Risk Analysis and Web Project Management

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***Abstract*—From the software engineering point of view, the development of web applications is a new area that requires an adaptation of many software engineering approaches or even the development of completely new approaches. Many failures associated with web applications development are the consequences of poor awareness of the risks involved and the weak management of these risks. The main objective of the study is to fill the information gap within web projects management by learning from the experiences of organizations who are already out there managing web projects. Additionally, the study investigates uncertainties that will affect web projects and the level of threat they pose to the success of web projects.**

***Index Terms*—web project, risk factor, risk management action**

I. INTRODUCTION

Within the last two decades, the World Wide web (WWW), more commonly known as the web, has had a massive and permanent influence on our lives, and works have been inexorably changed [1]. The web has become the main platform for deploying business and social application and organizational information systems [2]. From the economic sector to the entertainment world, hardly any part of our daily lives has been unaffected by the WWW. Many organizations have extended the scope of their web-based systems. They have also begun to provide mobile and wireless access to them. Therefore, web-based applications now present an array of content and functionality to a huge number of users and carry out many different purposes [3]. Because of its ubiquitous presence, the expectations and demands placed on the web applications have increased significantly over the years. At the same time, the development, deployment and maintenance processes of the web-based systems which have become more and more complex and difficult to manage, have not progressed at a sufficient rate to meet these demand and challenges [4].

Many developers of web applications projects do not take into concern many-sided, unique requirements of web applications [5]. They also fail to realize that characteristics and requirements of web-based systems considerably different from that of traditional software, and so does their development. They need to identify these differences and take suitable actions to perform the unique requirements of web applications [5]. Hence, many developers and maintainers conduct web applications in an ad hoc manner, and fail to adopt sound design methodologies, resulting in poor quality web systems and applications. A survey by the Cutter Consortium [6] shows that failure to meet business needs (84%), project schedule delays (79%), and budget overruns (63%), lack of functionality (53%) and poor quality of deliverables (52%) are the main problems cited by the stakeholders of such applications.

Risk management is an essential fraction of project management and plays a significant role in it [7]. Risks are factors that can present, adversely affect a project, unless project managers take appropriate actions [8]. Generally, the main reasons for delays or total failure of web projects are identical to the risks and problems identified and constantly updated by Boehm [9]. Effective management of these risks currently appears to be the most vital area of web project management [7].

Web project development is still in its infancy and as such, lacks of process models that can serve as a guideline for the development of web based applications. To circumvent this problem, contemporary process models that have been a devise for the development of conventional software have been widely adapted [10].

For this reason, this paper aims to understand the extent of web project development practices currently in use. In addition, to investigate the uncertainty of activities that have been performed and to elucidate specific incidents that occurred during the life of the projects that were risky and challenging. The rest of the paper is organized as follows. Section 2 presents the research methodology that was used in this research comprises a preliminary study and a survey. Then it presents the results in Section 3 and the discussion of this research in section 4. Finally it concludes the study and describes possible future work in Section 5.

II. RESEARCH METHODOLOGY

This section will describe how the preliminary study of this research was conducted. It was carried out in two main phases:

A. Phase One

The semi-structured interviews were conducted with eight experts from different countries who were involved in developing web applications for software markets as well as for in-house users within organizations. The guideline of the interview was sent to respondents a few days before the interview. During the interview, a recorder and a note scripting methods were used to record the interview. Each interview started with a briefing on the research background and explaining the goal of the study. The interviews captured the practices of the interviewees in development of web applications and/or related systems.

The purpose of the pre-study was to conduct an exploratory study. It investigated the similarities and differences among development processes in eight web application projects in Malaysia and Jordan. It also condensed the process scenarios in successful and unsuccessful web applications projects.

B. Phase Two

In the second phase, we used a questionnaire to collect the data. The questions were formulated based on the findings from the first phase of the research. The questionnaire consisted of twenty-eight questions. All questions are closed questions except three of them were open-ended questions. The closed questions used to seek information on web project context. The three open-ended questions used to collect information on actual web project development processes. The questionnaire included five parts as shown in Table I. Furthermore, there was a cover page provided to inform the details of the survey. It also provided a column that allowed respondents to give comments on the issues or the questionnaire.

