Revisiting McFarlan's Risk Model for IS Implementation Success - Does Culture Matter?

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Abstract

The majority of all IS implementation projects fails. McFarlan (1981) identified risk factors associated with organizational IT projects and created a model to predict project risk. The McFarlan Risk Model (MRM) provides a useful approach for the diagnosis and mitigation of IT project risks but can be improved in its predictive ability. In this paper, we suggest to augment the model, beyond its original three dimensions. Based on recent literature, which points to the importance of culture, specifically corporate culture, we develop an extension to McFarlan's model and assess the added value of this extended model through the evaluation of two business cases. Expert evaluations using the Extended McFarlan Risk Model (EMRM) indicate higher predictive power in the differentiation of project success and failure, based on differences in the model's culture dimension.

Keywords risk, risk assessment, IS implementation success, corporate culture, ERP, project management

1 Introduction

The majority of all IS implementation projects fails. Implemented typically via the traditional waterfall approach (Fair, 2012) instead of newer agile methods, these projects frequently fall short on multiple success metrics. It has been repeatedly documented (e.g., The Standish Group, 2014) that approximately 70% of all projects are either not delivered on time or on budget, or do not generate the benefits originally intended. When an organization embarks on an IT implementation project, it therefore literally carries out an "experiment" whose odds are stacked against success. One pioneering IS researcher to recognize this reality was Warren McFarlan (1981). McFarlan not only identified the risks associated with organizational IT projects, he also created a framework to predict project risk based on observable project characteristics. McFarlan also suggested approaches to mitigate project risks, among them a portfolio approach.

In the years since McFarlan's original model development, evidence has emerged for the existence of additional salient risk factors. Specifically, outside the USA, in Asia and Europe, projects that according to the MRM should have succeeded did not. This suggests the need to augment the model beyond the three original dimensions. Literature from 2000 onwards points to the importance of one previously left out dimension, namely culture, specifically country culture. Culture has been identified in other IT studies as a salient factor (Henderson and Venkatraman, 1992). And while country culture may not have been an important influence in the projects McFarlan observed in the US during the 1970s, in a global environment, country culture is becoming increasingly present and potentially important. Hence, our research seeks to explore the following three questions:

- How can the MRM be enhanced by culture as an additional dimension?
- What are the explanatory benefits of including a culture dimension?
- Which attributes of the cultural dimension need to be observed to better understand project success or failure?

Correspondingly, the remainder of the article is organized as follows. We first briefly explain the MRM and review the recent literature on project risk and project success to identify key themes, including culture. We then introduce an extended MRM (EMRM), adding the culture dimension. Afterwards, we describe a review exercise undertaken with a group of experts to formulate a new risk model with specific consideration of corporate culture as a risk dimension. We illustrate the process, explain the findings, discuss their impact and draw conclusions.

2 Literature Review

In the literature, there is no general agreement about the right project risk attributes (Wallace et al., 2004). However, McFarlan's model (1981) has been a widely-cited article to identify the software project risk, so in this section, his model will be described more deeply.

2.1 McFarlan's Risk Model

In 1981, McFarlan pioneered the assessment and mitigation of software project risks. McFarlan's view has had an impact on practice and researchers, with several researchers employing it to advance the knowledge of software development (Huang et al., 2004). McFarlan (1981) identifies three dimensions of risk: Project Size, Project Structure, and Experience with Technology. In discussing risks, McFarlan assumes that managers adopt appropriate methods and approaches during the project. Nevertheless, he also provides project management methods commensurate with the level of project risk. McFarlan's instrument to measure the dimensions of risk is based on a 54-item risk assessment questionnaire, originally used by Dallas Tire Corporation (Wallace, Keil & Rai, 2004). McFarlan's model extracted the most salient 14 items from the original questionnaire, subsumed under three risk dimensions:

a) Project Size (PSI) is defined in terms of cost, number and level of extra staff needed, time required in the project and number of departments' processes affected by the project implementation. Larger numbers imply greater risks.

b) Project Structure (PST) is defined as how many procedural and structural changes are required in user departments and the attitude of users to fit the changes. Such as if the user department needs to change a lot of procedures to meet the project requirement, it is classified as a low Project Structure, there is a higher risk in the project. The dimension includes six questions (attributes) in the questionnaire.

c) Experience with Technology (TEX) is calculated by familiarity with the project, dealing with unexpected technical problems and requiring a larger size of a system development group. If the team has high Experience with Technology, such as when the project uses familiar technologies, the risk is lower than if the team lacks the appropriate experience. Similarly, if the team involves qualified external experts, the risk arising from the TEX dimension will be lowered. But, if the experts do not work in partnership with the company, the risk still remains. The TEX dimension includes five questions (attributes) in the questionnaire.

