Comparing risks in individual software development and standard software implementation projects: A Delphi study

Stefan Hoermann
Chair for Information Systems
Technische Universität München
stefan.hoermann@in.tum.de

Marco Aust
Chair for Information Systems
Technische Universität München
email@marcoaust.de

Michael Schermann
Chair for Information Systems
Technische Universität München
michael.schermann@in.tum.de

Helmut Krcmar
Chair for Information Systems
Technische Universität München
krcmar@in.tum.de

Abstract

This paper aims at exploring differences in risk profiles across various types of IS projects. IS project managers face a variety of risks. Before taking appropriate countermeasures, the first step in successfully managing risks is to identify and prioritize them. While many researchers have investigated risks in IS projects in general, few take into account the specific nature of different types of IS projects. However, discrepancies in extant risk rankings suggest that a project's risk profile changes depending on which type of project is being investigated. In order to explore these differences across IS project types we conducted a Delphi study at a German-based financial services company in order to identify and compare the risk profiles of individual software development and standard software implementation projects. Our results comprise a) a list of 100 distinct IS project risks, which not only includes new risks but also emphasizes the importance of technical risks, and b) ranked risk profiles for different types of IS projects. The heterogeneity of the risk profiles suggests that while there are indeed project-generic risks which are likely to occur across different types of IS projects, project-type-specific risks do considerably influence a project's risk profile.

1. Introduction

Despite the considerable experience gained over the last decades, a lot of IS projects still face time, quality and budget issues. Depending on the definition of success, failure rates of IS projects range from 23% to 68% – even in the optimistic case of 23% a high number for a professional discipline [21, 18].

At the same time, successful IS project managers tend to be good at managing risks [4]. Thus, project risk management – as a sub domain of project management – has increasingly gained importance among practitioners and academics [2]. Formal risk management commonly consists of two phases: risk analysis and risk control. Risk analysis involves the identification, the assessment and the prioritization of possible events that pose a threat to project success whereas risk control comprises the planning of responses, risk resolution and continuous monitoring [5].

Extant research on project risk management in the IS discipline has primarily focused on the first phase of risk analysis. In particular, factors influencing the identification and the perceived relative importance of single risks, such as a person's role in a project [13, 11], his or her experience [24, 7] and his or her cultural background [16, 20] have been studied extensively.

However, besides these individual-related characteristics, a main factor affecting a project's risk profile seems to be the type of project that is being analyzed. In this regard, current studies tend to subsume different types of IS projects under the general category of software (or IS) projects and do not distinguish between different kinds of project activities such as software development or software implementation. While research on project-generic risks sets the basis for understanding success and failure in IS projects, a consideration of risk profiles contingent on distinct IS project types may allow for a more effective management of risks. Hence, our research question is: *How do IS project risk profiles vary depending on the project type?*

To answer this question, we conducted a Delphi study with 18 IS project managers in the German financial services industry representing three different types of projects: 1) internally driven software development projects, which are conducted out of company-internal, entrepreneurial reasons, 2) externally driven software development projects,

978-0-7695-4525-7/12 $26.00 © 2012 IEEE
DOI 10.1109/HICSS.2012.168

which are necessary to adapt to changing regulations within the European and German financial services industry, and finally 3) standard software implementation projects, which integrate standard software packages such as data base management systems or ERP systems into the existing IS landscape.

The remainder of the paper is structured as follows: In section 2, we review previous research on IS project risks with a focus on risk identification and risk ranking. Section 3 outlines our research approach. In section 4 we present the results and compare them to prior findings. Finally, we conclude by pointing out the implications as well as the limitations of our approach.

In contrast to extant lists of IS project risks, our results suggest that technical issues are frequently seen as threats to project success. Moreover, the heterogeneous risk profiles of individual software development and standard software implementation projects supports the distinction between project-generic risks which are likely to occur across different types of IS projects and project-type-specific risks, that are linked to a certain type of IS projects.

2. Related Work

Research on IS project risks is comprehensive. While on an abstract level the concept of risk is typically defined as comprising a probability of occurrence and a negative impact on project success [4, 14], IS researchers seem to struggle with a coherent set of concrete risks and risk categories in IS projects. Two major themes of articles dealing with risks in IS projects can be distinguished: On the hand, researchers aim at expressing the concept of risk in a more concrete way, i.e. the main goal of these articles is to identify concrete instances (often called risk factors) and categories of IS project risk. On the other hand, risk is seen as a major factor influencing project performance. Here, researchers are first and foremost interested in the size and the significance of the relationships between these concrete instances or categories of risks and project performance. As for analyzing this relationship the concept of risk has to be made explicit, this second theme of articles also belongs to the theoretical basis of this paper.

