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CRITICAL FAILURE AND SUCCESS FACTORS OF INFORMATION TECHNOLOGY PROJECTS

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1 INTRODUCTION

Information technology (IT) has been one of the most rapidly growing industries for the last few decades. The sphere of IT is both remarkable and exciting as it has always been changing the way we live. Think of this: the author of the present paper, a graduate student in his twenties, witnessed the time when the only means of communication at home was a rotary phone. Rapid technological advancement has enabled almost everybody and anywhere to be connected through the global network of the Internet. Nowadays, it is hardly possible to surprise anyone with a smartphone – a portable device that is capable not only to make calls but also determine the location through GPS, transfer data over the Internet and perform various resource-intensive operations that have previously been possible only on desktop computers. Given what was available on the market fifteen-twenty years ago, this advancement already seems incredible, let alone a massive market of wearables, such as smartwatches, fitness bands and similar devices designed to supplement smartphones with relevant extra features. For example, the author of the dissertation has recently acquired his first smartwatch and literally been stunned by the computational capacity of this tiny device: its 512 megabytes of RAM are on par with the memory volume of the author's first personal computer. Thus, 512 MB as a standard moved out of a bulky PC box into a tiny wrist device, all in just ten years! Further, the same pace of progress can be found in most of industrial sectors including enterprise resource planning (ERP) software, client relationship management (CRM) systems, software-as-a-service (SaaS) solutions and others. The developments in these sectors are routed towards reducing costs and time to market, enhancing reliability and efficiency of operations, enabling richer data insights for decision makers etc. Last but not least, digitalization leads to a deal of public benefits: better informed decisions, availability of a range of innovative and traditional products/services in the Internet, time/cost savings with online bookings and payments and many others. Although the achievements in IT are more than impressive, it is noteworthy that they require enormous investments. For instance, only in 2012 alone, global IT spend increased by 5.4% and amounted to $3.4 trillion (Stoica and Brouse, 2013, 728).

According to the definition provided by Meriam-Webster online dictionary, IT is "the technology involving the development, maintenance, and use of computers and software for the processing and distribution of information." Information system (IS) is defined as the aggregate of individuals, business processes, and IT that operate and produce data and information within an organization (Aier et al., 2011, 77). Thus, the definition of IS technically encompasses the notion of IT. Development of a new technology, product, service or integration of existing solutions are normally performed through projects. Per the definition provided of Caupin et al. (2006), project is "a time

and cost constrained operation to realize a set of defined deliverables (the scope to fulfil the project's objectives) up to quality standards and requirements." Vaidyanathan (2013, 619) defines project as "a unique activity that adds value, has beginning and end dates, and has constraints that include cost, schedule, performance, and customer satisfaction." According to Schwalbe (2015, 4-5), IT projects imply application of software, hardware and network technology to produce a desired result, such as a product or service. Vaidyanathan (2013, 3) refers to information systems projects as "computer-related hardware and software projects", such as "networking, infrastructure, and software design and development projects". Based on these two definitions, it is possible to conclude that although the terms "Information technology" and "Information systems" reflect different phenomena, both IT projects and IS projects relate to the same kind of activities. Thus, the notions of "IT project" and "IS project" in this dissertation are used interchangeably henceforth.

There are multiple methods to initiate, plan, control, manage and close a project. However, most of them fall under one of the two main project management methodologies: traditional and agile. While both traditional and agile methods are comprehensively described, studied and broadly used, there is still an ongoing and worrying tendency: IT projects continue to fail. Hastie and Wojewoda (2015) summarize the data insights from a recent CHAOS report made by the Standish group. The Standish group redefines the traditional view on project success in terms of a triple constraint of budget, time and scope, by determining success as meeting the project goals of schedule, budget, and client satisfaction (Johnson and Crear, 2015). The report covered fifty thousand projects ranging from small incremental changes to complex large-scale developments. In line with the data, over the period of five years (2011 – 2015) the percentage of successful software development projects ranges from 27 to 31 percent with 29 percent in the year 2015. The rest of the projects from the reports are either classified as failed – cancelled or not accepted by end users – or challenged meaning not meeting one of the key outcomes as described above. According to the report released in 2015, large-scale software projects have a much lower success rate comparing to smaller projects ranging from 2 percent for grand projects to 62 percent success rate of small projects. Interestingly, agile projects have a significantly higher success rate amounting to 39 percent in comparison to the 11 percent for traditionally handled projects.

