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Research Article

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Empirical study of software project risk factors

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ABSTRACT

In software development process, identifying the key risks factors are the important premise for the risk management and project cost and schedule controlled. Based on the analysis of literature study, project interviews and expert consultation, 47 potential risk factors are put forward from requirements, organizational environment, user, technology, personnel, plan and control and market. Then, through questionnaires, factor analysis and regression analysis, 8 factors and 38 risk factors are identified, which constitutes the key risk factors set of software project.

Key words: software project, risk factor, empirical study

INTRODUCTION

Software is the part of information-based products with the most intensive knowledge and core competitiveness ,which is the core work and the premise of informatization and it has great meaning for enhancing enterprise, industry and even national competitiveness .According to statistics, business income of China's software industry has reached 2.5 trillion yuan in 2012, which accounts for 22.7% of the whole electronic information industry, and it is 31.4 times than that of 2000.At the same time, workers also increased from 300 thousands in 2000 to more than 2000 thousands in 2012.However, due to the inherent characteristics of software projects, such as the technical complexity and management complexity of software development, ambiguity of software development goal ,instability of customers needs, which make the software projects be full of many uncertainties, especially with the widely application of software, the continuous expansion of software projects and the rapid development of information technology, the phenomenon of software project overruns and delay has become widespread, which brings loss to customers, software development, enterprise and society. Given the nature of the software project itself, there has a large number of literature to study the software project risk problems.

EXPERIMENTAL SECTION

Literature review

It is generally believed that the software project risk management research has started from Boelm.He did in-depth investigation to a few large aerospace and defense system software project in 1989, and the risk list method was adopted, and he put the personnel shortage, frequent changes in demand and unreasonable schedule or budget arrangement as the most popular 10 risk factors in software project development[1] .Two years later, Boehm did investigate to some experienced software project managers again, and combined with the life cycle of software project development, new 10 major risk factors were put forward [2] .In 1993, Barki et al. has listed 35 software project risk factors on the basis of literature summary, and then through the questionnaire survey to 120 software projects of 75 organizations with the tools of factor analysis, risk factors were divided into five aspects: system complexity, organizational environment, advanced technology, experience, skills and application scale[3]. In 1997, Moynihan did interview to 14 senior project managers of Ireland system development and implementation, 113risk factors have been summarized in the software project development. Domestic scholars, Ji Nianfang et al.,took 270 software projects as the research object which were developed by a famous domestic communications software

company in the nearest 3 years through historical data compilation methods, 26 risk factors were put forward from a risk management plan and project report.

It can be seen from the above studies, there is no unified classification for software project risk factors, which may be because of cultural or research perspectives differences, or different awareness of risks for project managers from different countries. For software project risk analysis method, most of the existing researches are started from the qualitative perspective, and using empirical research methods to explore the risk factors of software project is relatively lacking.

Variable setting

Through literature summarizes of software project risk researches, and combined with the project interviews and expert consultation, this paper set 47 risk factors of 7 aspects including demand risk, environment risk, customer risk, technology risk, personnel risk, plan and control risk and market risk as the potential risk form of software project development. For the variables of risk consequences, related scholars also made statement in the past studies. Shenhar thought the definition of project success can be considered from four aspects, namely the function requirements, technical requirements, schedule and cost budget[4-5]. Jiang thought that the performance of the software project can be divided from some aspects, such as schedule, budget and quality and so on[6]. According to the above studies, this paper defines software project risk consequences from the aspects of function, quality, customer satisfaction, budget and schedule.

Study Method

Questionnaire design

Questionnaire design has gone through 4 stages:

The first stage: literature research. Through referring to the software project risk research literature, 51 initial risk factors including seven aspects are decided.

The second stage: enterprise interview. Through consulting the interviewee's opinion, the scientific nature and rationality nature of designed variables, and whether it can accurately reflect the views of the respondents are tested;

At the same time, according to consultation and the results of interviews, 47 basic risk factors are set.

The third stage: experts consultation. Taking the designed variables of the first two stages to experts for consultation to ensure the rationality of the indexes set ,and check the presence of omission and problems.

The fourth stage: check the reliability of scale initial inspection.

Data collection and sample characteristics

Five point likert scale are adopted to measure survey questionnaire. Positive score evaluation method is adopted. The higher the score is, the higher the evaluation possibility of project risk factors is. Questionnaires were distributed mainly in two forms: one form was through field distribution .74 pieces were gotten and the recovery rate was 100%; another form is through the enterprise yellow pages. Surveyed enterprises were randomly picked up and survey questionnaires were distributed through letters and email .Total 238 pieces were distributed and 107 pieces were gotten, the recovery rate is 45%. Through the above two ways, and excluding the samples which cannot meet the quality of survey requirements, 162 questionnaires were effectively collected.

RESULTS AND CONCLUSION

Reliability and Validity Analysis

Cronbach A coefficient test was used by this study to test the reliability of survey questionnaire.

Test results show that the overall Cronbach A coefficient value was 0.956, and Cronbach A coefficient value of each scale was more than 0.7, which is in line with the minimum standards of 0.6.It shows that the reliability of software project risk factors scale is higher. In terms of validity test, strict rules were made in the process of data collection and respondents choose , therefore, the risk factor scale has high reliability.

