective of providing a better understanding to risk management in construction industry, from contractor perspective, where New Capital Cairo was taken, as a case study and touch on the most important of these risks, their impact, how to avoid them and developed appropriate plans to reduce their impact on the project.

Primarily, objectives were set and the research methodology was put forward to attain such objectives. This research implemented a closed-ended questionnaire with interviews to assemble data from local construction companies in New Capital Cairo that identified the risks that faced their projects.

The research methodology encompassed 4 studies (Theoretical Study, Field Study, Analytical Study and Inferential Study).

During the **Theoretical Study**, literature in the field of risk management in construction industry were accumulated, studied, scrutinized and categorized into groups.

All through the **Field Study**, a questionnaire form was structured and distributed among a population of 60 individuals in the construction field. The questionnaire forms were answered and assembled.

Throughout the **Analytical Study**, the questionnaire forms were analyzed using SPSS "Statistical-Program-for-Social-Science" and AHP "Analytical-Hierarchy- Process". The results were presented on 96 charts so as tables and discussed.

During the **Inferential Study**, conclusions were drawn and recommendations for future research and Engineering practice were suggested.
The research prioritized construction industry risk factors, their importance and frequency. Moreover, risk mitigation actions were settled. In addition, some actions that would most probably improve risk management practices were recommended.
KEYWORDS: risk, management, construction, New Capital Cairo, projects.

1- INTRODUCTION

Risk management is identifying; evaluating and prioritizing of risks by the coordinated so as economic resources in order to monitor and control impact of unfortunate events probability or to maximize opportunities. Risks come from different sources (i.e. uncertainty in markets, threats of project failure during design so as development all through its life-cycle, legal obligations, accidents, natural disasters, deliberate attack from events of unpredictable cause. There are 2 events types (i.e. negative events or risks and positive events or opportunities. There are various risk management standards. Methods and goals vary according to risk management method of project management. On the other hand, there are strategies to manage uncertainties with negative significances (i.e avoiding threats or reducing threat probability and retaining actual consequences of a threat. However, there are strategies to gain opportunities (i.e. uncertain future with benefits). Certain aspects of risk management standards are under criticism, as they have no measurable improvement.
Previous studies rarely tackled risk management maturity in construction industry from contractor perspective. Accordingly, this research was initiated in order to provide a better understanding to risk management in construction industry, from contractor perspective, statistically.

2-LITERATURE REVIEW

Literature was assembled from different journals so as published reports; reviewed; scrutinized and categorized into groups. Based on the assembled literature, it was apparent that many researchers investigated the construction risk management. Among them are the following:

Yakubu BABA (2014): He investigated the perceptions of contractors in identifying and evaluating the most significant risks factors, in terms of their allocation and the effective remedial actions in Nigerian building projects. He conducted a survey to collect data from practitioners (in the industry. 60 risk factors were identified and categorized into 9 groups. He implemented SPSS‟ version 20 to obtain the mean score representing the practitioners' perspectives. He adopted a descriptive analysis for data analysis. The findings indicated that Contractors perceived payment delays of 4.76 scores. He looked forward for findings to aid the Nigerian contractors to thoroughly understand the critical risk factors and impacts on the building projects in Central zone of Nigeria via a risk management system.
Bader Ahmed Al Harthi (2015): He investigated risk management framework, in fast projects of construction in UAE. The study aimed to identify risks in UAE construction industry attitudes; provide a better understanding to it and propose effective framework for it in fast- construction projects. A mixed-method approach was implemented to attain the set objectives in UAE). 65 questionnaire forms were prepared; distributed to construction industry professionals (i.e. contractors, project managers so as private consultants). Their answers were analyzed using statistical techniques in order to a focus on experts. The results indicated that construction projects risks might be internal

or external. Knowledge about risk management needs to be perceived to eradicate problems of poorly managed fast construction projects.
The study recommended that applying the reached conclusions, the practitioners will encounter positive change and profitability will be enhanced.
Johan Bonander and Hampus Ulriksson (2016): They conducted a study at a Swedish construction company, which houses residential development units. Their study focused on analyzing risk management process to a residential project constructed by the same company. They described and analyzed risk management in a project in an organization in the construction industry in order to provide a better understanding risk management implementation practice. The study included the perspectives of the developer so as the constructor, here interviewees were interviewed. They implemented a general risk management model to offer an analysis framework. The model consisted of four steps (i.e. risk identification-risk assessment-risk mitigation and monitoring). The results indicated that risk management in residential construction depends on personal knowledge and experience.