Given the above figures on failed and challenged projects and considering tremendous amounts invested in the field, a topical endeavor would be to find ways to elevate the success rate of IT projects. Although there has been a significant number of publications related to the topic and investigating both success factors and reasons for failure, the statistics shows that projects continue to fail and therefore, there is a strong

need to extend our understanding of critical factors and develop recommendations against failure.

In this regard, the first question this study aims to answer is "What are the critical factors of success and failure in IT projects?" Answering the question would contribute to a better comprehension of what aspects of project work require most attention for a project as a whole to succeed. This knowledge is crucial for organizations making significant investments in IT and striving to gain considerable benefits from these investments. On a practical level, it is also vital to managers immediately involved in IS projects as these insights should guide key strategic and tactical project decisions.

The second research question aims to examine the consistency and alignment between critical success factors (CSFs) and key reasons for failure, or critical failure factors (CFFs). It is formulated as "How do known CSFs and CFFs correlate with each other? In particular, what factors are critical only to success and which ones only to failure? What are the factors critical to both success and failure?" The dissertation's findings might demonstrate that some factors are critical both to success and to failure. Such areas of project work would require a special attention from the management while initiating and executing IT projects. In particular, these areas would have to be analyzed carefully and provided with resources sufficient for satisfactory performance. This would maximize a project's chances for success and minimize the probability of failure. The other two categories that might emerge are factors critical to failure only and critical to success only. As for the former, such factors would seriously increase a project's chances for failure given poor performance in corresponding areas. Yet these factors might not necessarily contribute to success given the performance is satisfying. As for the latter, such factors would significantly elevate a project's chances to succeed in case the results in the respective areas are good. On the other hand, they might not affect the likelihood of project failure in case the results are poor. Management would have to concentrate, first and foremost, on the factors critical both to success and failure as they have a bidirectional influence, then on the factors critical to failure only – to minimize the probability of failure, and finally, on the factors critical to success only – to enhance the chances for project success. Figure 1 below suggests a classification scheme of critical factors and outlines a relationship between the classes of factors.

To summarize, the key questions of the present research are the following ones:

RQ1: What are the critical factors of success and failure in IT projects?

RQ2: How do critical factors correlate with each other? In particular, which factors are only critical to success and which ones only to failure? What are the factors critical both to success and failure?

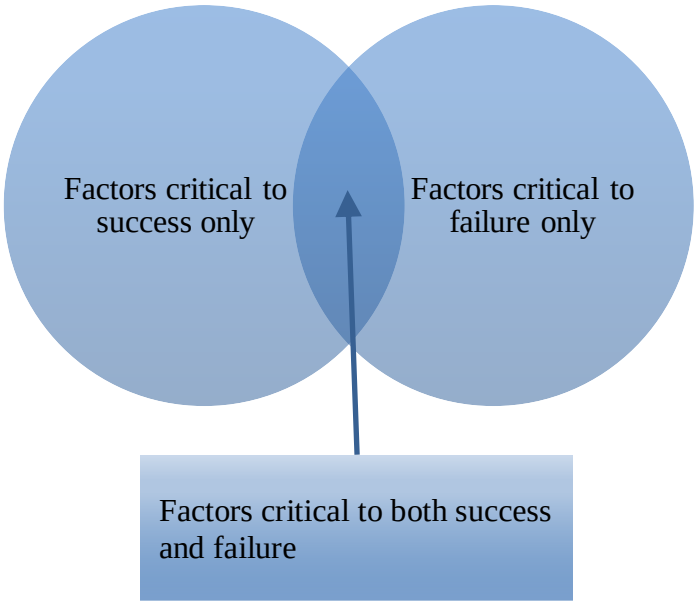

Figure 1 Classification scheme of critical success and failure factors.