Factor analysis

KMO measurement and Bartlett sphere test were adopted by this research. Test results showed that each KMO value was greater than 0.7, Bartlett ball test results was 0.000, which significantly showed that there was strong correlation between variables, and it is suitable for factor analysis.

Through factor analysis, 47 risk factors were divided into 11 factors, and the risk result index was summarized to 1 factor, which were shown in Table 1.

Table1 Software projects risk factors and variables

Requirement factors	Requirement variables	Project requirements are not clear, and it is difficult to define; Project requirements definition is unreasonable, even it is wrong; Identification for system demand is not enough; System requirements are frequently changed; Relevant personnel on the system requirements definition is different
Organization environment factors	Organization support variables	Due to the change of corporate strategy or the benefits decrease, the resources of project needed are transferred; Lack of support of top management team; The knowledge sharing or knowledge accumulation mechanism is not sound
	Organizational rules constraint factors	Project implementation needs to drastically change organizational structure; Project implementation has a great influence on organizational business processes; Business process change of projects requires dose not match with organizational culture .
Users variables	Users attitude factors	Users do not pay attention to the project management; Users engagement is not enough; Users are more resistant to change ; Users are against to the project.
	Users behaviors factors	Users are lack of effective communication with project team; Users have conflicts with developers in system design ; System applications involved in multiple user department, and there are many differences between government departments; Users do not have enough budget of arrangement for system maintenance phase.
Technology variables	Technology complexity factors	Project adopts a new technology which has never used before; Project selects operating system which is not suitable ; Excessive dependence on a single development tools; Adopt not suitable development methods or procedures; Project needs to be more integrated with the other systems; System platform architectures are safe and reliable enough.
	Professional knowledge requirement factors	Higher requirements of professional knowledge in application areas or industry ;professional knowledge demand is high for statistics or operations research.
Team members variables	Team members factors	The departure of key personnel in the project team; Team members lack the sense of responsibility, and work efficiency is low; Difference between team members ; Developers without adequate training; Developers are lack of required skills; Project managers are lack of experience or skills
Plan and control variables	Plan and control factors 1	Lack of a large amount of historical data as a reference; Estimate for time needed for the project and schedule is not enough; No effective risk management
	Plan and control factors 2	No comprehensive project plan; No clear project milestones; Lack of strict change control and version control; No effective cost management; No enough supervision for project implementation process
Marketing variables	Marketing factors	Market demand changes, which takes adverse influence on the project commercial value; Alternatives on the market or technology have become obsolete; Competitors develop similar systems or take other preventive action; Project suppliers or partners do not provide positive help and services; projects outsource to many developers, and not compatible software package is very difficult to integrate
Risk consequences variables	Risk consequences Factors	The system can meet the expected functional requirements; The system is reliable and easy to use; Users are satisfied with the system; The system can be finished within plan budget; The system is finished within the schedule plan

Correlation analysis

Table 2 Model test and Diagnostic parameters

Variation Analysis					
	variation	df	variance	F	Sig
Regression item	30.286	11	2.753		
Residual item	19.024	94	2.02	13.604	.000
Total	49.310	105			
R=0.784； R^2=0.614； adjusted R^2=0.569					
Durbin-watson=1.826					

Regression coefficients and the test results are presented in table 3 ,which shows that T value significant probability of constant term is greater than 0.05, and it shows that there is no significant difference between the constant term and 0, so it doesn't appear in the regression equation; Users attitude factor, professional knowledge demand factors and plan and control factors 1 failed to pass the test , and it cannot appear in the equation as explanatory variables ; T value significant probability of other factors is less than 0.05, which shows that these factors have significant effects on the risk consequences.

Table 3 Regression coefficients and the significant test results

Variables	unstandardized regression coefficient B	Standardized difference	standardized regression coefficient BB	T value	Sig	VIF
constant term	1.429E-03	.051	-	.027	.978	-
Demand	.190	.093	.201	2.049	.043	2.341
Organization support	.163	.075	.201	2.181	.032	2.079
Organization rules constraint	.040	.073	.165	2.244	.026	2.073
Users attitude	-.116	.078	-.073	-.704	.483	2.605
Users behaviors	.133	.057	.144	2.132	.000	1.875
Technology complexity	.152	.059	.248	2.563	.012	2.271
Professional knowledge requirement	.121	.088	.175	1.517	.133	3.257
Team numbers	.238	.084	.348	2.828	.006	3.681
Plan and control 1	.001	.092	.024	.327	.744	1.300
Plan and control 2	.030	.057	.160	2.863	.001	1.754
Market	.211	.088	.274	2.393	.019	3.187

DISCUSSION

T value of demand factors is significant at 0.05 level, which shows that demand factors' coefficient is significantly different from zero, and it shows that there is the larger uncertainty of variables contained in the process of software project development. During software project development, on the one hand, software is a kind of abstract logical entity which is not visible, and the description of the system requirements is mostly described on profile. On the other hand, with the development of software system development, system function indexes will be gradually thinning and high-precision, and demand changes are inevitable, but the cost of the change needed grows in the form of exponential , which leads to the uncertainty of software project development and high risk.