3- STRUCTURING THE QUESTIONNAIRE

In 1838, questionnaire was devised by the "Statistical Society of London". It is a set of printed questions with a set of choice answers, devised for the survey purposes or statistical study purposes. It is a research device encompassing a series of types of prompts or questions for gathering information of respondents. Questionnaires possess advantages over surveys that are summarized, as follows:

- They are cheap.
- They do not need much effort like the verbal or telephone surveys.
- They have standard answers, which makes it simple to compile data.

Questions should flow a logic sequence in order to achieve its purpose. They should flow, as follows:

- from least to most sensitive
- from factual to attitudinal
- from general to specific

The present questionnaire was prepared following the fore-given regulations concerning the following aspects:

- The questionnaire was prepared while being aware of its advantages and disadvantages.
- The questionnaire was structured taking care about its construction.

Following the above regulations, the questionnaire was divided into 5 blocks with 41 questions. They inquired about the risks attributed to the following aspects:

- Block no. 1: Project site relevancy with 7 questions
- Block no. 2: Project design relevancy with 7 questions
- Block no. 3: Project during construction with 8 questions
- Block no. 4: Project financial condition with 5 questions
- Block no. 5: Project administrative and applicability conditions with 14 questions

The answers were to state:

- The probability of risk occurrence was characterized between 1 and 99%, as follows:
  - ✓ 1-20% occurrence
  - ✓ 21-40% occurrence
  - ✓ 41-60% occurrence
  - ✓ 61-80% occurrence

- ✓ 81-99% occurrence

- The impact degree of the risk was characterized between very low and very high, as follows:
  - ✓ very low and low
  - ✓ moderate
  - ✓ high and very high

4- STATISTICAL SOFTWARE AND QUESTIONNAIRE RESULTS

There are several available software for questionnaire results analysis, for example:

- ***SPSS:*** It is a software package for statistical analysis. It was developed by IBM Corporation in 2009. Its current version is named "IBM-SPSS-Statistics. Its license is Trialware. Its stable release is on 09.04.2019. Its operating system: is Windows, macOS or Linux on z Systems or Linux and UNIX. Its size is ~1.2 GB.
- ***PSPP:*** It is a free software application. It is developed by GNU Project. Its stable release is 06.11.2018. Its operating system is GNU or, macOS or Microsoft Windows. It is implemented for analysis of sampled data. It is a free version of IBM SPSS Statistics. It has a graphical-user interface with conservative command-line interface. It is in C language and accesses "GNU Scientific Library" for the mathematical routines. Its name has no acronym.

The implemented software, in this study is ***SPSS version 23***. This software was selected as it has many advantages. Among them, for example, are the following:

- It has many accessible features with pull-down menus
- It simplifies repetitive tasks
- It handles complex data
- It can be run unattended by using "Production Job Facility".

SPSS encompasses the following statistics:

- Frequencies and descriptive ratio statistics
- Bivariate statistics
- Linear regression
- Factor analysis
- Python

Among its output files are tables, graphs histograms, pie charts and tables.

The forms were distributed among 60 respondents. They were assembled after 1 week. The answered were segregated and aggregated to form the questionnaire array, which is presented on tables (1a) to (1c) to indicate the frequency and risk impact for the considered factors.

5-SPSS AND RESULTS ANALYSIS

SPSS was implemented and 82 pie charts were obtained. 41 charts designate the probability of risk occurrence for every aspect and 41 charts designate the risk impact of every aspect.

The obtained charts were analyzed, from which charts (1a) and (1b) are presented here, as a sample of highest probability of risk occurrence that affects the construction process, from the contractors' perspective, which belongs to the block of project design relevancy.

In conclusion, 2 extra charts were drawn to represent an overall outlook to the entire replies to all the respondents, in terms of frequency of occurrence and risk impact; charts (2a) and (2b), respectively.

