

# Relationships Between Risks in an IT Project Development Portfolio

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**Abstract**— More and more it is seen that IT (Information Technology) projects are managed as a whole as part of a IT project portfolio. As one of the arguments for doing so, risk management at the portfolio level was identified as one of the advantages that could benefit from this. This was based on the notion that risks are not independent from each other and that an understanding of relationships between risks should support portfolio management. Given this origin it is somewhat surprising that the notion of relationships between risks does not play a part in IT portfolio literature. This prompted this research project aimed at investigating the existence and relevance of risk relationships in practice. A series of interviews with experienced IT project portfolio managers confirms both the existence and relevance of the risk relationships providing a basis for further research.

**Keywords**— portfolio project management; risk management; risk relationships

## I. INTRODUCTION

IT projects are managed as a whole as part of a IT project portfolio. As a concept this was proposed as early as 1982 by McFarlan [17], who, as one of the arguments for doing so, identified risk management at the portfolio level as one of the advantages that could benefit from portfolio management. He based this on the notion that risks are not independent from each other and that an understanding of relationships between risks should support portfolio management.

The importance of using risk management at the portfolio level is evident [21]. Interactions between projects, in terms of shared scarce manpower and usage of project results in other projects, are unavoidable. Ignoring these will lead to more problems than taking them into account. Even for small organizations that means someone should monitor risks across projects. In larger organizations part-time or even dedicated portfolio managers are seen to take up this task.

Given the original argumentation by McFarlan, it is somewhat surprising that the notion of relationships between risks does not play any part in IT portfolio literature. This prompted this research project aimed at investigating the existence and relevance of risk relationships in practice. In this paper, we will first discuss the theoretical background of this study. Next, the research design used will be discussed,

followed by the results of the study. Finally, a discussion of results and conclusions will be provided.

## II. BACKGROUND

Risk, in the context of IT projects, can be defined as the possibility of an unfavorable outcome in terms of time, cost, or functionality of the final project deliverable [22]. There is an extensive body of literature on identifying risks for IT projects [19], and managing risk in IT projects [19][22][23][24][11].

Risk can also be discussed at the IT development portfolio level. Turner & Müller [21] give the following definition of such a portfolio “a portfolio of projects is an organization, (temporary or permanent) in which a group of projects are managed together to coordinate interfaces and prioritize resources between them and thereby reduce uncertainty”. De Reyck et al [4] state that: “the selection of projects to compose a portfolio should ensure that all areas of the organization’s strategy are properly addressed and that the portfolio is well balanced”. Risk is an important aspect of this balance [11] and therefor plays an important role when managing a portfolio.

This is also emphasized in the definition of portfolio management by McFarlan who states that within the context of a portfolio “assessing the risk of their projects, separately and in the aggregate, will help managers make more informed decisions and ensure more successful outcomes” [17]. He also states that risk analysis of individual projects should play a major part in selecting projects for such a portfolio since “risks in practical situations, of course, are not independent of each other; rather, they are closely related” [17]. McFarlan based his work on the still widely used financial portfolio theory as developed by Markowitz [16] who states: “Sometimes the addition of the risky security produces a more conservative portfolio than the addition of the conservative security. This illustrates a basic principle: the security which is risky or conservative, appropriate or inappropriate, for one portfolio may be the opposite for another. One must think of selecting a portfolio as a whole, not securities per se”.

Identifying portfolio risk can start by identifying all individual project risks and adding these to a single portfolio, see e.g., [3]. This approach can already provide significant insight. However, it misses the notion contended by

Markowitz and McFarlan that risks themselves can have relationships. If risks of individual projects can influence each other (across projects) these interactions should also play a role when making decisions of additions to a project portfolio.

When looking at literature for the management of a portfolio as a whole, attention has mainly be focused at interrelationships between projects. This relationship can be complementary, negative, or neutral [1][5]. Chien [1] identified four types of interrelationships among projects: outcome or technical, cost or resource-utilization, impact or benefit, and serial (present-value) interrelationships. Santhanam and Krypakis [18] identified three fairly similar types of interdependencies involving IT projects: resource, benefit, and technical. And in 2011 Kundisch & Meier [15] describe project interactions based in outcome or resource interaction. It is interesting to see that direct relationships between projects have received explicit attention, while relationships between risks receives no attention in this part of the portfolio literature.