The first theme, which we – according to its prevalent research focus – term "Risk Identification", employs qualitative methods of data collection such as interviews or Delphi studies to come up with collections of risks in IS projects. For instance, [1] analyze 56 individual software development (ISD) projects and identify eight risks to project success which the authors map to the phases of the system development process. Similarly, based on a survey with experienced project managers, [4] suggests the following list of ten major sources for software development risk. Comparable lists are provided by [15] and [9]. To quantify ISD project risk, [3] conduct a comprehensive literature review resulting in 35 risk variables which the authors assess via a survey among 120 project managers. Factor analysis reveals five major risk categories: technological newness, application size, lack of expertise, application complexity, and organizational environment. In a related approach, [22] identify six key software project risk drivers (methodological fit, customer involvement, use of formal PM practices, similarity to previous projects, project complexity, and requirements volatility) which can be used to provide "a quick back-of-the-envelope assessment of each project's risk exposure". A second set of studies within the first theme investigates how different research contexts affect risk identification: For example, Schmidt et al. [20] elicit 53 risks (and 14 risk categories) using a Delphi study approach and analyze how different cultural backgrounds affect the relative importance of these risks. The authors suggest that the perceived relative importance of IS project risks depends to a certain extent on several cultural dimensions. The Delphi approach is also applied by [16], [11], and [13]. While [16] also investigates the relative importance of IS project risks in different cultural contexts, [11] and [13] both focus on role-based differences in risk perception: Project managers, senior executives and users are found to have differing views on the relative importance of risks in IS projects.

Articles within the second theme, "Risk Analysis", use multivariate methods in order to identify significant relationships between risk and project performance. With regard to the conceptualization of risk, researchers partly build on the results of the first theme. However, while a consensus seems to have emerged as to how overall project performance should be conceptualized (i.e. in terms of project and product performance), risk is conceived in many different ways. For instance, [17] conceptualizes risk as technological and requirements uncertainty, whereas [23] suggests six dimensions of IS project risk: Planning and control, team, complexity, requirements, user, and organizational environment. These dimensions can be grouped into three risk domains: The social subsystem, the technical subsystem and project management. [8] in turn differentiates between a priori (knowledge resource and structural risks) and emergent risks (organizational support and volatility risks).

In general, it can be said that researchers either focus on information systems development projects or do not specify the analyzed project type in more detail. We argue that the observed heterogeneity concerning

the number and the relative importance of risks may partly be due to a missing differentiation between IS project types. In the following, we explore this proposition by contrasting the risk profiles of information system development projects and standard software implementation projects.

3. Research Approach

In order to identify project-type specific risk profiles we conducted a ranking type Delphi study with three different expert panels with each panel representing one project type. The Delphi approach has been successfully applied before for this kind of research (especially [20]) and is particularly apt for reaching consensus among experts in complex problems through iterative feedback loops [12].

The study was conducted between October 2010 and April 2011 within the IS department of a German-based, DAX-30-listed financial services company (for reasons of anonymity called DELTA). In order to control for any bias inflicted by organizational culture or industry, a one-company setting was chosen [6, 24].

DELTA's IS department acts as an internal service provider and is responsible for the development, implementation, operations and maintenance of DELTA's information systems. Basically, two types of IS projects can be distinguished: 1) Individual software development projects, where new software is developed according to DELTA's specific requirements. These projects can be further categorized into a) internally driven ISD projects, which are conducted out of company-internal, entrepreneurial reasons such as achieving efficiency gains or enabling DELTA to sell new products and b) externally driven ISD projects, which are necessary to adapt to changing regulations within the European and German financial services industry. 2) Standard software implementation (SSI) projects, where standard software packages such as operating systems, data base management systems or ERP systems are integrated in DELTA's IS landscape.

3.1. Composition of the panels

Since the willingness and experience of the participants directly affects the quality of the study's results, particular attention was paid to the selection of participants. We followed a systematic selection approach as recommended by [12]. To account for role-based [11, 13] and cultural [20] biases we limited our study participants to German project managers. Besides, the participants were chosen according the following the selection criteria: Project managers with 1) more years of experience, 2) a self-critical attitude, and 3) a visible interest in the research topic were selected as target participants in order to achieve meaningful results and keep the drop-out rate as low as possible. Furthermore, the study participants' projects should cover various project contexts within their panel to gain a picture as holistic as possible.