The structure of the paper follows the chronology of the performed research. It starts by providing definitions of project, project success and failure, critical success and failure factors, and describing criteria to assess project success/failure. The paper continues by reviewing currently available body of literature on key success and failure factors in IT projects. Thereafter, the author lists identified CSFs and CFFs, describes and justifies research methods and data collection tools. The following sections present the results of the data collection. This is followed by the discussion of the identified factors through the prism of the classification from RQ2 and the development of practical recommendations. The final chapter offers concluding remarks and some directions for future research.

2 LITERATURE REVIEW

2.1 Key notions

2.1.1 IT project success

According to McLeod and MacDonell (2011, 8-9), there is still a lack of agreement in the literature on how to approach the definition of success and failure in IT projects. The terms seem to be ambiguous and difficult to evaluate. The authors point out that both success and failure are multi-facet constructs comprising intertwined technical, business, psychological, behavioral and political aspects. They also notice that project success can be evaluated in terms of both high-quality outcomes of project management (PM) and business benefits from a developed or implemented product.

Following the authors' observation, some researchers have been inclined to consider only PM outcomes as key determinants of overall project success (McLeod and MacDonell, 2011, 9). Similarly, Montequin et al. (2014) recognize that for a project to be considered a success, it should fulfil more than just schedule, budget and scope targets. For instance, it is likewise important to account for customer satisfaction with a delivered product. In their survey of IT project failure, Emam and Koru (2008) also acknowledge that project success goes beyond PM success and in addition to the traditional cost and time criteria, measure project performance based on user satisfaction, quality of the final product, and productiveness of staff. Last but not least, Baccarini (1999) suggests viewing project success as a bi-dimensional variable defined by both project management and product success. In light of the above, in this research projects are considered successful only when both the project management and the product dimensions yield successful outcomes.

DeLone and McLean (2003, 11) define the following six dimensions of IS success: system quality, information quality, service quality, system use, user satisfaction, and net benefits. System quality is determined in terms of how well the system implements all the desired features. Information quality corresponds to the intended characteristics of information output produced by the system. Service quality is related to the level of customer support that the users receive from the supplier of the system. System use is defined as the extent and ways, in which end users utilize the functionality offered by the system. User satisfaction reflects the level of satisfaction of end users with the system. Finally, net benefits correspond to the degree, to which the system facilitates the success of individuals and the organization.

Wixom and Watson (2001, 19-20) distinguish between organizational, project and technical kinds of success in IS implementation. This means that the project team should first obtain a buy-in from the organization to execute the project, then they should complete it within the time and budget constraints surmounting technical difficulties should they emerge in the process.

Markus and Mao (2004, 525-526) differentiate between system development success and system implementation success. The former is related to a high-quality system development process and/or a high-quality result of this process – the developed system. The latter is defined as a successful change management process translated into a high-quality process of preparing target users to accept the system and to use it so that the desired outcomes are achieved. The authors observe that the success in the technical project of building a system is not always followed by the success in the system implementation.

Indeed, a software project can be successfully carried out but once the software is built and ready to be deployed, the following questions can emerge: "Will this software be adopted by users?", "Will it indeed be used?", "If the software is used, will it realize all or at least some of planned benefits?" and so forth. Doherty et al. (2012) further enrich the existing views on IS success by reasoning that IS development success should be evaluated based on how the system realizes meaningful benefits, rather than based on the fact of completing the development in time and on budget. Therefore, the authors argue, organizations should take a proactive stance towards benefits planning and delivery when deciding to invest in a new IT system. Such an approach is facilitated by emphasizing of certain key aspects during IT implementation projects.

Savolainen et al. (2012) analyze how project success is perceived from the supplier's perspective and deliberately remove from consideration the customer's internal projects, continual services, and the customer's viewpoint. In this way, they distinguish the following success criteria: long- and short-term business success for the provider, project success among users (client satisfaction) and project management success.

It is also noteworthy that success is a relative notion because project outcomes are perceived differently by various stakeholder groups like top management, project team, and end users (McLeod and MacDonell, 2011, 9; DeLone and McLean, 2003). Moreover, these perceptions can change over time depending on a range of factors. Therefore, some authors suggest thinking of IS success as a process rather than a single definite outcome (Wilson and Howcroft, 2002).