The three dimensions, in aggregate, determine a risk score, which then also specifies the risk level. A project can be classified according to the eight types, varying from very low to very high risk, according to the Risk Matrix introduced in Table 1 (Applegate, McFarlan & McKenney, 1999).

Technology Experience	**Project Size**	**Low Project Structure**	**High Project Structure**
High experience with technology	Large size	(1) Low risk (very susceptible to mismanagement)	(5) Low risk
	Small size	(2) Very low risk (very susceptible to mismanagement)	(6) Very low risk
Low experience with technology	Large size	(3) Very high risk	(7) Medium risk
	Small size	(4) High risk	(8) Medium - low risk

Table 1: Risk Matrix: Effect of Project Size, Project Structure and Technology Experience on Implementation Risks (Applegate, McFarlan & McKenney, 1999)

Risk levels vary based on the characteristics for each project. Considering an Enterprise Resource Planning (ERP) project for a global manufacturing company as an illustrative case, the dimensions are as follows. With a global footprint and multiple sites, the size will be large. The project structure will be low to medium because procedural changes will need to be made in business practices to accommodate the ERP logic, thus creating significant change. The overall risk level would then depend on the company's familiarity with the relevant project technologies. If the company has little (low) expertise with the technologies required to implement the project, the project risk will be very high (3), if it has strong familiarity, the project risk will be low (1), but the project will be very susceptible to mismanagement, according to McFarlan (Table 1). Decision makers seeking to assess their risk levels do not need to abstractly consider risk dimensions, but can ascertain them through answers to specific questionnaire questions (e.g., "how many person hours?").

McFarlan's approach not only focuses on risk assessment but also on mitigation. After assessing project risks, IT and business decision makers can further explore the risk sources and define a managerial approach to manage the risks, according to McFarlan's contingency approach for risk management. McFarlan suggests four principle management mechanisms.

a) **External integration tools** include organizational and other communication devices that link the project team's work to the users at both the managerial and the lower levels.

b) **Internal integration devices** ensure that the project team operates as an integrated unit.

c) **Formal planning tools** help to structure the sequence of tasks in advance and estimate the time, money, and technical resources the team will need to execute them.

d) **Formal control mechanisms** help managers evaluate progress and spot potential discrepancies so that corrective action can be taken (McFarlan, 1981).

McFarlan's model is logically consistent with other operational risk approaches as to risk drivers and their impact. Nevertheless, the model does not provide an assurance of completeness nor does it explain the calibration of input uncertainties and output risk levels. McFarlan (1981, p. 144) himself points out that "no analytic framework lies behind these questions". Without an analytic framework. there is no guarantee that the model captures the major relevant dimensions or their relative impact appropriately. The following section identifies one arguably missing dimension, culture, and explains it in the IS implementation context.

2.2 Culture Dimension

One dimension absent from McFarlan's model is culture. Triandis (1995) describes culture as a pattern of shared attitudes, beliefs, categorizations, self-definitions, norms, role definitions, and values that is organized around a theme, which can be identified among those who speak a particular language, during a specific historic period, and in a definable geographic region. Most people belong to multiple groups at the same time with different cultures, and layers of culture. Hofstede and Hofstede, (2005) outline six layers, as shown below:

- National level, according to one's country (or countries for people who migrated during their lifetime);
- Regional and/or ethnic and/or religious and/or linguistic affiliation level, as most nations are composed of culturally different regional and/or ethnic and/or religion and/or language groups;
- Gender level, according to whether a person for instance identifies as a girl or boy;
- Generation level, separating grandparents from parents from children;
- Social class level, associated largely with educational and economic opportunities and with a person's occupation or profession;
- Organizational level, for those who have been socialized by their work or other organization.