Finally, for each of the above mentioned project types, a panel consisting of six experienced project managers (whose last or ongoing project belonged to the panel's project type) was composed. Table 1 shows descriptive statistics for the three panels.

	Internally driven ISD projects				**Externally driven ISD projects**				**SSI projects**			
	Ø	SD	Min	Max	Ø	SD	Min	Max	Ø	SD	Min	Max
IS experience [in years]	17,3	8,1	10	25	18,5	6,3	10	29	23,5	7,5	14	35
PM experience [in years]	13,3	7,2	7	22	12,5	5,6	5	24	14,3	4,3	10	30
Project effort [in man-months]	491	320	53	1033	185	161	34	530	46	49	6	150
Project duration [in months]	13,6	4, 8	9	24	15,6	5,7	6	24	15,8	9,5	8	36

Table 1: Descriptive statistics for the three panels

3.2. Data collection and analysis method

We followed a modified version of the Delphi approach as described by [19] to investigate the relative importance of IS project risks within our three panels: Data was not only collected via electronic mail but also via structured interviews which allowed us to develop a deep understanding of the identified risks and the reasoning behind the participants' individual rankings.

The overall study from recruiting the experts until the last ranking round took seven months and involved three sequential phases as depicted in Figure 2. After each phase, feedback was send to the panellists.

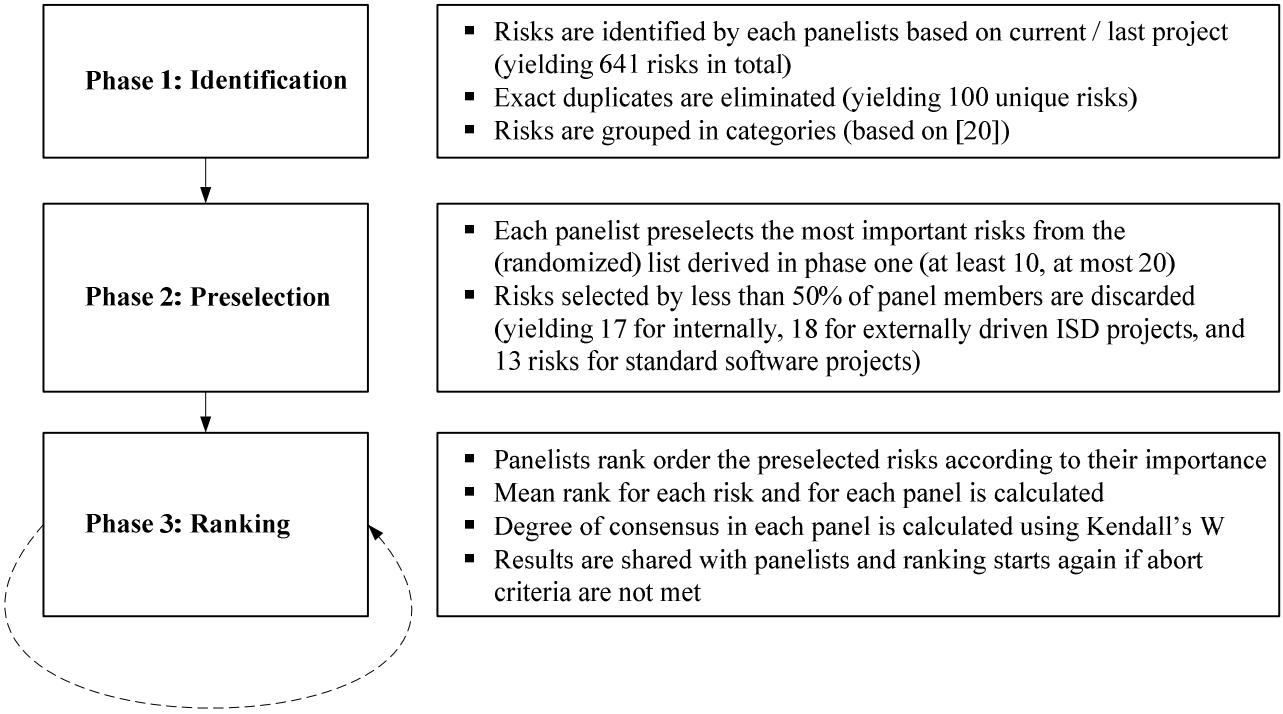

Figure 1: Delphi methodology as proposed by [19]

In phase one, we conducted structured interviews with each project manager to identify as many risks as possible. Hence contrary to previous studies we were not limited to individual brainstorming but also discussed the risks extensively with the study participants. 641 risks were identified. The discussions with the project managers allowed us to get the necessary understanding for the following consolidation: Exact duplicates were removed from the list, yielding 100 unique risks. Similar risks were grouped together based on the categories of [20].