T value of Organizational support factors is significant at 0.05 level, which indicated that the factors coefficient is significantly different from zero, and it has strong explanatory power to risk the consequences. Regression results show again that high-level organization, organization resources and the accumulated knowledge play an important influence in the success or failure of the software project.

T value of organizational rules constraint factors is significant at 0.05 level, which shows that the factor has strong explanatory power to risk consequences . Typically, the user thinks that the change of organization structure and process is necessary, and also is allowed. However, if the change is too big, it will destroy something in the company, even it can let employees be not used to, and constraint of the project will greatly increase.

Unstandardized regression coefficient of users attitude factors is -0.116, t value was not significant at 0.05 level, which indicated that users attitude factors coefficient is not significantly different from zero, and it dose not have explain consequences for risk ability. For the reason why regression coefficient is negative is because that as the importance degree to informatization construction for enterprises becomes higher, for software projects, especially large projects, users attitude on the whole is positive. This dose not match the research conclusion of Schmidt et al[7], and it shows that the attitude of project staff's to risk under is different cultural background.

T value of users behavior factors is significant at 0.05 level, which indicated that this factor of risk consequences have strong explanatory power. Hofstede argues that under the current tendency of strong uncertainty, people like reform, but they may not be willing to put effort to implement, because they worry that software projects could damage the interests of their own. To resist negative change of software project, differences and conflicts are inevitable, which is not conducive to project progress[8].

T value of technological complexity factor is significant at 0.05 level ,which shows that the factor coefficient is significantly different from zero. Software project is very different from project development, because general projects have a lot of repetition in the process of development .But in software entity expansion, it is not only an add of the same elements , but also an add of different elements, moreover, these elements also interact in the form of nonlinear increasing ,which makes the complexity of software development technology is increased with more nonlinear progression. So, the requirements of development technology, tools and methods are higher, and uncertainty is bigger also.

T value of professional knowledge demand factors is not significant at 0.05 level, which indicated that the factor coefficient is not significantly different from zero, and it can not enter the regression equation. This may be due to the characteristics of software consulting industry and the rapid development of software outsourcing, project

developers and managers think that requirements of professional knowledge leads to lower possibility of risk consequences.

T value of the project team factors is significant at 0.05 level, which shows that the factors have strong explanatory power of risk consequences .Software projects are that kind of products with intensive intelligence and knowledge transformation. if you can't fully dig up intellectual ability and creative spirit of project team member, it is difficult to complete the project on schedule. Although, there are more and more application of secondary development tools in recent years, but a lot of manual labor in different stages of the project is needed, and the manual labor are very detailed and complex, which have relatively greater influence on the sense of responsibility and ability of staff.

T value of plan and control factor 1 is not significant at 0.05 level, which shows that it is not significantly different from zero, and can not enter the regression equation. Another reason of non-significant regression is possibly because that most of the research projects are successful, and the understanding is still insufficient.

T value of plan and control factors 2 is significant at 0.05 level, which indicated that the factor coefficient is significantly different from 0, and it can enter the regression equation. Generally, whether a comprehensive plan to reduce the project's conceptions and increase the success rate can be built has great significance, while during the planning, whether the set of milestone is clear or not ,it also plays an important role to control the project progress. Among the research results of Mishra,it is also confirmed that in the project plan execution, the degree of supervision or control is significantly associated with project success or failure[9].

T value of market factors is significant at 0.05 level, which indicated that this factor has strong explanatory power to risk consequences. Software project is not only a kind of complex structure which is composed by entities ,such as logic, language, computer and specific physical staffs, but a kind of nonlinear complex system which is composed of many independent stakeholders .Due to the sensitivity of software projects to external environment changes , once there is any change in the market demand, competitors, replacement, suppliers ,it will increase the uncertainty in the process of the project, even leads to serious consequences.

REFERENCES

[1]IEEE.IEEE Standard for Software Life Cycle Processes-Risk Management [R]. New York: IEEE Inc, 2001.
[2]Boehm B W. Software Risk Management: Principles and Practices [J]. IEEE Software, **1991**, 8(1): 32-41.
[3]Barki H, Riverd S, Talbot J. *Journal of Management Information Systems*, **1993**, 10(2): 203-225.
[4]Shenhar A J, DvirD, LevyO. *Project Management Journal*,**1997**,28(2): 5-13.
[5]Yetton P, Martin A, Sharma R, Johnston K.A *Information Systems Journal*, **2000**, 10(4): 263-289.
[6]Jiang J, Klein G, Beck P, Wang E T G. *Information Resources Management Journal*, **2007**, 20(3): 32-45.
[7]Schmidt R, Kalle L, Mark K, Paul C. *Journal of Management Information Systems*,**2001**, 17(4): 5-16.
[8]Hofstede G. Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations [M]. Thousand Oaks, California: Sage Publications, **2001**.
[9]Mishra S, Kim D, Lee D H. Factors *The Journal of Product Innovation Management*,**1996**,13(6): 530-550.