Upon the whole, it is possible to conclude that currently there is no precise and overarching definition of what project success is and what elements exactly it consists of. The definition seems to be situation specific. Project success can differ in terms of the degree, to which the desired outcomes are achieved, as well as depending on perceptions of stakeholder groups with different and sometimes even opposite views of

the same outcomes. In addition, perceptions of project success can change with time through processes of sense-making and discussions in the organization (McLeod and MacDonell, 2011, 9).

Given numerous different explanations of project success found in the literature, the author of the present dissertation does not attempt to give a precise definition to this phenomenon. Thus, the discussed definitions will be neither reinterpreted nor unified in the subsequent literature review on critical success and failure factors.

2.1.2 IT project failure

There is also a lack of consensus on how to define IT project failure. The lack of clear definition is supported by Savolainen et al. (2012): in their systematic literature review on software development project success and failure from the provider's perspective, the authors were unable to find any definition of project failure.

According to Robertson and Williams (2006), a project is recognized as a failure if it does not meet its budget, schedule, or scope targets. Normally, one more criterion is taken into account – the organizational benefits resulting from the project. Al-Ahmad et al. (2009), define IT project failure as any project aiming to support the organization's operations with the capabilities of IT that:

- Fails to deliver the desired outcomes within the planned budget or schedule.
- Fails to deliver the agreed-upon functionality.
- Fails to fulfil the stakeholders' needs.
- Is not accepted and utilized by end users after the introduction.

In addition, the authors notice that to reduce the ambiguity of notions of success and failure it might be helpful to consider them as subjective statements. Lehtinen et al. (2014, 624) view a software project failure as "a recognizable failure to succeed in the cost, schedule, scope, or quality goals of the project". The word "recognizable" in this definition implies that a project failure is considered significant enough to be precluded in future projects.

Devos et al. (2008) provide the following categorization of IS project failure:

- Expectation IS failures refer to the incapacity of an IS to meet the expectations of the parties engaged in the IS project. Expectation failures are further divided into:
    - Correspondence failures that happen when there is insufficient correspondence between IS design goals and the results of the evaluation of whether the developed IS has reached these goals.
    - Process failures that take place in case of unsatisfactory project management performance, which means that the project fails to develop a

working IS or to produce it within the specified time, cost and scope requirements.

- Interaction failures that manifest themselves in the lack of correspondence between initially identified IS requirements and final user adoption leading to the IS not being used by end users.

- Termination IS failures refer to situations when key stakeholders displeased with the project management process or IS usage cancel the project. Emam and Koru (2008) view a project as cancelled if it had not provided any workable functionality by its first release.
- Outsourced IS failures refer to IS failures that occur in the context of outsourced IS development.

Kerzner (2009, 366-369) defines project failure simply as unmet expectations. The author develops the notion of failure by distinguishing between actual failure, planning failure, and perceived failure. Actual failure happens due to a mismatch between what was intended and what was carried out, whereas planning failure takes place due to an incompatibility between what was planned and what was in reality attainable. Planning failure expresses itself in either under-planning – the planned outcome is less than in fact achievable – or in over-planning – the planned outcome is more than actually achievable. In case of over-planning, the project has "unmeetable" expectations from the outset, which automatically means eventually unmet expectations and project failure. Finally, perceived failure is defined as the net total of actual failure and planning failure.

These definitions give the ground to assume that the notions of project failure and success go hand by hand: when one criterion of project success is not fulfilled, then the project can be considered a failure. Yet given the project meets all the key success criteria of project management process – it is completed in time, within budget, all requested functionality is delivered and the product's quality is sufficiently high – if the product is not accepted by its intended audience, then this project is a failure. Further, even if the product gets adopted and the users are satisfied with it, if it does not entail substantial long-term business benefits, then the product, and thereby the project have failed. Hence, similarly to success, failure is a subjective notion and the same project can be perceived both as a success and as a failure, let alone the perceptions can differ per stakeholder group and change with time (McLeod and MacDonell, 2011, 9-10).