Starting with phase two, we separated the project managers according to their panels / project types. To enable a meaningful assessment of the risks it was necessary to narrow down the list. Therefore, the project managers were asked by email to select at least 10 and at most 20 risks, they consider most important with regard to their risk exposure, from a randomized list of the 100 unique risks derived in phase 1. Risks which were selected by at least half of the project managers in a panel were taken to the next phase. Phase two yielded 17 risks for internally driven ISD projects, 18 risks for externally driven ISD projects, and 13 risks for SSI projects.

In the third and final phase each panellist was presented an ordered list of risks for his panel. Since continuous and consistent feedback of the interim results is one of the key strengths of the Delphi method and following the approach of [11, 13], the preselected risks were sorted based on the percentage of panellists who selected each risk in phase two. To address misinterpretations we emphasized that a high number of mentionings in the second phase doesn't have to be equivalent to the importance of the risks. As in phase one, the first round of the ranking phase was done with interviews in order to capture the reasons for ranking risks high or low. To assess the importance of the risks, each panellist was asked to sort the risks by descending importance and to provide an open-ended explanation for the assessment. The subsequent ranking rounds were carried out per email and the degree of consensus within the panels was calculated using Kendall's coefficient of concordance (W). To enable the project managers to better understand the results of the rankings, the mean rank for each risk was computed and the reasons for high or low rankings were provided in the next round. The ranking rounds stopped when either the coefficient of concordance indicated a strong consensus ($W > 0.7$), or we could be sure that the level of consensus within a panel would not improve in subsequent rounds.

In all three panels, ranking was stopped after two rounds as participants made clear, that their individual rankings won't change. The internally driven ISD projects as well as the externally driven ISD projects reached a weak consensus (W = 0.43 and W= 0.45 respectively). The SSI projects reached a moderate to strong consensus with a Kendall's W of 0.68.

4. Results and Discussion

In the following section, we present and discuss the results of our study in three subsections: First, we analyze the results of the identification phase. Second, we take a detailed look at each panel's final risk ranking. Third, we compare our results to those of other studies.

4.1. Risk Identification

During the interviews with the project managers, it emerged that the participants had different conceptions of what the concept of risk actually means. While some project managers focused more on the cause of a negative situation or event (e.g., dependencies on key personnel) others focused on the event itself (e.g., the loss of key personnel) and others again on its consequences (e.g., loss of capabilities). This different understanding could not be resolved completely, because a consequence can be a cause for the next risk and thus chains of different risks can be formed. Nevertheless, we separated the risks as good as possible from each other.

Figure 2 depicts the number of risks identified by project type and risk category. A full list of the identified risks (100 unique risks in total) including a detailed description is available upon request from the authors.