Other researchers have put forward organization-focused views of culture, among them Lave and Wenger (1991) and Schein (1984). Lave and Wenger stress the role of culture in defining individual expectations and demands. For example, in a Chinese organizational setting, company members may have the culture-based expectation that the consultant will be an answer provider, instead of a coach, easily leading to expectation mismatches in an implementation project. Schein (1984) discusses culture in the relationship between basic assumptions, values, and "artifacts" (including behaviors), to explain how groups may function. Schein points out that invisible and "taken for granted" assumptions are powerful drivers of behavior. For example, in an Indian corporate setting, the purchasing manager may consider the relationship with sellers as his or her personally-owned relationship, one that should not be dis-intermediated by an ERP system. Any attempt to do so, would thus face implementation obstacles.

With the importance of culture, a cultural mismatch would introduce a new risk factor, as the above examples illustrate. Problematically, global companies, with various country cultures and possibly other cultural elements embedded in them, would be prone to cultural mismatches in the implementation of global ERP systems. Even firms with a strong internal culture, such as IBM, have cultural differences across different subsidiaries (Hofstede & Bond, 1988). Cultural differences easily lead to conflicts over corporate policies (Hofstede & Bond, 1988) and global management.

Cross-cultural difference therefore is a challenge for global companies and global information systems management (Martinsons & Westwood, 1997). Information systems developed for headquarters may not be transferrable globally because of different cultures, business practices or requirements. Today's dominant ERP systems have been developed largely by firms in the US and Germany. They embed Western views on information sharing, process transparency, and standardization. In contrast, Martinsons & Westwood (1997) suggest that factors such as paternalism, personalism and high context communications shape the use of information systems in the Chinese business culture. Western ERP systems thus may lead to a loss of control for Chinese managers or may destabilize established social networks (Martinsons & Chong, 1999) and may thus not be a good fit. Managers may feel their power being eroded and thus undermine ERP system implementation or use.

With the high failure risks of information systems projects, IS implementations in general and ERP implementation in particular, have been widely covered in the literature. Coverage has included areas such as implementation methodologies, vendor selection, and project management frameworks. Various implementation methods for ERP had been proposed in the past decades. Nevertheless, implementation risks appear to remain high (Hong & Kim, 2002 and Aloini, Dulmin & Mininno, 2007). In light of the failure rates, and concerns about culture as an influence, we carried out a review of studies on critical success factors for ERP implementation. 20 articles published since 2000, were identified. Articles had to cover "factors", risks, critical success factors, or critical failure factors and had to focus on ERP projects. The factors they identified were grouped into eight risk categories (dimensions). For the 20 articles, the frequency of mention of the dimensions was: culture (20), human resources (13), project management (13), IT and technical abilities (12), change management (11), external parties (7), cost and budgets (3) and environment (1).

Accordingly, culture was the only factor mentioned in every article (Amid, Moalagh & Ravasan, 2012; Chen, Law & Yang, 2009; Ehie & Madsen, 2005; Hakim & Hakim, 2010; Hong & Kim, 2002; Huang et al., 2004; Ke and Wei, 2008; Law & Ngai, 2007; Mabert, Soni & Venkataramanan, 2003; Motwani, et al., 2002; Motwani, Subramanian & Gopalakrishma, 2005; Soh, Kien & Yap, 2000; Soja, 2006; Sumner, 2000; Umble, Haft & Umble, 2003; Wong et al., 2005; Woo, 2007; Wright & Wright, 2002 and Xue et al., 2005), with the next most significant items mentioned about one-third less. This strong indication of the importance of culture since 2000 may be due to the emergence of ERP, the emergence of global business, or a heightened awareness of the role of corporate culture. At any rate, it speaks to the necessity of including culture as a separate dimension into an enhanced risk model.

3 Proposed Extended McFarlan's Risk Model

Based on the lack of a culture dimension in the MRM, and the recognized need in the literature to include culture as a significant factor with respect to ERP project success, in this article we seek to extend the MRM into an analytics-backed instrument that specifically measures the dimensions of risk which the original model lacks (McFarlan, 1981). Therefore, culture–in particular corporate culture—will be added as an additional dimension to the MRM to formulate the extended model shown in Figure 1.