2.1.3 Critical success factors and key reasons for failure in IT projects

Most of the reviewed literature cites the canonical definition suggested by Rockart (1979, 85): critical success factors (CSFs) are "the limited number of areas in which

results, if they are satisfactory, will ensure successful competitive performance for the organization." To put it in another way, CSFs are those crucial aspects where everything should go as planned for the organization to thrive.

Pinto and Slevin (1987) relate to CSFs as aspects capable to crucially increase chances of [successful] project execution. Lim and Mohamed (1999) describe CSFs as conditions, circumstances or effects facilitating successful results of project implementation. In line with Sadeh et al. (2000), CSFs are managerial factors that guide successful execution of projects when they exist in the project settings. According to Ashja et al. (2015), CSFs can be defined as key aspects that organizations should concentrate on to ensure successful accomplishment of IS projects.

As for reasons for failure, Kappelman et al. (2007) define a reason for failure as a realized project risk that contributed to the eventual failure of a given project. Having the definitions of CSFs from above makes it possible to reflect them into corresponding definitions of CFFs. For example, rephrasing the citation of Rockart (1979), CFFs can be defined as the limited number of areas, in which results, if they are unsatisfactory, will ensure poor competitive performance of the organization. Further, rephrasing Pinto and Slevin (1987), CFFs can be seen as aspects capable to crucially increase chances of project failure. Following Lim and Mohamed (1999), CFFs can be described as conditions, circumstances or effects contributing to poor results of project implementation. Finally, based on the definition of CSFs of Sadeh et al. (2000), CFFs can be defined as factors leading project execution to failure when they exist in the project settings.

Last but not least, it is logical to assume that since perceptions of both project success and failure usually vary per stakeholder group (McLeod and MacDonell, 2011, 9-10), perceptions of success and failure factors should also differ depending on a stakeholder. It is worthwhile to mention that the differences in attribution of project success and failure (a so-called "attribution error") inevitably affect the stakeholders' perceptions of critical success and failure factors (Standing et al., 2006). In a nutshell, the attribution error manifests itself through biased perceptions of individuals: they view themselves as key contributors to success whereas they see external circumstances as main contributors to failure. Considering the definitions of CSFs and CFFs given above, it makes sense to outline relationships between CSFs, CFFs, project success and failure (Figure 2). The arrows in the figure depict the relationship "contributes to" or "increases chance of". It is important to notice that as it was mentioned in Introduction poor performance in critical-success-factor areas does not necessarily contribute to project failure as well as satisfactory performance in critical-failure-factor areas might not facilitate project success. Therefore, on Figure 2, the corresponding arrows are distinguished through dotted background and a question mark.