The unit of analysis for the survey was by county in which the participants were from companies in different countries including Malaysia, USA and Jordan. The targeted population included all companies in the three countries which developed web applications for software market as well as for in-house users. The SEI questionnaire was employed as the survey instrument. The survey involved all levels of staff in web application development or maintenance. Only the maximum two participants from the same company were allowed to respond the survey. The respondents selected the web projects in the study randomly.

The researcher conducted the survey by contacting participants who had been in researcher's contact list using e-mail or telephone. Questionnaire files were attached to the e-mails in document or text format. Then the contacted persons sent and distributed the questionnaire file to other participants. Besides, researchers contacted and distributed some identified respondents with the printed copy of the questionnaire. This method made the response rate higher compared to the method of contacting all software engineers in a telephone directory. Ninety-one respondents (72.2%) finally took part in the survey after the researcher contacted and e-mailed one hundred twenty six individuals.

III. DATA ANALYSIS

A. Phase One

We analyzed the data from the preliminary study based on three objectives. The first objective was to investigate the actual development processes used in the project. The data was analyzed using the constant comparison method [13] as all respondents had a clear definition of the main processes used in their project. These processes were clustered into two main groups: traditional (prototyping, waterfall, or incremental) or new processes.

TABLE I.
QUESTIONNAIRE IN THE SURVEY

Part 1: Background of the respondent	
Br1	What was your position in this project?
Br2	How long have you been working with web application development?
Br3	How many web application based projects have you been participated in?
Br4	What is your principal education degree?
Part 2: Information on the context of the project and system	
Cp1	• What is the staff size of your company?
Cp2	• What are the main business areas of your company?
Cp3	• What is the duration time of the project?
Cp4	• What was the emphasis on customer satisfaction, time-to-market, meets budget, goals, performance, flexibility, new functionality of the system?
Cp5	• Did you use software architecture?
Cp6	• What are the driving forces in software architecture creation?
Cp7	• To what extent did you expect the chosen software architecture to contribute the project characteristics?
Part 3: General development processes	
Gp1	• What was the main development process?
Gp2	• Who decided the main (i.e. lifecycle) process?
Gp3	• At which stages is the end customer involved in your project?
Gp4	• Do you take enough time to try understanding the special challenges inherent with web projects?
Gp5	• What were the main challenges in your web project processes?
Part 4: Web metrics and technology used in web projects	
Mt1	• Did the project use any standard to estimate process?
Mt2	• Did the project use any standard to measure the size of web project?
Mt3	• What aspects of web project size do you consider?
Mt4	• Did you use any software base models for the cost prediction?
Mt5	• If you use the functions/features of a web application to estimate the effort to develop this application, how do you identify what functions/features to develop?
Mt6	• What factors did you use to estimate the effort for a project?
Part 5: Risk Management	
Ra1	• What does your organization understand by the term 'risk management'?
Ra2	• Were potential risks identifying at the beginning of the project?
Ra3	• Were risks incorporate into the project plan?
Ra4	• What risk management tools and methodology were uses?
Ra5	• What actions were performing during development or maintenance of the project?
Ra6	• What is your opinion on the aspects (risks) of your web project?

The second objective was to explore similarities and differences among the development processes and their changes in the projects. We used cross-case analysis [13] to analyze these aspects. This method dealt each project as a distinct "case". The following steps were used:

1. Reviewed the responses for the first two web projects. After that, for each of these two web projects, a list note was assembled with short notes, which illustrate

the process change in each of these projects, for instance, illustrate the a new or changed activities. Subsequently, these two lists were balanced to discover the similarities and differences.

2. Organized the analysis of the two project lists in the form of propositions; each proposition describes the changing process that supported it.
3. Examined third project, then the third project list note was assembled with short notes that described its process changes.
4. Investigated whether the third web project accepted or rejected any of the propositions expressed from the first two projects. Accordingly, if a proposition was accepted, then this third project was put into the list that supporting the evidence. If it rejected a proposition, then either the proposition changed or the project was noted as rejecting the concerned proposition. Any supplementary propositions recommended by the third inspection were included in the list.
5. Repeated step 4 for each project.