Also, a wider search for literature aimed at identifying these relationships between risks in a IT project portfolio context yielded no results. In other fields the notion does exist. For example, Fan, Suo & Feng [7], when discussing the related area of IT outsourcing identify the existence of risk relationships. They state: “in some situations, the interrelationships among risk factors can induce the transmission effect from one risk to another”. In their research they elaborate further on this statement and identify

eight relevant risks and their relationships. The notion of relationships between risks is also known in other disciplines. Examples are engineering [13], finance [6], and medical science [20][25].

Given this, it was found worthwhile to investigate the existence of relevant relationships between risks in an IT project portfolio setting.

### III. APPROACH

The objective of this study is *to investigate if relationships exist in practice between risks of projects in an IT portfolio setting that are relevant at the portfolio level.* The notion of relevance has been added to the original question since slight interactions between phenomena can always exist, but from a management point of view these are only worth investigating if they have a significant effect on the management of the portfolio. The notion of ‘relationship between risks’ can now be further detailed. An obvious form exist when occurrence of risk X will impact the likelihood and/or the impact of risk Y. This can be termed a direct relationship between risks X and Y and can be interpreted as “if risk X occurs, this can influence the likelihood and/or the impact of risk Y”. A second type of relationship occurs when an external event can influence both the likelihood and/or the impact of risks X and Y (see Figure 1). In both cases the impact on likelihood and / or impact can be positive or negative, resulting in either a mitigating of aggravating effect on the portfolio level.

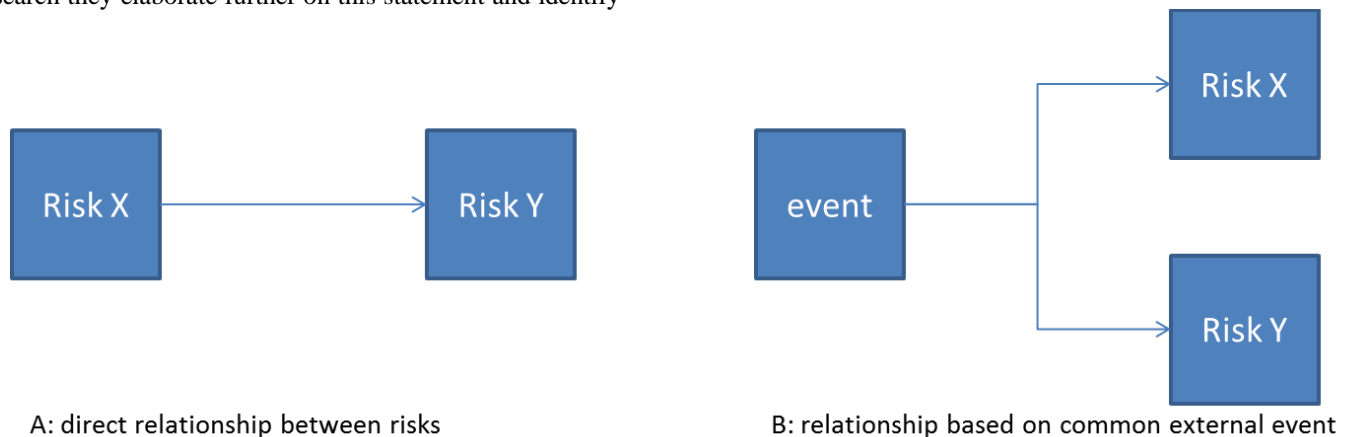


Figure 1. types of relationships.

Given the explorative nature of the research, and the fairly complex notions of ‘risk relationship’ involved it was decided to perform the research by interviewing a number of experts. This would provide the possibility of explaining the issues, seeing if these were understood and assessing the answers, also by asking additional questions if possible. These advantages of interaction, enabled by the interview format in our mind outweigh the more detailed and possibly more representative results that might be obtained from a survey.