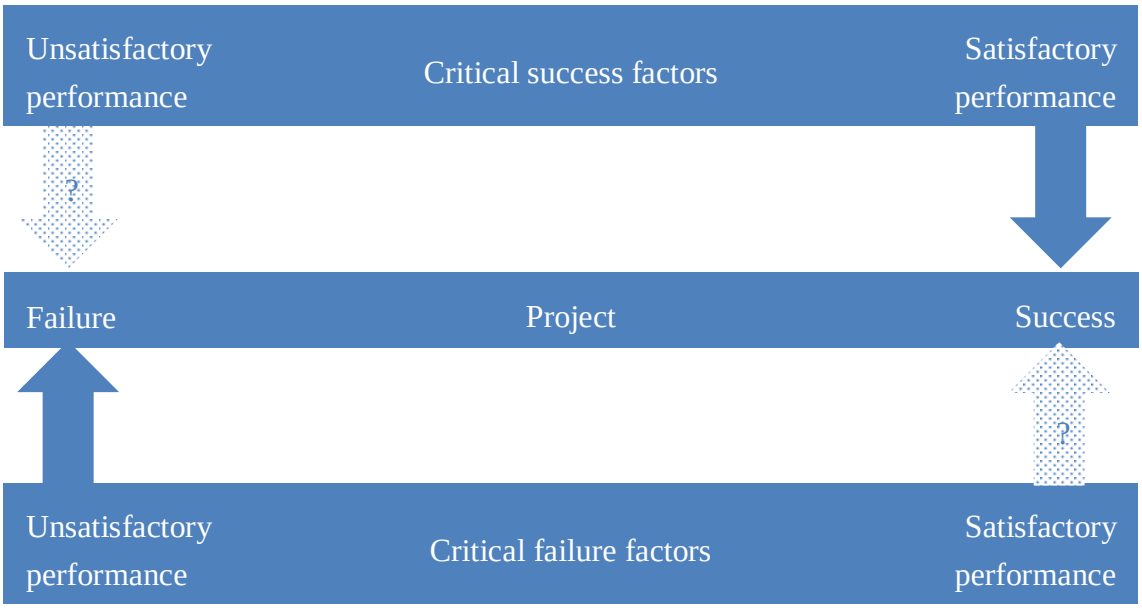

Figure 2 Relationships between project success, failure, critical success and failure factors

2.2 Critical success factors

Rosacker and Olson (2008) examine the applicability of critical success factors, which have been studied mainly in relation to IT projects executed in private enterprises, in the context of the public-sector organizations. Their findings demonstrate that CSFs from the private sector also contribute to the success of the public-sector projects. However, the degree of influence and thus, the relative importance of each of the factors reported by private sector projects research is different for projects in public sector organizations. As a result, the authors identified the following CSFs (in the order of decreasing impact on IT project success):

- A project mission relates to the clarity of project goals.
- Support from senior management ensures that required resources, such as financial and human, are allocated to the project throughout its lifespan.
- A project plan and schedule refer to a detailed declaration of the activities required for project execution.
- Consultations with the customer refer to the active communication and interaction with the client and other key stakeholders on project matters.
- Personnel relates to hiring and educating team members possessing required skills.
- Technical tasks refer to the presence of necessary technology and corresponding competence.

- Adoption by the customer refers to the act of acceptance of project outcomes by end users.
- Monitoring and providing feedback secures timely provision of essential project information and data to all project personnel.
- Communication refers to timely provision of essential project information and data to key project stakeholders.
- Finally, trouble-shooting relates to the capability to handle unforeseen problems and variations in schedule.

Remus (2007) examines CSFs related to enterprise portals (EP) implementation projects. The author further compares the resultant set of factors ranked in order of importance with the list of factors from a similar study of CSFs of Enterprise Resource Planning (ERP) system implementations. These two types of projects carry different characteristics due to the differences in organizational purpose and technical aspects of resultant information systems – EP and ERP. Thus, the top critical factors in these two kinds of projects differ likewise. The combined list of identified CSFs for EP and ERP is represented below:

- Adoption by end users (EP).
- Careful choice of a suitable IS solution.
- Support from senior management.
- Careful analysis of requirements (EP).
- Well-oiled project management process.
- Strong internal and external project communication.
- Deployment of application and business processes (EP).
- Making prototypes (EP).
- Proper solution design (EP).
- Proper management of associated organizational changes.
- Expertise and proficiency of project team.
- Training and education of end users.
- Selection of proper architecture.
- Ensuring dedicated project resources.
- Reengineering of existing business processes.
- Establishing clear and precise project mission.
- Developing an EP implementation roadmap.
- Crafting EP strategy.
- Monitoring and control of project execution.
- Ensuring project structure is flexible (EP).
- Corporate culture (EP).
- Instructing end users about new business processes (ERP).
- Project cooperation between involved organizational functions (ERP).

- Stakeholders' expectations management (ERP).
- Presence of the project's champion (ERP).
- Assuring strong support from the supplier (ERP).
- Careful analysis and migration of existing data (ERP).
- Establishing project steering committee (ERP).
- Ensuring minimal customization of out-of-the-box system (ERP).
- Partnership with the supplier (ERP).
- Utilization of the suppliers' tools (ERP).