6-CONCLUSIONS AND RECOMMENDATIONS

Based on the above investigation, the following were the deduced conclusions:

- The risk occurrence of 81-99% ranged between 1 and 29%.
- The risk impact of high so as very high affected the project with a ranged between 10 and 46%.
- The research prioritized construction industry risk factors, their importance and frequency.
- ***Project site relevancy*** signposted that the 81-99% risk occurrence ranged between 0 and 1 of the population (with an average of 0.5)
- ***Project design relevancy*** specified that the 81-99% risk occurrence ranged between 1 and 5 of the population (with an average of 3)
- ***Project during construction*** designated that the 81-99% risk occurrence ranged between 0 and 3 of the population (with an average of 1.5).
- ***Project financial condition*** denoted that the 1-20% risk occurrence ranged between 4 and 8 of the population (with an average of 6).
- ***Project administrative and applicability*** designated that the 81-99% risk occurrence ranged between 2 and 39 of the population (with an average of 20.5)

Based on the above investigation, the following were the suggested recommendations:

- Some actions would improve risk management practices in the pre-construction phase (Use quantitative risk analysis techniques, Use experience in determining project duration, Update project information schedule, Put forward to Plan B and Adjust project duration to encompass risk).
- Some actions would improve risk management practices during construction phase (i.e. Increase the labor and equipment, Increase the working hours, Change the construction method, Change the construction method sequence and Coordinate with the sub-contractor).
    - More factors are to be investigated and introduced to the questionnaire.
    - Other analysis techniques might be implemented to verify the results.
    - Carry out such investigation on a larger population.
    - Introduce labor to the population.

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Tables

Table (1a) Questionnaire results array

Question number	Block	Question	% of risk occurrence					Risk Impact		
			0-20	21-40	41-60	61-80	81-99	Very low or low	Mode-rate	High very high
1	Project location relevancy	Accidents due to safety absence	25	8	16	9	2	30	16	14
2		Supplies of defective materials	35	13	6	6	0	32	17	11
3		Varied labor and equipment productivity	28	18	11	3	0	20	22	18
4		Natural Events	42	8	7	3	0	30	17	13
5		Project Location	37	12	6	4	1	34	16	10
6		Unfavorable climate conditions	20	28	7	4	1	30	19	11
7		Incorrect design	9	13	22	9	7	19	24	17
8	Project design Relevancy	Uncoordinated design branches	8	14	19	12	7	17	32	11
9		Inaccurate bill of quantities	22	17	15	6	0	27	19	14
10		Inconsistency between BOQ & specifications	22	15	16	6	1	21	30	9
11		Inequality of actual and contract quantities	24	18	3	12	3	28	18	14
12		Hasty design	11	24	15	5	5	17	25	18
13		Design alterations	10	9	25	12	4	20	24	16
14		Implementing unqualified designers	30	14	8	5	3	25	20	15

Table (1b) Questionnaire results array

Question number	Block	Question	% of risk occurrence					Risk Impact		
			0-20	21-40	41-60	61-80	81-99	Very low or low	Mode-rate	High very high
15	Project during construction	Unavailable labor, materials and equipment	29	15	10	6	0	20	29	11
16		Unavailability of trained labor	15	26	11	7	1	21	24	15
17		Low workers' productivity	32	14	9	4	1	15	32	13
18		Difficulty in training new labor	31	18	7	4	0	32	21	7
19		Material waste due to bad storage and misuse	23	10	14	8	5	20	24	16
20		Tight schedule	8	13	20	16	3	26	19	15
21		Specifications and execution irrelevance	23	12	8	14	3	19	33	8
22		Low work quality in terms of time	24	14	10	8	4	20	29	11
23	Project financial condition	Inflation	15	23	11	7	4	26	21	13
24		Delayed payments	16	27	9	5	3	29	19	12
25		Contractor uses project budget in other project	12	11	19	10	8	20	23	17
26		Unmanaged cash flow	10	12	21	8	9	24	20	16
27		contractor break	36	14	2	4	4	28	19	13