For the interviews persons with relevant experience as IT project portfolio manager in a sizeable organization were sought. Two years or more of experience was required, since the expectance was, that this would provide the required relevant experience from which to answer our questions. A sample of five respondents from different organizations was aimed at. A larger number would of course have increased the number of identified relationships. However, given the objective: give a proof of existence of these risk relationships across projects, this was deemed to be sufficient. For the search use was made of relevant groups in LinkedIn. In the

end, five experienced IT-portfolio managers were found with the required profile who were willing to participate in the research (Table 1).

TABLE I. OVERVIEW OF RESPONDENTS

Respondent	Type of organization	Size
1	Energy provider	1.000-5.000
2	Government	10.000+
3	Insurance	1.000-5.000
4	University	5.000-10.000
5	Hospital	5.000-10.000

Respondents are supposed to provide concrete risk relationships they themselves have experienced. This is a fairly difficult questions to answer. To support their thought process it was decided to provide them with a short list of candidate risks to trigger them. To develop this list, an additional literature search was executed. The search was aimed at identifying 12 often used but dissimilar risks. The number of 12 was chosen as sufficiently small to be usable in an interview but also sufficiently large to be able to give material for discussion. For this, seven useful papers were selected:

- Risks that influence the risk profile of an IT project portfolio [17].
- A structured overview of risks: [11].
- Sources that can originate common risks: [19].
- Twelve dominant risks [12].
- A top 10 of software risks [9].
- A number of risks derived from failed projects [2].
- A recent publication containing critical risks [8].

The selection process of these papers took into account a number of quality criteria: an assessment of the methodology used and the number of times the paper was referenced.

An overview of all risks identified in these papers was developed. Overlaps between papers were identified and the risks were sorted according to frequency of occurrence in the papers. This resulted in the following list (with between brackets the number of papers in which the risk is mentioned):

- incorrect or misunderstood requirements (6)
- insufficient project planning (6)
- lack of non-IT human and/or financial resources (6)
- inexperienced IS project team (5)
- unclear project scope (5)
- insufficient project approach (5)
- lack of end user participation (4)
- changes in team composition (4)
- changes in project scope and / or requirements (4)
- lack of man power (IS related) (4)
- unfamiliarity with hardware in the project team (4)
- unfamiliarity with software in the project team (4)

In order to achieve results of sufficient quality a semi-structured interview set-up was developed. The interview started with a question regarding the work experience of the respondent in order to confirm their level of experience. This was followed by an explanation of the issues involved and

the notion of risk relationship types (Figure 1). The objective was to explain the objective of the interview and the concepts involved. Part of this was a check on comprehension of these concepts, preferably by having the respondent explaining them in their own words.

This was followed by the key component of the interview: a discussion regarding possible risk relationships. To focus this discussion as a visual aid a (half) matrix was provided in which the risks identified were set off against each other. Also, a more detailed version of figure 1 was included as a memory aid.

Using the resulting matrix, respondents were prompted to identify relationships (direct and based on a common external event) between risks and to provide concrete examples of occurrences of these relationships which they personally encountered. The examples were required to ensure that only actually occurring risk relationships were identified and not just theoretical / hypothetical possibilities. No completeness in the discussion of all 66 possible combinations of risk was striven for. This would have been pointless in the limited time available for such an interview. Respondents could add risks on top of the twelve identified if this helped them in identifying additional risk relationships. These new risks were added to the risk matrix to be available for subsequent interviews. The basic question put to the respondents here was: do you have a specific relationship between risks from this matrix in mind which you want to discuss?

After this part of the interview, results from previous interviews were presented. Respondents could indicate if they agreed with them in principle, providing a face value validation of previous results.

The setup of the interview was tested beforehand with a test subject, who was not an active IT project portfolio manager but did have some experience with portfolio management. No changes were made to the set-up as a result of this test.