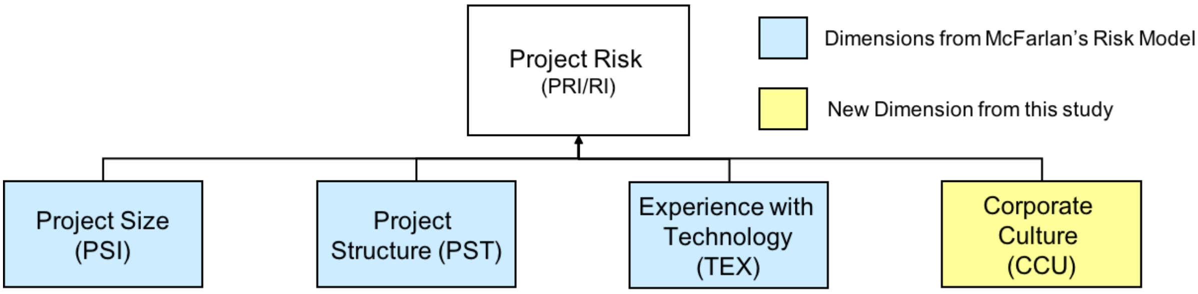

Figure 1: The Extended McFarlan's Risk Model (EMRM)

3.1 Risk

For the extended McFarlan's risk model (EMRM), risk will be defined as a condition with a possibility of an adverse deviation from a desired outcome, which can be resolved by action. The adverse outcomes of IT projects including ERP may lead to the following results, with items (1) to (6) put forward by McFarlan (1981) and (6) as well as (7) proposed by us: (1) failure to obtain any or all of the anticipated benefits; (2) costs of implementation that significantly exceed planned levels; (3) implementation time significantly exceeds expectation; (4) technical performance of resulting systems is significantly below pre-supposed levels; (5) incompatibility of the system with the selected hardware and software; (6) project termination and (7) systems that are idle or significantly under-utilized. For the following three dimensions in the MRM, we utilized the attributes used in McFarlan's original research.

3.2 Project Size (PSI)

Project Size (PSI) is defined in terms of cost, staff levels, time required in the project, and number of departmental processes needed to be changed during implementation. For any of the factors, more means riskier. Higher project costs, for instance, imply greater risk. According to McFarlane, size risks affect the company more if they are not recognized. The size dimension includes three attributes in McFarlan's model; we add another three attributes into the EMRM, drawn from the original source of McFarlan's questionnaire–the Dallas Tire Case (Cash, 1980). Attributes are listed in Table 2.

Code	Attributes of Project Size (PSI)	Sources
PSI1	Development man-hours	McFarlan (1981) and Dallas Tire Case (Cash, 1980)
PSI2	Project Implementation time	
PSI3	No. of departments involved (exclude IS)	
PSI4	No. of user-department staff involved to run it	Dallas Tire Case (Cash, 1980)
PSI5	No. of geographic locations	

PSI6	No. of existing interface	

Table 2: Codes and attributes of risk dimension – Project Size

3.3 Project Structure (PST)

Project Structure (PST) is defined as the extent of procedural and structural changes are required in user departments and the attitude of organization members to accommodate the changes. If the user department needs to change many procedures to meet project requirements, or need to make related changes, it is classified as low project structure and contributes to higher project risk. The dimension includes six attributes. The project structure dimension includes three attributes in McFarlan's model; we add three additional attributes into the EMRM, drawn from the original source of McFarlan's questionnaire, the Dallas Tire Case (Cash, 1980). Attributes are listed in Table 3. We note that four of the attributes in this dimension are closely related to culture. They are identified by a * (e.g., PST2).

Codes	Attributes of Project Structure (PST)	Sources
PST1	Percentage of functions replaced at one time	McFarlan (1981) and Dallas Tire Case (Cash, 1980)
PST2	Degree of procedural changes*	
PST3	Extent of user organization changes required to fit the new system*	
PST4	General attitude of users*	
PST5	Commitment from top management*	
PST6	Team composition (i.e. part-time vs. full-time)	
PST7	Prior exposure to the new system	Dallas Tire Case (Cash, 1980)
PST8	Overall rating of the pre-determined structures for the new system	
PST9	No. of estimated questions remaining unanswered or answered with a low confidence factor	