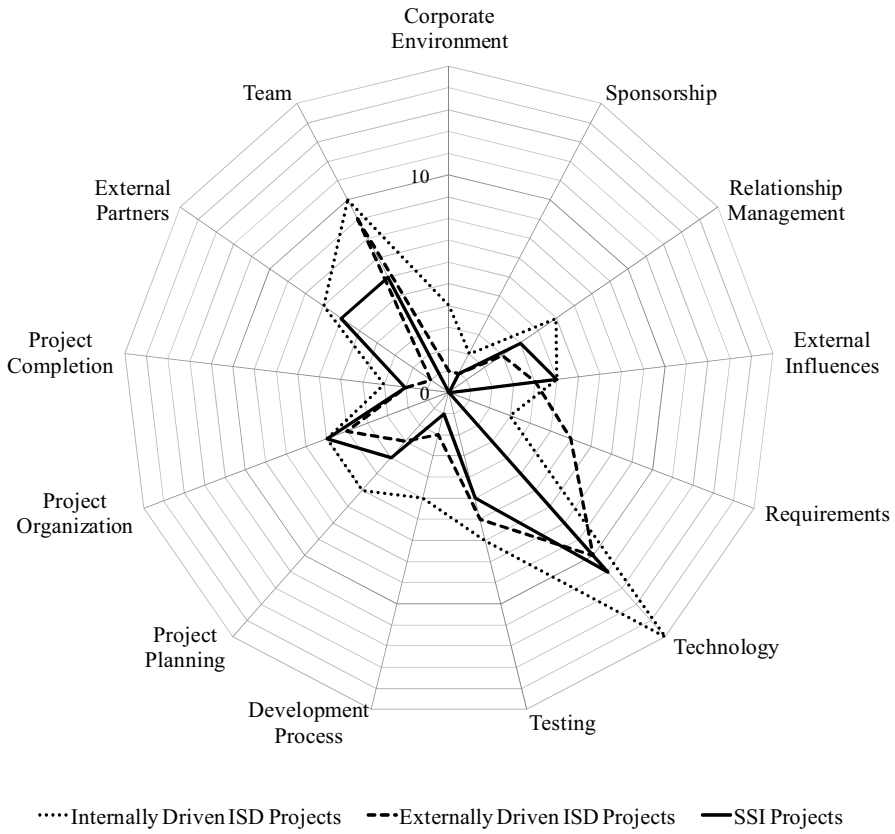

Figure 2: Number of risks identified by project type and risk category

At first glance, the risk profiles illustrated in Figure 2 look quite similar despite the differences in the number of risks identified in each panel and category. Overall, the most risks were identified for the internally driven ISD projects (79 risks), followed by

the externally driven ISD projects (53 risks) and the standard software projects (51 risks).

The internally driven ISD projects contain especially many technical risks, which is probably due to the use of new technologies and the development of end user system with special technical requirements (e.g., online portals). Not surprisingly, these projects also face many risks associated with the development process. Due to their considerable size, these projects also seem to be especially vulnerable to external influences. Except for the requirements category, panellists representing internally driven software projects identified the most risks in each category, suggesting that these projects in general are especially risk prone.

The externally driven ISD projects face the most risks in the requirements category. This makes sense as these projects usually have to implement legal requirements which are in most cases hard to interpret and impossible to refine. Often the regulatory details emerge over time, e.g. by recommendations from industry associations.

Finally, standard software projects contain remarkably few risks in the team category and virtually no risks in the requirements category. Instead, these projects seem to face relatively many technical risks. This is probably due to the fact that clear project goals and requirements in standard software projects suppress team conflicts and cause technical risks to surface instead. As SSI projects commonly are not very large, the corporate environment does also not tend to affect these projects negatively.

Besides these initial characterizations, the identification phase also confirmed the findings of [10]: Project managers who used checklists and risk registers to identify and track risks were able to identify 23.3 different risks on average. Their colleagues, who did not use checklists and registers, could on average only name 15.1 different risks. This confirms that the use of adequate tools increases risk awareness and therefore also increases the chance of successfully managing IS project risks.

4.2 Risk Ranking

Whereas the risk profiles depicted in Figure 2 could lead to the conclusion that the project types face largely similar risks, a detailed analysis of the risk rankings suggests otherwise. The final risk rankings per project type are shown in Table 2. In general, the notion of project-type-specific and project-generic risks seems to hold true.

In contrast to the SSI projects, ISD projects in general are often confronted with unrealistic deadlines. In externally driven ISD projects, this usually results from regulatory decisions, which need to be implemented within a short period of time. Additionally, the ISD projects typically face unclear requirements and unrealistic expectations by sponsors. The high ranking of these two risks is probably due to the fact that whereas in SSI projects the functionalities are clearly defined upfront by the respective standard software package, the development of new software leaves more room for own ideas which are also harder to express than the expectations toward standard software. At the same time, the development of new company-specific software usually affects many different departments. Thus, there are more disagreements and problems with the responsibilities and roles as well as difficulties with regard to make cross-departmental decisions.

Furthermore, the internally driven ISD projects face several risks directly connected to their size: For instance, the coordination between subprojects doesn't work as expected or direct dependencies to other projects cause problems. As a consequence, also scheduling the project becomes extremely difficult. This risk is reinforced by the parallel development of multiple releases or variants of certain applications. Additionally, internally driven ISD projects are also more likely to use new technologies, which again may feed unrealistic expectations and in general increases uncertainty. When these expectations are not met, user acceptance rates also tend to be low. The fact that often times multiple departments are affected by these projects also explains the risk of heterogeneous system architectures.

The dependency on third-party decisions in the externally driven ISD projects manifests itself in the risks of receiving the business concept too late, many legal changes, and unclear requirements which again result in unpredictable deadlines and make it hard to estimate costs.

Finally, the SSI project-specific risks suggest that these projects are being underestimated: Often planning turns out to be too optimistic, no post-go-live-approach is defined and the project is overloaded with additional requirements. Furthermore, as already seen in the identification phase, many technical risks are included: For instance, the complexity of interfaces or the fact that frequently no alternative or backup strategy is technically feasible. In addition, in these projects because of the necessary specialized technical knowledge often external workers become key players.