All interviews were recorded. The recording were transcribed and then analyzed. The analysis was aimed at identifying actual risk relationships discussed and the examples provided by the respondents. In recording these results, as much as possible the original statements made by the respondents were used. The results were send back to the participants for approval. Based on their feedback, some minor changes were made in the results.

#### IV. RESULTS

The interviews were carried out over a period of five weeks, allowing for sufficient time between interviews to have the results of a previous interview ready for the next. Of each interview an extended abstract was made, based on an audio recording. This abstract was sent back for confirmation to the respondents, who could make corrections.

All respondents have the required two years of IT portfolio management experience, ranging up to 10 year. The organizations involved are sizeable, indicating that the respondents have to deal with a significant IT-portfolio. Respondent 4 is also active as a consultant specialized in portfolio implementation and director / owner of a company

specialized in portfolio management (> 20 employees). This indicates that a sufficient basis exists to accept the expertise of the respondents.

During the interviews, all respondents indicated that after some discussion they understood the concepts of risk relationship and the associate types of direct relationships and those based on a common external event. This, then provided a solid basis for the further interviews.

In the next step, all respondents were able to identify (direct and based on a common external event) risk relationships. They also were able to support this by providing concrete examples. As mentioned in the foregoing respondents were allowed to add risks if required for their discussion. All in all 5 additional risks were added to the matrix:

- Change in planning
- Benefits not achievable
- Portfolio out of control
- Common resource usage across projects
- Safety or security endangered

All-in-all 15 relationships were found, of which 7 based on a common external event and 8 direct. Table 2 gives an overview of the portfolio risk relationships found. The first seven lines of the table contain situations where the relationship is based on a common external event (situation B in figure 1). The remaining eight lines contain situation where a direct relationship between risks across projects exists (situation A in figure 1).

## V. DISCUSSION AND CONCLUSIONS

This discussion will look at the validity and reliability of the results, and their degree of completeness. It will end with a discussion of the added value of this notion, set off against approaches already in use.

Let us first look at the validity and reliability of the results. In this project five 2-hour semi-structured interviews were conducted with experienced IT project portfolio managers from fairly large organizations. These respondents all understood and recognized the phenomenon. Together they succeeded in identifying and validating fifteen risk relationships, of which eight direct and seven based on a common external event. All fifteen risk relationships were supported by concrete examples, based on their own experience. In consecutive interviews respondents were asked to confirm the existence of the earlier identified relationships. In interviews 2, 3 and 5 this was done. In interview 4 this proved not to be possible due to time constraints since discussion in the first part of the interview took too long. Interview 5 focused only on the validation of the previous results. In total this provided 27 options to confirm or deny a risk relationship. In 26 of these, existence of the relationship was confirmed, providing an additional face value support for its existence and relevance. In one case a relationship was accepted by one consecutive interviewee and denied by another. This is the relationship mentioned in the seventh row of the table in Table 2. Together this provides strong evidence of the existence of the phenomenon and the relevance of the relationships

found. Together it can be concluded that the results are valid and reliable.

As mentioned above, the research was explorative and not aimed at achieving any degree of completeness. An indication of the degree of completeness achieved can be judged from the overlap between the relationships identified by the individual respondents. This is possible, since results from previous interviews were not shown until at the end of the interview. Of the fifteen relationships identified only two were identified more than once. Each was identified twice in different interviews. That means that four independent drawings (interviews) from a population of risk relationships of unknown size resulted in only two doubles. This would indicate that the results are far from complete and (many) other risk relationships are still to be identified.

When looking at the relevance of the results it is required to compare them with the approaches currently being used to see if any added value can be identified. In the background study two current approaches are identified. A first approach identified is adding individual risks to a portfolio risk profile see e.g., [3]. It is obvious that such an approach is likely to miss the additional insight in risk and benefit offered by the notion of risk relationship proposed here. The notion of risk relationship can be considered as a straight add-on to this approach. A second approach looks at describing project interactions e.g., in outcome or resource interaction (e.g., [15]). Such an approach is unlike to identify the common external events that are at the basis of some of the risk relationships identified in this study. The direct relationships could also be identified when looking at direct interactions between projects. However, the more detailed and forward looking approach enabled by the view on risk relationships is probably a useful addition to this approach.