In the end, the study produced a list of propositions; each proposition had a set of supporting and disagreed evidence (web projects).

The third objective of the study was to discover the process scenarios of the successful and unsuccessful web projects. Firstly, it divided projects into two clusters based on the negative or positive effects of the web projects regarding cost, time and common quality of web applications. In every cluster, we separated web projects into sub-clusters based on the actual processes they used. For each sub-cluster, the same cross-case analysis mentioned above for the second objective. This third objective enabled the derivation of more relevant data. For each web project, we combined a list of short notes that represent not just the process changes in every project, but also how these changes performed and when. In addition, we recorded the experience of each web developer and the lesson learned in different summary of process scenarios.

For the next phase, we selected the major problems faced by web projects and some instances of good practices performed in every process scenario. The study assembled the problems and instances of good practice that happened in more than one project into one list. In addition, it also listed the problems and instances of good practice that happened in just one project because they are also considered as the major factor that determined the success and failure of such project.

B. Phase Two

The second phase consists of the analysis of the pre-study that was explorative in nature to be the input on constructing the questions for the survey. It includes two parts:

1. Validated the findings of the pre-study of research and understood the extent of web project development practices currently in use.
2. Applied the theoretical measurement framework by Fenton and Bush [14]. The survey comprises one entity, which is the web project and two attributes: the potential risks of the web project and probable risk mitigation actions to prevent these risks. There are two relations: risks that are associated to a project and risk mitigation actions that affect the risks. The framework of the research is shown in Fig. 1.

We designed the study to perform posteriori measurements (after the project is complete) on the occurrence of project risks and the impacts of performed risk management actions on these risks. This will serve project managers in predicting the likelihood of risks and to map the risk management effectively much earlier before a project begins.

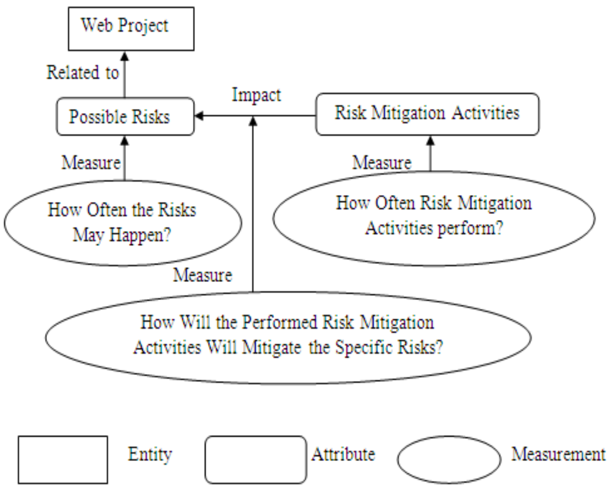

Figure 1. The risk management after a web project is complete.

IV. FINDINGS

A. Phase One

Results of the first objective demonstrate that the development processes of the studied web projects include three main categories: a hybrid of incremental and prototyping, pure waterfall, and a hybrid of waterfall and prototyping. Four projects used a hybrid of incremental and prototyping. For instance, during the discussion on requirements for graphical user interface part of a system, they used a simple prototype. Three projects used waterfall. One project used a hybrid of waterfall and prototyping. Therefore, the result to the first objective was reflects that "the web project development process is the customization of the traditional development process".

The second research objective explores the similarities and differences in development processes. To learn about the similarities in changes of processes, we studied the activities, roles, challenges and responsibilities in the web project processes. The top keys findings include:

1. Lack of processes and skills: Teams in five web projects did not have clear view of the progress of the project and its relation to risks. Eight web projects declared that there was no constant vision of what the project was attempting to deliver. Five web projects declared that the resources and effort of the estimation

tools were poor while three projects declared this kind of tool was not exist. In addition, four projects declared that the project was always planned in isolation from the rest of the company.