Risk		Internally Driven ISD Projects	Externally Driven ISD Projects	Standard Software Implementation (SSI) Projects
A	Dependencies on other projects	1	15	
B	Availability of testing infrastructure	2		4
C	Unclear requirements	3	6	
D	Unrealistic schedule / deadlines	3	7	
E	Complexity of interfaces	5		2
F	Lack of personnel	6	3	1
G	Decisions affect multiple business units	7	4	
H	Unrealistic expectations of sponsors	8	14	
I	Low project priority	9	10	3
J	Unclear roles and responsibilities	10	11	
K	User acceptance	11		
L	Parallel release development	12		
M	Lack of coordination of sub projects	13		
N	Missing stakeholders	14		11
O	Heterogeneous system architectures	15		
P	No integration of experienced colleagues	16		
Q	Use of new technology	17		
R	Instable requirements		1	6
S	Delayed business concept		2	
T	Complexity of system architecture		5	5
U	Difficulty of cost estimation		7	
V	Key personnel		9	
W	Legal changes		11	
X	Optimistic planning		13	7
Y	Cutback of personnel		16	
Z	Unclear legal requirements		17	
AA	Unpredictable deadlines		18	
AB	Lack of post-go-live-approach			8
AC	No budget for external experts			9
AD	Size of project scope			10
AE	No alternative solutions			11
AF	Dependency on external experts			11

Table 2: Most important risks by project type

Despite this heterogeneity in risk profiles, which also can be seen in Figure 3, on a more abstract level some commonalities between the project types can be identified:

(1) Requirements: Almost all the investigated projects have problems with the reliable specification of the requirements. While in ISD projects, the requirement specification is not detailed enough, and thus results in confusion about the necessary project tasks, the SSI projects are faced with excessive project scopes and therefore many requirements. In the externally driven ISD projects an additional instability in the requirements results from the difficulty in interpreting the regulatory decisions.

(2) Technical complexity: An increasingly important aspect in the technical project planning is the system architecture. This is also reflected in the risk profiles: The complexity of systems and interfaces rank comparatively high in all three project-types. This is reinforced not only by the technological progression but also because the systems evolved over time. While the internally driven ISD projects tend to be confronted with complex interfaces because of the high number of interconnected systems, the externally driven ISD projects need to implement a variety of different models and calculations. In SSI project both of these risks occur.

(3) Lack of adequate personnel: The general trend to streamline IS departments, is also reflected in the projects' risk profiles of DELTA: All types of IS projects struggle when it comes to acquiring the right personnel at the right time. Much of the IS staff already works at full capacity and especially key personnel tends to become overstrained. Low staff levels reinforce the dependencies on key personnel.

(4) Competition with other projects and low project priority: Individual projects are increasingly competing with other simultaneously conducted projects for top

management attention and other scarce resources. This not only leads to a difficult project planning but also affects the overall efficiency because additional communication efforts are necessary to resolve the conflicts.