## VI. CONCLUSIONS AND FUTURE WORK

Following this discussion, we conclude that the notion of risk relationship in the context of IT project portfolio management is a useful addition to the current state of the art and merits further research. Such relationships do appear to exist and are unlikely to be fully captured by existing approaches. This holds especially for the notion of external events impacting several risks across projects. Further research could be directed at providing a more complete overview of relationships as depicted in figure 1 and table 2. Extending the approach used in this research seems not feasible. There are not that many experienced project portfolio managers around willing to invest the large amount of time required for the required structural analysis.

Given that a structured literature review would yield a list of risk factor far larger than the one used in this research such a set of interviews would need to discuss hundreds of risk combinations, each again in combination with dozens of possible external events, leading to thousands of items to be analyzed.

A more feasible approach might be found in the analysis risk documentation, e.g., as captured in risk repositories. That would also be more directed (looking at actual occurrences) while not trying to cover an extreme number of

combinations of which probably only a limited number yield results.

TABLE II. OVERVIEW OF PROJECT RISK RELATIONSHIPS

External event Z	Risk X	Risk Y	Example
Change in organization (culture)	incorrect or misunderstood requirements	changes in team composition	This type of change can lead to outflow of current staff. This will then influence both the understanding of requirements by new staff and will immediately impact team composition, with the entailing loss of common project understanding.
Change in organization (culture)	lack of man power (IS related)	benefits not achievable	The change caused a difference in usage of the document management system which impacted the effectiveness of running projects. It also caused outflow of current staff.
Market competition stronger	changes in team composition	change in planning	Competitive pressure caused moving deadlines forward. Due to unreasonable pressure projects got out of hand. This also caused outflow of staff.
Change in labor market	lack of (non-IT) human and / or financial resources	lack of man power (IS related)	Staff with specific competences left for higher wages. This caused a lack of these competences within the organization. Similarly, hiring temporary replacement staff became too expensive.
Change in (marketing) policy	changes in project scope and / or requirements	change in planning	The change resulted in new projects, resulting in delay and higher risk because of the delay for other projects. Also, other projects were required to change their scope to fit in with the new projects.
New legal requirement	changes in project scope and / or requirements	safety (or security) endangered	Decentralization of youth care to civic communities impacted the scope of projects for existing suppliers. Also, because of this decentralization, security risks increased.
Downsizing due to external circumstances	inexperienced IS project team & lack of (non-IT) human resources	lack of man power (IS related)	In a downsize situation the best staff had a tendency to leave (because they can). This resulted in lack of manpower and experience.
	changes in project scope and / or requirements	changes in project scope and / or requirements	When a project was faced with a change of scope, this directly impacted the scope an output related project.
	lack of financial resources	changes in project scope and / or requirements	When a project consumed too much resources, this directly impacted the availability of the (remaining) resources for the other / later projects.
	changes in project scope and / or requirements	benefits not achievable	When a project adjusted its scope, an output related project was unable to achieve its objectives.
	lack of man power (IS related)	lack of financial resources	Staff works on several projects. A specific project is put on hold. As a consequence, the capacity that became available was absorbed by the other projects, increasing their costs.
	change in planning	lack of man power (IS related)	A project required specific and scarce capabilities. When the project ran late, this capability was not available for other projects, who all ran late as well.
	portfolio out of control	insufficient project planning	A program with many dependencies between projects ran out of control. The result was that planning of these projects could not be maintained.
	common resource usage across projects	insufficient project approach	An organizations used configuration management tools of insufficient quality. This impacted the entire portfolio.
	lack of financial resources	lack of financial resources	A specific project had lack of funding. Portfolio management challenged all other projects to work more efficient in order to release the required funding.

Another field of research is the notion of external event. It could be envisaged to do further research into the type of events that could impact project risk and thus provide a reference that can be used by portfolio managers to support their work. Finally, it could be worthwhile to investigate the strength of the relationships identified and the likelihood of occurrence.

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