Table 3: Codes and attributes of risk dimension – Project Structure

3.4 Experience with Technology (TEX)

Experience with Technology (TEX) is measured in terms of familiarity with the project, ability to deal with unexpected technical problems and skill requirements of the system development group. If the team has more Experience with Technology, such as the project that uses familiar technologies, there is less risk (is called low Experience with Technologies required) than if the team does not have similar Experience with Technology. If the team involves qualified external experts the risk on that dimension will be less. But, if the experts do not work in partnership with the company, the risk remains. The dimension includes five attributes in the questionnaire. These five attributes added into the extended risk assessment model are extracted from the original source of McFarlan's questionnaire – Dallas Tire Case (Cash, 1980). Each attribute has an individual code, shown in the left column of Table 4.

Code	Attributes of Experience with Technology (TEX)	Sources
TEX1	Company's prior experience with the new hardware	McFarlan (1981) and Dallas Tire Case (Cash, 1980)
TEX2	IS team's prior experience with the new software	
TEX3	Users' prior experience with the new software or new IT knowledge	
TEX4	User representatives' prior experience with the new IT knowledge or the new system or the implementation	
TEX5	IS team's knowledge of the new system	
TEX6	Vendor's prior experience with the new hardware	Dallas Tire Case (Cash, 1980)
TEX7	Hardware dependence for system success	
TEX8	Vendor's prior experience with the new software	
TEX9	Vendor's support for the new system	

TEX10	System complexity	

Table 4: Codes and attributes of risk dimension – Experience with Technology

Moreover, in the Experience with Technology categories (dimension) section, there are minor changes on the answers of three questions (TEX1, TEX2 and TEX6). The technology has changed much over the last decades, so answers were amended to fit today's environment and its technology. Answers were checked with the original model developer, Professor McFarlan, in face to face discussion.

3.5 Corporate Culture (CCU)

Whereas McFarlan did not give insight on relevant culture-oriented risk attributes, the recent literature offers guidance for the formulation of appropriate attributes. Thus, we add the fourth dimension, Corporate Culture (CCU) in the extended risk assessment model as show in Figure 2.

Unfortunately, there is no standard definition of the concept of organizational culture (Hofstede & Hofstede, 2005). Even in the narrower context of the ERP literature, no clear definition or set of commonly agreed upon attributes for culture exists. Consequently, prior ERP research related to culture was analysed for relevant attributes. We included articles published 2000 and later as well as containing success or failure factors. These are described in Table 5.

	Attributes of Culture (CCU)	Authors within ERP literature
A1	Cultural differences between Western and Asian	Soh, Kien & Yap, 2000
A2	Settle multi-sites issues	Umble, Haft & Umble, 2003; Davison, 2002 and Martinsons & Westwood, 1997
A3	Cultural readiness	Motwani, Subramanian & Gopalakrishma 2005; Motwani et al., 2002; Umble, Haft & Umble, 2003; Wright & Wright, 2002 and Wong et al., 2005
A4	Top Management support, commitment and leadership	Ehie & Madsen, 2005; Umble, Haft & Umble, 2003; Hakim & Hakim, 2010; Law & Ngai, 2007; Mabert, Soni & Venkataramanan, 2003; Woo, 2007; Huang et al., 2004; Wong, et al., 2005; Soja, 2006 and Ke & Wei, 2008
A5	Good communication	Mabert, Soni & Venkataramanan, 2003; Woo, 2007 and Huang et al., 2004
A6	Cross-team relationship and manage of conflict in the company	Chen, Law & Yang, 2009; Motwani, Subramanian & Gopalakrishma 2005; Hakim & Hakim, 2010 and Huang et al., 2004
A7	Organizational fit or company strategies, vision and objectives are fit for ERP project	Hakim & Hakim, 2010; Hong & Kim, 2002; Umble, Haft & Umble, 2003; Soh, Kien & Yap, 2000; Sumner, 2000; Amid, Moalagh & Ravasan, 2012 and Ke & Wei, 2008
A8	Organizational culture and policies	Xue et al., 2005
A9	Integration Management and Process Integration	Chen, Law & Yang, 2009