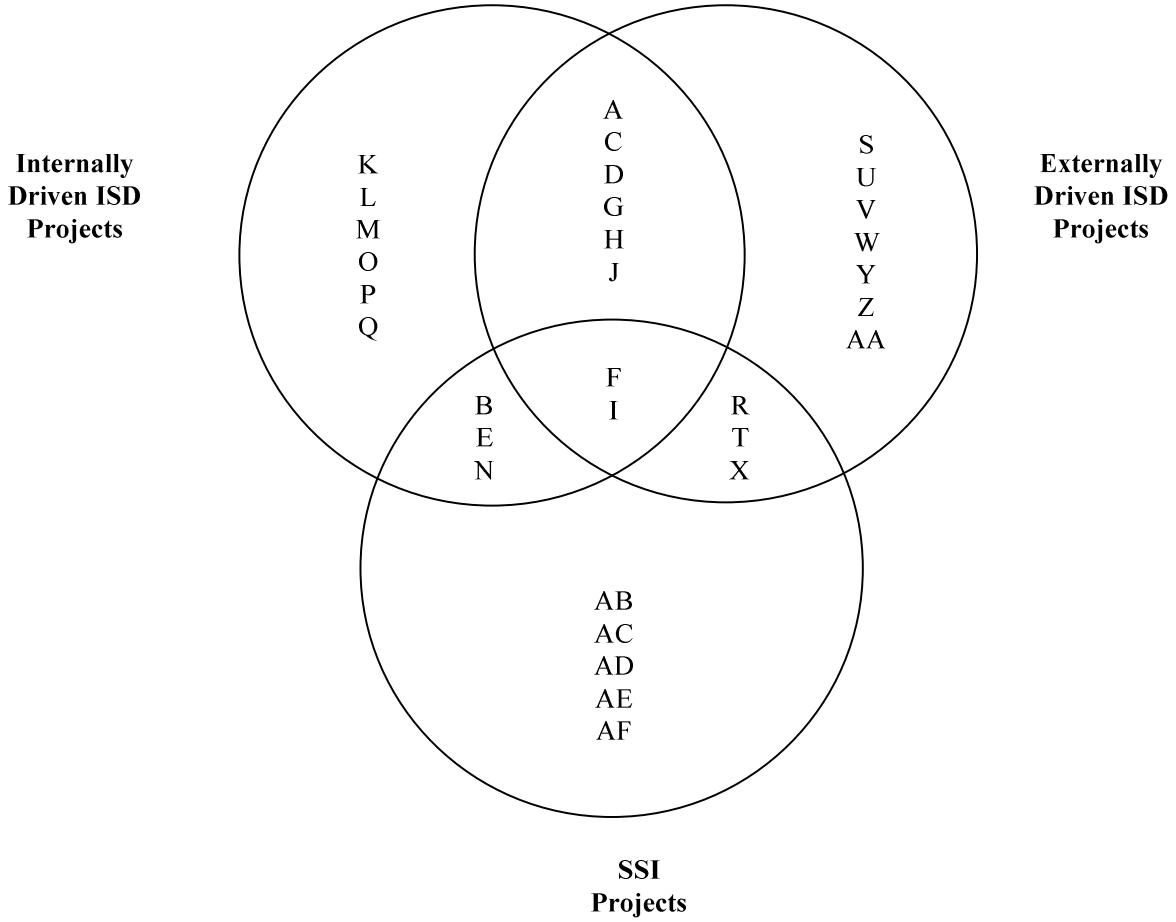

Figure 3: Zones of concordance and discordance between project types

4.3. Comparison with previous studies

As the main goal of our study was to explore whether the proposition of project-type-specific and project-generic risks can be supported or not, we will refrain from a detailed comparison of the risks identified in this study with the risks identified in other studies. What is more differing levels of abstraction seem to make a one-to-one mapping of risks nearly impossible. On a general level, it can be said that the majority of risks identified in our study are somehow reflected in [20] and [13]. However, there are also considerable differences:

On the one hand, several risks identified by prior studies did not appear at DELTA. These risks mainly refer to an instable corporate environment or the lack of a sound business case and top management support – conditions which simply do not apply to DELTA's business or are not relevant because of a sound project approval process. Further risks we could not identify at DELTA are related to a wrong development approach or missing project management processes. The absence of these risks is in our eyes no surprise as project management practices and organizations in general have become more mature over the years.

On the other hand, our study revealed quite many risks related to technical and testing issues, which are almost not existent in other studies. Several reasons may be brought forward to explain this discrepancy: First, the prominence of these risks may partly be due to our project-related approach and the rather technical perspectives of DELTA project managers. Having said that, today there may also be a more general perception that the complexity of corporate information systems is increasing. This notion is

supported by the mounting popularity of approaches to counter this complexity such as Enterprise Architecture Management. Third, as mentioned above, the high maturity of project management practices may simply have moved the focus to technical issues.

5. Conclusion and Implications

In addition to national culture, hierarchical roles, and personal experience, the type of a project (as defined by its primary activity) also seems to exert considerable influence on a project's risk profile. In this study, we explore this proposition using a Delphi study approach with three different panels representing individual software development projects (internally and externally driven) and standard software implementation projects.

Our results suggest that the notion of project-generic and project-type-specific risks is in general supported: While all project types in our study face the risks of unclear or instable requirements, a considerable degree of technical complexity, a lack of adequate project personnel, and completion from other IS projects, there exist also type-specific characteristics such as the increased uncertainty and many user-related risks in ISD projects. In general, ISD risks seem to face a larger variety of risks as the more stable SSI projects.

The following limitations should be kept in mind: First, the specific setting of our study questions the representativeness of our results. Some project-type-specific risks may well be the result of specific company or industry characteristics. Nevertheless, the plausibility of our results as well as the fact that we chose quite different project contexts makes us confident, that the findings can be replicated in different research settings.