2. Realistic project approach: Five web projects encountered risks due to poor project approaches. Determining the finest approach, the most effective project design and development methodology and putting the right budget were among significant activities should be conducted at the beginning of a web project.
3. Changing requirement: Six web projects declared that they knew requirements would change during the project development. They dealt with these changes only when it actually happened.
4. Experience in project management: The capability of the project management is a significant risk success factor. However, two projects declared that while skillful project management was necessary but it was not sufficient for project success. Organizational capabilities are another significant risk success factor. It supports project managers and projects. This includes reward and support for in-house skills in project activities.

In summary, the findings related to the second research objective indicate that there are several common activities, challenges and responsibilities across the web projects. The variations occur in terms of issues related to how and when these activities are performed.

The third research objective was to discover the process scenarios of the successful and unsuccessful web projects. In this stage, the research focused on discovering the relationships among possible risks and web project development processes. First, we asked all respondents to summarize the problems they faced in web project development processes and their proposal of good practices. Secondly, we extracted the related processes parts. For instance, how and when the new activities performed, what were the key development processes. After that, we summarized additional problems and good practices. In our definition, when project contributed positively to time-to-market and system quality, we regard it as a successful web project. Otherwise, it is unsuccessful or a failure. Thus, we found seventy-three risk process scenarios and examples of good practices obtained from the studied web projects. It would be redundant to outline the complete list seventy-three risk process scenarios and good practices. Therefore, we decided to consolidate this list to avoid duplications. To achieve the goal, we analyzed the list of the process scenarios and good practices to re-identify and remove possible redundancy.

Since web applications differ from conventional software applications, we consider the lacking characteristics in traditional applications such as non-linear navigation and characteristics that are of particular importance in web applications as proposed in the literature [11],[12]. These characteristics constitute the reasons why many concepts, methods, techniques, and tools of traditional software projects are either insufficient to meet the needs of web projects or have to be modified in order to do so. Hence we decided to use web applications characteristics as the main category to list the selected typical risk process scenarios. The selected typical risk process scenarios in web project developments are shown in Table II.

TABLE II.
TYPICAL RISKS IN WEB PROJECTS

Characteristics	Code	Descriptions
Content	Rf1 Rf2	• Lack of understand the structuring of content. • No explicit define about the standard of project qualities.
Navigation	Rf3 Rf4	• Difficult to navigate and finds problems. • Too large volume of information contains.
Presentation	Rf5 Rf6	• Difficult in operate and simplicity. • Lack of the aesthetic used in content.
Social Context	Rf7 Rf8	• Difficult in define content and functional requirement. • Hard to term possible threaten from competitors.
Technical Context	Rf9 Rf10	• Complexity of designing models increases by using mobile devices. • Lack of understand delivery medium concept.
Natural Context	Rf11 Rf12	• Time and location from where the applications were access could not be predicts. • Meet user's expectation to have accessibility around the clock.
Development Team	Rf13 Rf14 Rf15	• Lack of development concerning on safety, security, reliability. • Build on emerging technology and methodology. • Web developers have variety of background, experience and age.
Technical Infrastructure	Rf16 Rf17	• The inhomogeneity and immaturity of used components • Hard to predicted operational environment.
Process	Rf18 Rf19	• Lack of define user categories. • Continually change project/scope/ objectives.
Integration	Rf20 Rf21	• Many external suppliers involve in the development project. • Legacy systems are poor documented.

The typical risk management activities are show in Table III. In addition, we also investigated additional activities in web project development that may help to mitigate the risks in web project development.

TABLE III.
RISK MANAGEMENT IN WEB PROJECTS

Code	Risk Management Action
Rm1	• Design patterns aspect can help to solve design problems
Rm2	• Stakeholders and developer understand the unique challenges inherent in web projects
Rm3	• OTS components qualities (reliability, security etc.) were seriously considered in the selection process
Rm4	• Teams have visibility of the progress of the project and its associated risks and issues
Rm5	• In successful organizations collaboration is built into the process from the very top of the organization
Rm6	• Good project management is considered crucial to project success
Rm7	• Customer had been actively involved in the defining requirements and decisions
Rm8	• Web projects need to be part of an overall business strategy
Rm9	• The used approaches were able to tailor to the specific circumstances of the project and the organization they are in
Rm10	• Customer feedback into the project give an early indication of the effectiveness of solution

B. *Phase Two*

This section discusses the overview of data collection from the survey of web project practices in Malaysia, USA and Jordan as follows:

Respondents' Background: This part of the survey contained four questions. The respondents were from different job position. The majority of the respondents were software engineering (49.5%), the second highest ratio was software architect (17.6%), managers constituted (13.2%), multimedia designers (4.4%), and technical members, team leaders, and others (15.4%).