Table (1c) Questionnaire results array

Question number	Block	Question	% of risk occurrence					Risk Impact		
			0-20	21-40	41-60	61-80	81-99	Very low or low	Mode-rate	High very high
28	Administrative and applicability condition	Poor communication between involved parties	25	16	10	7	2	30	17	13
29		Poor coordination bet. contractor & workers	14	20	16	8	2	19	20	21
30		Poor communications between office and field	26	12	10	5	7	19	20	21
31		Incompetence of the administrative team	23	17	14	5	1	19	26	15
32		Lack of experience of site consultant team	25	20	2	9	4	28	20	12
33		Strict site supervision of the consultant	26	13	10	6	5	28	19	13
34		Undefined scope of working objectives	25	19	8	5	3	32	17	11
35		Inconsistency of owner-contractor-consultant	19	23	7	6	5	28	15	17
36		Poor event documentations	30	15	6	7	2	27	20	13
37		Legal disputes during construction	35	11	6	6	2	39	10	11
38		Delay in resolving conflicts	33	14	3	7	3	26	20	14
39		Absence of Engineering referee	36	16	4	3	1	30	17	13
40		Mismanagement of resources	12	21	15	5	7	23	22	15
41		Changing administrative methods	12	16	21	6	5	25	17	18

Charts

Chart (1a) Designating the probability of risk occurrence

Project design relevancy (contractor break)

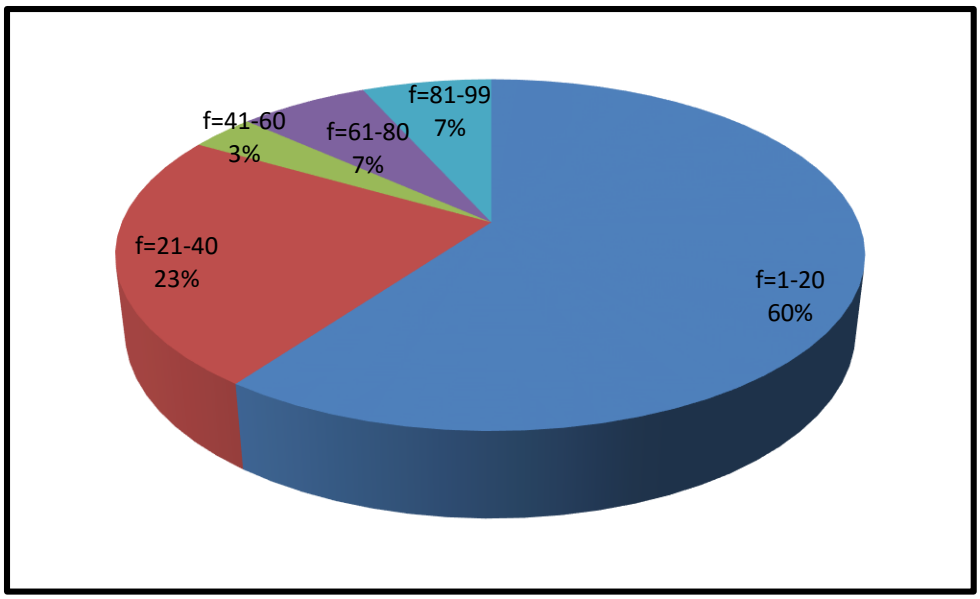


Chart (1b) Designating risk impact

Project design relevancy (contractor break)