Another potential limitation of the study relates to the selection of project managers: We preferred experienced project managers with an interest in the research topic to benefit from their knowledge and at the same time ensure a high response rate. However, this focus potentially disguises risks that less experienced and less interested project managers are faced with [24].

Overall, we argue that these limitations need be addressed in further research. Since our research is of exploratory nature, they do not affect the general implications drawn from the heterogeneity of the risk profiles. In our opinion, promising avenues for future research include the development of project risk profiles and matching project risk management approaches. Also, investigating dependencies between several risks in specific project risk profiles seems to bear great potential in order to be able to tackle problems in IS projects at their root cause.

References

[1] S. Alter and M. Ginzberg, "Managing uncertainty in MIS implementation", Sloan Management Review, 20 (1978), pp. 23-31.

[2] P. Bannerman, "Risk and risk management in software projects: A reassessment", Journal of Systems & Software, 81 (2008), pp. 2118-2133.

[3] H. Barki, S. Rivard and J. Talbot, "Toward an assessment of software development risk", Journal of Management Information Systems, 10 (1993), pp. 203-225.

[4] B. Boehm, "Software risk management: Principles and practices", IEEE Software, 8 (1991), pp. 32-41.

[5] R. Charette, "The mechanics of managing IT risk", Journal of Information Technology, 11 (1996), pp. 373-378.

[6] J. Dibbern, J. Winkler and A. Heinzl, "Explaining variations in client extra costs between software projects offshored to India", MIS Quarterly, 32 (2008), pp. 333-366.

[7] S. Du, M. Keil, L. Mathiassen, Y. Shen and A. Tiwana, "Attention-shaping tools, expertise, and perceived control in IT project risk assessment", Decision Support Systems, 43 (2007), pp. 269-283.

[8] A. Gemino, B. Reich and C. Sauer, "A temporal model of information technology project performance", Journal of Management Information Systems, 24 (2008), pp. 9-44.

[9] L. Kappelman, R. McKeeman and L. Zhang, "Early warning signs of IT project failure: The dominant dozen", IT Project Management, 23 (2006), pp. 31-37.

[10] M. Keil, L. Li, L. Mathiassen and G. Zheng, "The influence of checklists and roles on software practitioner risk perception and decision-making", Journal of Systems & Software, 81 (2008), pp. 908-919.

[11] M. Keil, A. Tiwana and A. Bush, "Reconciling user and project manager perceptions of IT project

risk: A Delphi study", Information Systems Journal, 12 (2002), pp. 103-119.

[12] H. Linstone and M. Turoff, "The Delphi method: Techniques and applications", Technometrics, 18 (1976), pp. 363-363.

[13] S. Liu, J. Zhang, M. Keil and T. Chen, "Comparing senior executive and project manager perceptions of IT project risk: A Chinese Delphi study", Information Systems Journal (2010).

[14] J. March and Z. Shapira, "Managerial perspectives on risk and risk taking", Management Science, 33 (1987), pp. 1404-1419.

[15] T. Moynihan, "An inventory of personal constructs for information systems project risk researchers", Journal of Information Technology, 11 (1996), pp. 359-371.

[16] A. Mursu, K. Lyytinen, A. Soriyan and M. Korpela, "Identifying software project risks in Nigeria: An international comparative study", European Journal of Information Systems, 12 (2003), pp. 182-194.

[17] S. Nidumolu, "The effect of coordination and uncertainty on software project performance: Residual performance risk as an intervening variable", Information Systems Research, 6 (1995), pp. 191-219.

[18] C. Sauer, A. Gemino and B. Reich, "The impact of size and volatility on IT project performance", Communications of the ACM, 50 (2007), pp. 79-84.

[19] R. Schmidt, "Managing Delphi surveys using nonparametric statistical techniques", Decision Sciences, 28 (1997), pp. 763-774.

[20] R. Schmidt, K. Lyytinen, M. Keil and P. Cule, "Identifying software project risks: An international Delphi Study", Journal of Management Information Systems, 17 (2001), pp. 5-36.

[21] The Standish Group International, Chaos summary for 2010, Boston, 2010.

[22] A. Tiwana and M. Keil, "The one-minute risk assessment tool", Communications of the ACM, 47 (2004), pp. 73-78.

[23] L. Wallace, M. Keil and A. Rai, "How software project risk affects project performance: An investigation of the dimensions of risk and an exploratory model", Decision Sciences, 35 (2004), pp. 289-321.

[24] M. Warkentin, R. Moore, E. Bekkering and A. Johnston, "Analysis of systems development project risks: An integrative framework", ACM SIGMIS Database, 40 (2009), pp. 8-8.