Concerning the level of experience in web development, little knowledge (Less than one year) of web applications development obtained (7.7%), basic knowledge (1-3 years) of web application development (41.8%), good knowledge (3-5 years) of web application development (36.3%), and finally the advanced knowledge (More than five years) of web applications development (14.3%).

Regarding the third question, the majority of the participants had less than five projects of web applications development (58.2%), while those who participated between five to ten projects was (26.4%), and lastly more than ten web projects (15.4%).

Concerning the principal education degree, the majority of the participants had bachelor (67%), master (13.2%), and no one of the participants had a PhD degree, and lastly 19.8% of the participants did not have any school degree and they learned the process by training in courses and self study.

Project Context and System: This part of the survey contained seven questions. First question about the size of the responding companies, we categorized the company size into three categories: small (5-19 employees), medium (20-99 employees) and large (100 or more employees). The majority of the participants companies have small size (51.6%), medium (28.6%), and finally large size (19.8%).

Regarding the main business area, the majority of the participants companies were software house or software vendor (53%), and the second highest ratio was government, education, or non-profit organizations (20%), Information Technology or Telecommunication industry (13.2%), and finally business services (19.8%).

Concerning the project duration, the majority of the participants' companies had the duration between six months to one year (51.6%), 12-24 months (27.5%), less than six months (5.5%), and only (9.9%) of the participants companies had more than two years.

Regarding the success factors in developing web project in the fourth question, we asked the participants to rate the success factors of their projects based on the following criteria: Never, Sometimes, and Always. We selected the following success factors in the survey: customer satisfaction, time-to-market, meets budget, goals, performance, flexibility, new functionality of the system. The results are summarized in Table IV.

TABLE IV.
SUCCESS FACTORS IN WEB PROJECTS

Success Factor	Never	Some-times	Always	Mean
• Customer satisfaction	2.2%	39.6%	58.2%	2.56
• Time-to-market	4.4%	48.4%	47.3%	2.43
• Meet budget	5.5%	60.4%	34.1%	2.29
• Achieve goals	2.2%	56.0%	41.8%	2.40
• Performance	8.8%	50.5%	40.7%	2.32
• Accept flexibility during development	12.1%	37.4%	50.5%	2.38
• New functionality (first launch in the market)	16.5%	49.5%	34.1%	2.18

In question five the distribution between the uses of the software architecture surveyed was almost 2 to 1. In question six we tried to identify the driving forces in software architecture creation. Non-functional requirements and functional requirements are significant in software architecture creation (39.6%), while business needs were 20.9% and organization's culture was 7.7%.

In question seven we tried to identify the expectation of projects using software architecture. The majority expectation of using software architecture is to shorten the time-to-market (40.7%) and to save development cost and effort (33%). While better system performance (19.8) and market share (6.6%) is less expectation than time, cost, and effort.

Development Processes: This part of the survey contained five questions. First question was about the methodologies employed to manage the web projects. The incremental approach was the majority used approach by the participants' companies (37.4%), XP (18.7%), waterfall (8.8%), and finally (35.2%) of the participants' companies revealed that they did not use any approaches.

The second question was about who decided the actual development process. The response reveals that 42.9% of all participants' companies; the process development was described by the company or the department rules, project manager (17%), software architect (6.6%), and software developer (13.2%). In question three, 83% of all the research participants identified that they did not take enough time to ensure they understood the special challenges inherited in web projects.