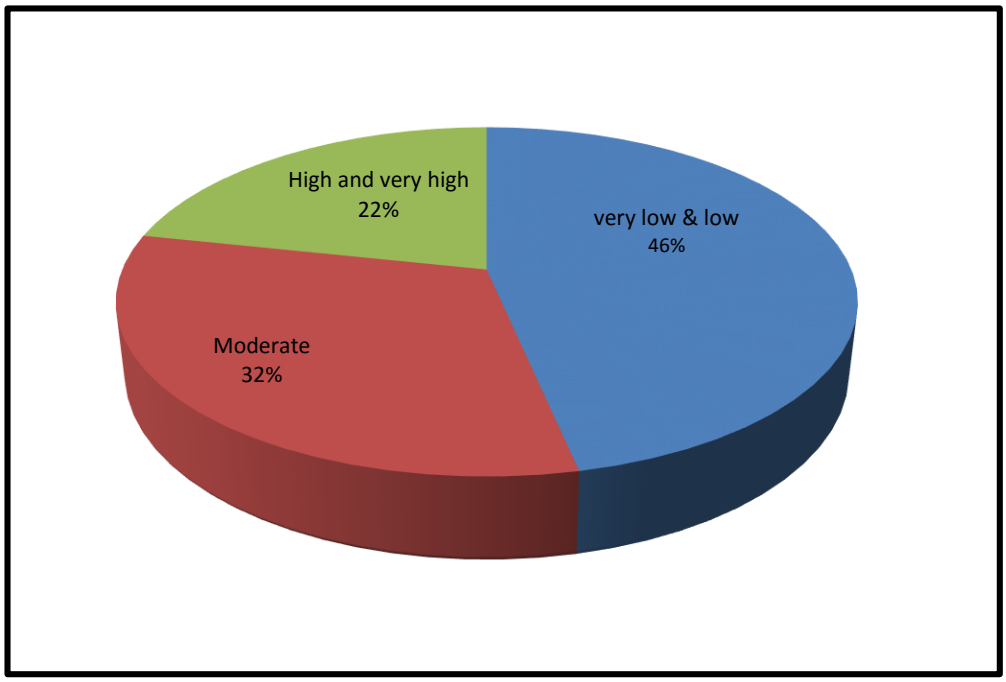


Chart (2a) Overall outlook to the entire replies to all the respondents in terms of frequency of occurrence