Table 5: Attributes of corporate culture related to ERP implementation

The culture attributes listed in Table 5 are abstract and qualitative in nature. To align them with the quantitative nature of the EMRM, quantitatively measurable surrogates have to be found that can be relatively easily assessed by corporation members. A first step has been the formulation of more concrete attributes of corporate culture (CCU). The alignment between original attributes and operationalized attributes was not unique (1-to-1), resulting in a new 10-attribute culture dimension. These ten attributes were subsequently discussed face-to-face with McFarlan and their reasonableness was confirmed. Corporate culture (CCU) is thus measured in terms of users' practices, users' attitudes, company practices in terms of working practices, organizational polices such as information technology policy and data flow practices, the practices for internal and external communication in the organization and also cross-cultural and cross-functional coordination. If the corporate culture is not appropriate, the implementation risk increases. The ten attributes are shown in Table 6.

Code	Attributes of Corporate Culture (CCU)	Reference
CCU1	Company information policy	A7, A8
CCU2	Strength of company shared objectives	A7, A8
CCU3	Permission of the free flow of information	A7, A8
CCU4	Cultural difference in multi-sites	A1, A2
CCU5	Company culture on individualism or collectivism (i.e. process-oriented or result-oriented)	A3
CCU6	Receptivity to new changes and company-wide project	A3
CCU7	Open communication between IS, Users and Consultants (open and collaboration communication)	A3, A5
CCU8	Open mindedness in the company (Users, top management, IS)	A3
CCU9	Readiness for cross-functional cooperation and job (process) design	A6, A9
CCU10	Team readiness for multi-cultural communication and discussion	A1, A2, A5

Table 6: Codes and attributes of risk dimension – Corporate Culture

Combining the four dimensions with their combined 35 attributes into a single measurement model results in an assessment model with 19 marks for PSI, 36 for PST, 36 for TEX, and 50 for CCU, for a total maximum score of 141, as shown in Figure 2.

4 Empirical Evidence for the Added Value of an Extended McFarlan's Risk Model

In order to investigate the added value of the EMRM, we carried out interviews with two sets professional experts, asking them to review the model, and to apply the model to two business cases.

4.1 Interviews with Professional Experts

One main objective for the interviews with the professional experts was to validate and refine dimensions, attributes and weights in the EMRM. To this end, we conducted six interviews. The interviewees engaged IT and subject experts from the user community. All experts were managerial grade or above and had an average working experience with ERP of 12.7 years. Interviewees were invited to add more risk dimensions and attributes, and to rank the dimensions for their importance.

As a result of this exercise, the marks allocated to CCU rose from 50 to 55, PSI marks from 19 to 34, while PST dropped from 36 to 29, and TEX decreased from 36 to 23. Based on the interview results we revised our EMRM as show in Figure 2 marked with refined attributes and weights (marked #). The main difference are the attributes in PST and TEX. PST attribute 10, defined as "general attitude of a local and in-house project manager", replaced PST 9, while for TEX, we deleted TEX6.

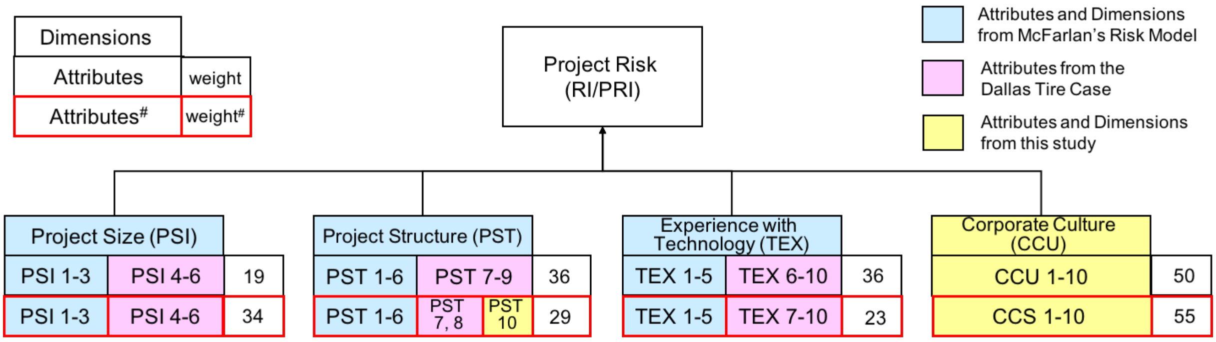

Figure 2: Extended McFarlan Risk Model (EMRM) with refined attributes and weights (marked #)