Concerning "which" stage that a customer involved in the project; the majority of the participants' companies had their customers involved in requirements gathering stage (34.1%), design solution (17.6), prototyping (22%), and finally the testing stage (26.4%). Regarding the challenges in web projects development in question five, all participants identified the main challenges they confronted in delivering web projects. Their answers served to emphasize the fact that a massive number of organizations' problems related to the challenges inherent to the web projects nature. The biggest challenges facing web project development base on participants' perspectives are the constant change of requirements during the project development (71%). Developers often have to deal with an unknown field of business whose requirements can change dramatically as developers gain a better understanding of that business during the project (56%). Time in web application development is not usually sufficient (38%) besides the need for efficient standards and tools to estimate process, cost, size, resources, quality, and risks identification (27%).

Web Metrics: This part contained six questions. The answer to first and second question served to emphasize the fact that there is a need for efficient standards and tools to estimate process, cost, size, quality and identifies risks. The majority of the participants' companies did not use any standard to estimate the actual development process (48%), as well as 34.1% of all participants did not use any standard to measure the size. Concerning the tool to measure the size of the web project, the participants stated features and functions as the main concern to measure the projects (24.2%), number of images and photos (12.1%), number of animations (15.4%), number of audio/video clips (8.8%), number of web pages (5.5%). Finally 34.1% of all participants did not use any standard to measure the size.

Concerning the tool to estimate the effort for a project, the majority of the participants used functions/features to be offered by the application (35.2%), size of the application (20.9%), experience of the developers with the development environment (12.1%), and 31.9% of all participants companies did not use any standard to estimate the effort.

Regarding functions and features identification, the response reveals that 53.8% of all participants using the functions and features were predefined by asking the clients what they wanted without using a list or offering suggestions. The factor of asking clients what they wanted and offer suggestions without using a list (27.5%), give clients a list of functions and features and ask them to pick what they wanted (4.4%), and other aspects (14.3%). Concerning the complexity, the majority of the participants' companies had a degree of complexity and innovation in their projects (64.8%), most projects were complex with lots of new technologies and applications (24.2 %), and finally most projects were not complex (11%).

Risk Management: This part contained six questions. First question we tried to identify what mean the "risk management" to participants, we categorized their responses into three main categories: risks related to the end users (performance, availability, security, etc), project development (maintainability, testability, etc), and risks related to the business (cost and benefits, target market, etc). The majority of the participants companies revealed that the risks related to project development (41.6%), risk related to the end users (34.8%), and finally risk related to the business (23.6%).

In question two the distribution between the risks identify risks early surveyed is almost 3 to 1. Consequently, in question three the distribution between risks incorporated into the project plan surveyed is almost 3 to 1 also.

Concerning the risk identification and quantification methodology and tool, the majority of participants revealed that they did not use any tool or methodology for risk identification (61.5%), brainstorm (25.3%), and checklist (13.2%). All participants did not use any common tool or methodology for risk quantification, and they just employed their experience to quantify risks.

For the risk management actions, we compared risk management actions and the results are shown in Fig. 2. Observe that the actions Rm1and Rm 8 employed more regularly than others. However, the actions relevant to the participants, such as Rm2 and Rm3, are least regularly used.

Regarding the risk factors occurrences in web project, we compared typical risks factors in Table II, and the results are shown in Fig. 3. Notice the most risk factors Rf1, Rf4, Rf7, Rf13, Rf18, Rf19, and Rf21 are more regularly happens than others.

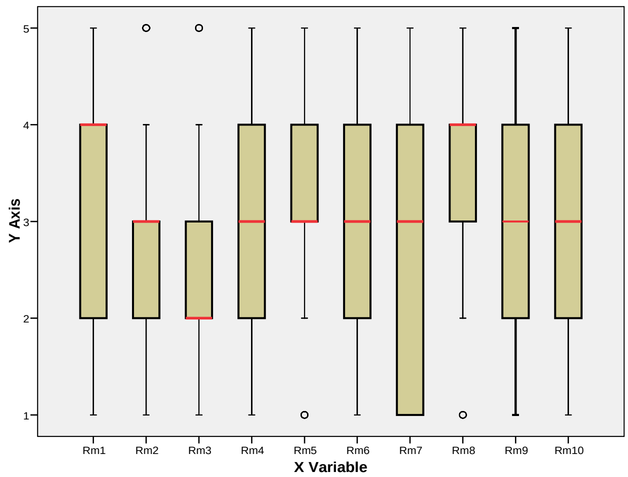

Figure 2. Risk management actions.