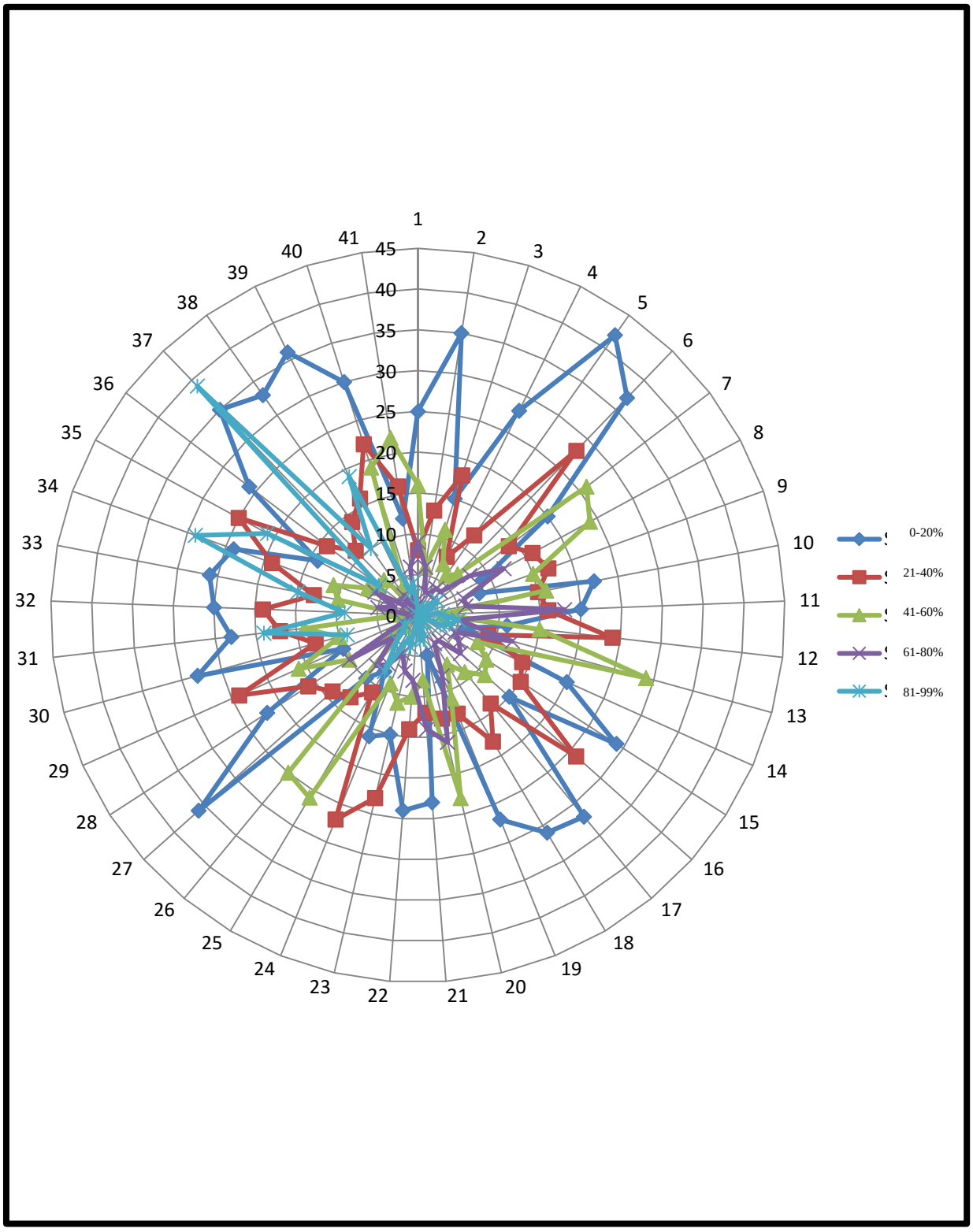
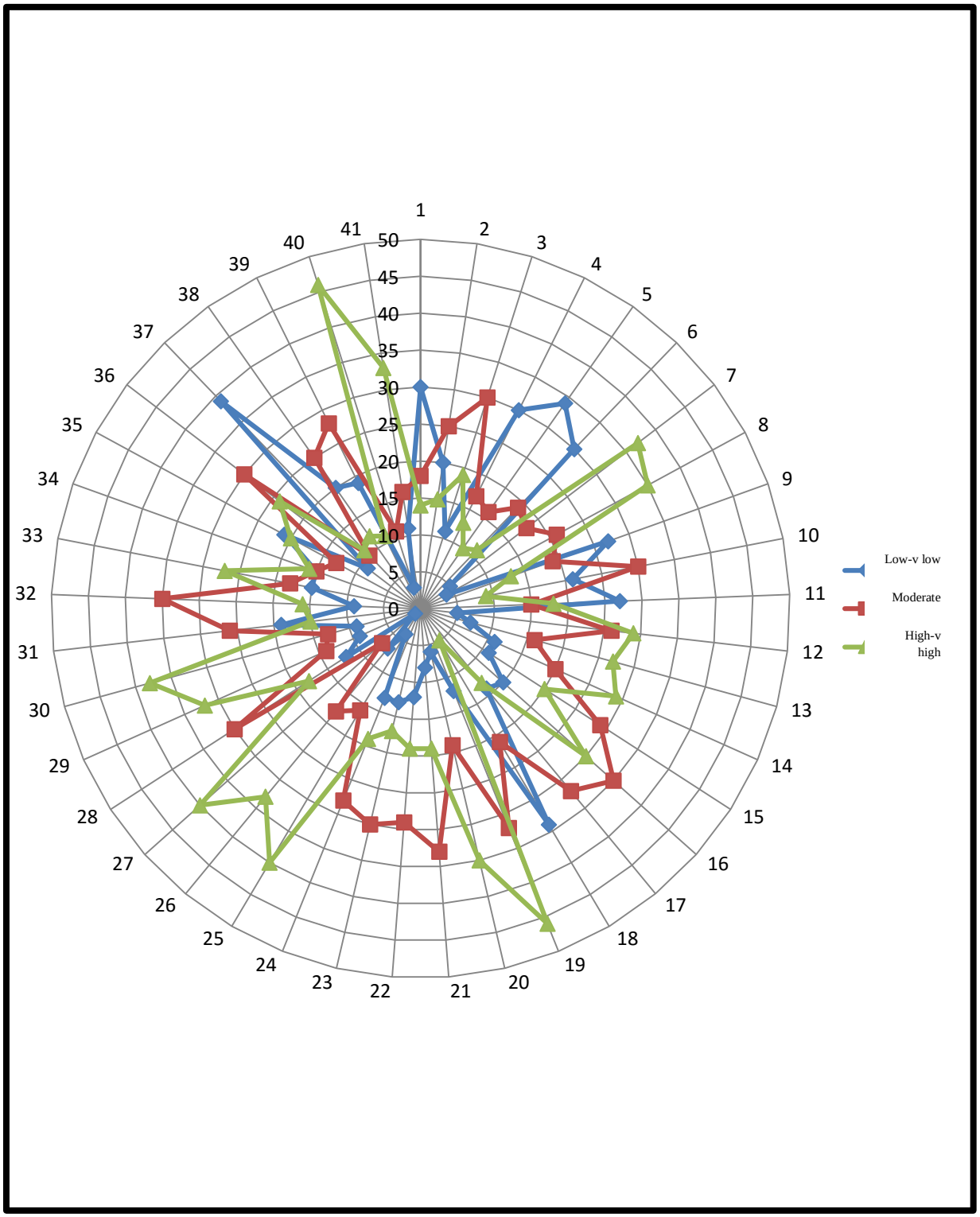


Chart (2b) Overall outlook to the entire replies to all the respondents in terms of risk impact



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