4.2 Business Cases

For the two business cases, we used multiple sources of evidence such as documents provided by the companies and interviews with ERP professionals from the companies. Both companies are global fashion manufacturers with at least one offshore plant located in China. During a recent 18-month period, the following data collection was performed (T referring to project start date):

a) **Company A:** Documents including project plans, meeting minutes, gap analysis and a third-party analysis report which analysed the ERP project progress in T + 2. Five interviews were conducted with three representatives (project manager, IT expert and key business user). All three participated in the project until it was abandoned. Company A is a failure case.

b) **Company B:** Documents including project plans, meeting minutes and gap analysis in T and T+1. Six interviews were conducted with four representatives (business process owner, team leader and key business user as well as project director from the ERP system and service provider). All four participated in the project until completion. Company B is a success case.

After collecting data, the risk indices of each dimension and the overall project risk index were calculated for companies A and B. Our results show clear differences in the risk indices for the two cases with Company A rated high risk and Company B medium risk (see Table 7). Table 7 reveals the explanatory power of CCU as a dimension. The difference in CCU (Δ = 0.9) was (together with that for PST) highest among all dimensions. In essence, it suggests that companies engaging in an ERP project have little choice over the projects size, as ERP projects are usually large or very large, and relatively little choice concerning technology. Then, the differentiating factors are projects structure, and cultural readiness. Whereas for Company B, the project created a medium size risk on cultural aspects, it created a high risk for Company A, with the same being the case for project structure.

Risk Dimension	**Average RI by dimension**		**Average RI Difference (ΔRI)**
	Company A	Company B	
Project Size (PSI)	2.6	2.0	0.6
Project Structure (PST)	2.0	1.1	0.9
Experience with Technology	2.3	2.1	0.2
Corporate Culture (CCU)	2.4	1.5	0.9
Overall Risk Index	**2.4**	**1.7**	**0.7**

Table 7: Risk index comparison by dimension

Company A's culture was not ready for the information sharing that ERP required. Users passively resisted by not sharing or delaying necessary information. At times, they bypassed the system when they changed business decisions. These practices rendered the system non-functional and delayed full implementation. Company A's lack of readiness also expressed itself in a lack of process orientation (affecting PST). Whereas ERP requires adherence to the process logic of ERP, employees frequently side-stepped the ERP logic and "invented" work-arounds to system processes which undermined proper ERP function implementation. Significant changes in the project team during implementation (induced by absenteeism and resignations) further affected PST negatively. Company B avoided culture and structure challenges through a solid process orientation from the start, and through the extensive use of cross-functional teams to overcome differences between conflicting user interests.

Given the small sample, with only two projects, the data is insufficient for the meaningful computation of significances between A and B. Nevertheless, at a qualitative level, the results pinpoint project differences that project management teams must take into consideration.

5 Conclusion and Limitations

We demonstrated that IS project risk prediction as pioneered by McFarlan can be improved through the formulation of an extended risk model which explicitly includes culture as a dimension, and which augments and calibrates risk attributes. While the extended model retains the 14 attributes of McFarlan's original model, it also extracts 11 attributes from the Dallas Tire Case (Cash, 1980) which informed McFarlan's model, but were not included in it. 10 additional attributes make up the fourth risk dimension, corporate culture (CCU). The resulting extended model offered better explanatory power for the risk assessment of two business cases related to ERP implementation in global manufacturing companies.

For future research, we highly recommend further validation of our EMRM in other culture settings, other IT domains, and with larger samples. Additionally, we recommend for future studies to carefully investigate how the calculation of the overall risk index, based on individual risk dimensions, should be performed. Specifically, following McFarlan, we used an additive model to compute an overall risk index, implying that a high risk level in one dimension can be compensated by a low risk in another dimension. This may not be true. Especially the culture dimension (CCU) may be non-compensatory, meaning that a high culture risk cannot be mitigated by lower risk elsewhere. If a system contradicts corporate culture, its implementation may be fought equally hard, regardless of other factors, and thus it may create an equally large overall risk. Future research should evaluate at least some of the dimensions as non-compensatory, success conditions or "critical success factors".

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