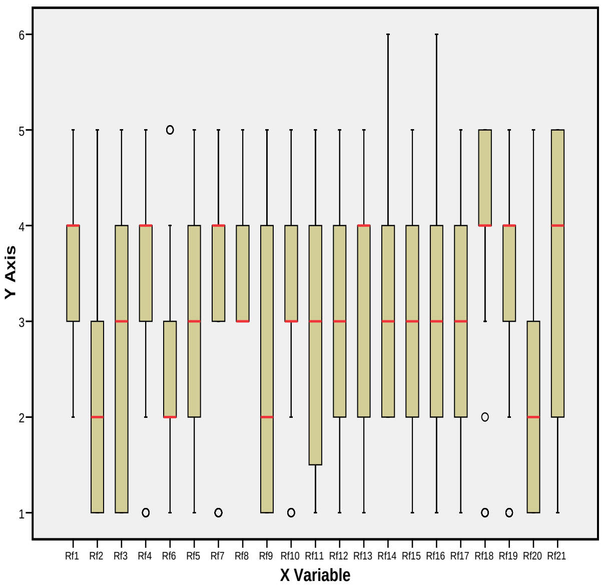

Figure 3. Risk factors incidence.

C. Correlations between the Risk Management Actions and Risks

The analysis was organized in ten sections. In the first part, we analyzed the correlation among the content risk factors (Rf1 and Rf2), with the risk management actions (Rm1 to Rm10) for web project development. Even though Rm1 to Rm10 have been planned as effective actions to mitigate possible risks in web project-based development, there are a small number of studies to confirm and compare which risks they can successfully mitigate the most. The goal of our analysis is to discover which of the actions (Rm1 to Rm10) are most effective to avoid overly optimistic **Content** problem structure. In the second part, due to the equivalent rationale, we analyzed the correlation among the **Navigation** risks (Rf3 and Rf4) and the risk management actions Rm1 to Rm10. Then we analyzed the correlation among the **Presentation** relevant risks (Rf5 and Rf6) with the same actions (Rm1 to Rm10) in the third part. Consequently, from part four to ten we also analyzed the same correlation among possible risks for **Social Context, Technical Context, Natural Context, Development Team, Development Team, Technical Infrastructure, Process, and Integration** with the risk management actions (Rm1 to Rm10).

D. Content Risks - Rf1 and Rf2

The result of the correlations among the content estimation risks (Rf1, Rf2) and risk management actions (Rm1 to Rm10) were analyzed with Non-linear Canonical Correlations OVERALS (Define range and scale ordinal, a number of variables not multiple nominal, multiple sets and two dimensions) in SPSS. We selected to use two dimensions because the upper bound of the number of the dimensions that is the number of the canonical variates is the minimum of the number of the variables in each set. In our study, the minimum number of the variable in our analysis is two. The interpretative expediency of two-dimension crest [15] is an additional reason to choose the our analysis, the risk management actions from (Rm1 to Rm10) specified to the first set and each of them defined as an ordinal variable with range scale from 1 to 5. The content risks (Rf1 and Rf2) specified as the second set and each of them is defined as ordinal variable with range scale from 1 to 5.

The target of the analysis is to provide the instances of the most negative correlation among the risk management actions and the incidence of possible risks. The analysis comprises two phases:

1. For every possible risk, we first test the dimension one and two to find out where the risk has been mostly loaded. If Rf1 is more loaded in one dimension, for example dimension one, it indicates that the correlation among Rf1 and the dimension one is stronger than the correlation among the Rf1 and dimension two.
2. Based on the most loaded dimension of a possible risk, for instance Rf1, we then test the plot component loading to instance the risk management actions (Rms), which is in the crest positions of the reverse domain of Rf1.

The abstract of OVERALS analysis for the content risks (Rf1 and Rf2) demonstrate that 51% of the actual fit is account for by the first dimension, and the 49% of the actual fit is account for by the second dimension. Table V shows the summary of the analysis. It shows the Eigenvalue for each dimension equals 1 minus the average loss for the dimension and indicates how much of the relationship show by each dimension. The Eigenvalue add up to the total fit. For Verdegaal's data, 0.990 / 1.938 = 51% of the actual fit are account for by the first dimension.

TABLE V.
SUMMARY OF ANALYSIS

		Dimension		Sum
		1	2	1
Loss	Set 1	.010	.024	.034
	Set 2	.010	.024	.034
	Mean	.010	.024	.034
Eigenvalue		.990	.976	
Fit				1.938

The plots component loadings are show in Table VI. The results disclose that Rf1 is much more loaded (.720) in the Second dimension (the vertical axis) than (.685) in the first dimension (the horizontal axis). Rf1 is in the positive domain of the second dimension and the Rm7 (with loading -.772) is in the crest of its negative domain as shown in "Fig. 4." In addition, Rm3 is very close to Rm7 (with loading -.737) in the crest of the negative domain of the second dimension.

Rf2 is also much more loaded (.926) in the first dimension (the horizontal axis) than (-.363) in the second dimension (the vertical axis). Rf2 is also in the positive domain of the first dimension and the Rm6 is in the crest of its negative domain.

TABLE VI.
THE COMPONENT LOADINGS

Set		Dimension 1	Dimension 2
1	Rm1(a,b)	.831	-.505
	Rm2(a,b)	.575	-.467
	Rm3(a,b)	-.173	-.737
	Rm4(a,b)	-.011	-.622
	Rm5(a,b)	-.136	.563
	Rm6(a,b)	-.488	.157
	Rm7(a,b)	.498	-.772
	Rm8(a,b)	.969	-.065
	Rm9(a,b)	.012	-.240
	Rm10(a,b)	.893	-.267
2	Rf1(a,b)	.685	.720
	Rf2(a,b)	.926	-.363

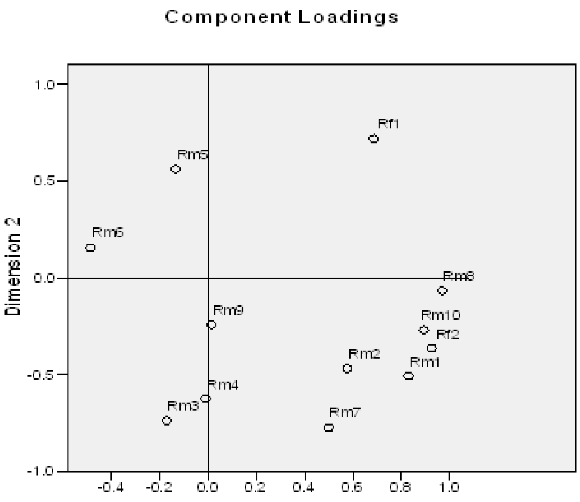

Figure 4. Plots of component loadings for content risks

E. *Summary between the Risk Factors and Most Efficient Risk Management Action*

Table VII shows the results between the risk management actions and risk.

TABLE VII.
SUMMARY OF RISK FACTORS AND ACTIONS

Characteristics	Risks	Effective Risk Method
Content	Rf1 Rf2	Rm 6 Rm3 and Rm 7
Navigation	Rf3 Rf4	Rm1 and Rm2 Rm5
Presentation	Rf5 Rf6	Rm6 Rm10 and Rm8
Social Context	Rf7 Rf8	Rm1 Rm6
Technical Context	Rf9 Rf10	Rm1 Rm9
Natural Context	Rf11 Rf12	Rm2 Rm4
Development Team	Rf13 Rf14 Rf15	Rm3 Rm5 Rm9
Technical Infrastructure	Rf16 Rf17	Rm9 Rm8
Process	Rf18 Rf19	Rm5and Rm8 Rm6
Integration	Rf20 Rf21	Rm3 Rm6

V. CONCLUSIONS

This paper has discussed the results of an investigation done on different web project domains in different countries. The study consisted of two phases: pre-study and a survey. The survey investigated the challenges and requirements for development process and the tools used in web project, risk management activities performed in complete web projects. Finally, the summary between the risk factors and most efficient risk management action was identified.

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