Doherty et al. (2012) explore the effects of CSFs reported in the literature on successful implementation of benefits that should arise from a developed IS. According to the definitions of project success cited above, IS project success is determined by a variety of criteria including both project management success and product success. While the former is a requirement for any successful project in a methodological sense, the latter is crucial to the organization to be able to reap business benefits and justify the investments poured into the project. Thus, the product success implies successful benefits realization. The authors consider CSFs through the prism of benefits realization management, which is defined as "the process of organizing and managing, such that the potential benefits arising from the use of IT are actually realized" (Ward and Elvin, 1999). In their research, Doherty et al. (2012) demonstrate that existing CSFs, which have been mainly investigated through the prism of software project delivery, can be augmented to make them more oriented on benefits realization. This can be accomplished by shifting the focus:

- From clarifying the project mission to thorough planning of benefits.
- From well-oiled project management to the change and reorganization management.
- From competent and balanced project teams to coherent project governance framework.
- From support from top management to dynamic business leadership.
- From user involvement to stakeholders-enabled realization of benefits.
- From thorough testing of software to continuous revision of benefits.

The main message coming from the authors is that IT projects would be significantly more successful in terms of tangible business benefits, if the project endeavor was accentuated more on the related technology-enabled change than on purely software delivery.

Sudhakar (2012) investigates critical success factors in software development projects. Based on a thorough literature review, the author ranks individual factors based on the number of citations and identifies the following top thirty-five CSFs grouped into seven categories:

- Communicational factors:

  - In-project communication.
  - Leadership.
  - Relationship between end users and IT personnel.
  - Decrease of uncertainty.
  - Upsurge of stability.
- Technical factors:
  - Technical tasks.
  - Technical crisis management.
  - Technical ambiguity.
  - Issues of technical implementation.
  - Deployment of the system.
- Organizational factors:
  - Backing by senior management.
  - Stakeholders' expectations management.
  - Workplace politics.
  - Monetary support.
  - Organizational influence.
- Environmental factors:
  - User involvement.
  - Customer participation.
  - Partnership with supplier.
  - Effects of outer environment.
  - Adoption by client.
- Product related factors:
  - Correctness of output information.
  - Trustworthiness of output information.
  - Promptness of output information.
  - Control of quality.
  - Systems and processes documentation.
- Team related factors:
  - Team capability and expertise.
  - Efficient in-team work.
  - Selection of appropriate project personnel.
  - Coordination of project personnel effort.
  - Orientation on task accomplishment.
- Project management related factors:
  - Creating a robust and extensive project plan.
  - Efficient techniques for project monitoring and control.
  - Careful project scheduling.

  - Expertise and skills of project manager.
  - Clear and comprehensive project mission.

Sudhakar (2013) examines CSFs in offshore software development projects. Based on a thorough literature review, the author identifies seventy-five success factors and classifies them into 10 categories. Further, the author distinguishes the top two factors in each of the category thereby creating a list of 20 critical success factors:

- Factors related to client's and supplier's cultures:
  - Mutual cultural comprehension.
  - Management of differences in cultures of the supplier and the customer.
- Language related factors:
  - The ability to effectively overcome barriers in spoken languages.
  - Language proficiency.
- Time-zone related factors:
  - Management of time-zone differences.
  - Multiplicity of time zones.
- Organization related factors:
  - Maintaining trust.
  - Maintaining client-vendor relationship.
- Environment related factors:
  - National legislation.
  - National ICT infrastructure.
- Communication related factors:
  - Ensuring robust communication.
  - Deploying efficient and suitable communication tools.
- Factors related to technology transition:
  - Technical skills of offshore employees.
  - Ensuring security of data and its non-disclosure.
- Factors related to knowledge transition:
  - Effective transfer of knowledge from the client to the provider.
  - Business knowledge.
- Project management process related factors:
  - Creating a careful project plan and well-oiled project management.
  - Sharing of project risk between the client and the supplier and risk management.
- Project team related factors:
  - Team knowledge and skills.
  - Management of associated organizational changes.

Ahimbisibwe et al. (2015) perform a thorough review of existing literature on critical success factors in software development projects and identify twenty-eight unique CSFs classified into the four groups as follows:

- Organizational factors:
  - Backing by senior management.
  - Corporate culture.
  - Level of project planning.
  - Establishing monitoring procedures.
  - Leadership.
  - Proper management of associated organizational changes.
  - Establishing clear and precise project vision and mission.
- Team related factors:
  - Robust in-team communication.
  - Commitment of project personnel.
  - Competency of project personnel including expertise in project management and technical tasks.
  - Empowerment of project personnel.
  - Insufficient development competency of project team.
  - Project personnel's experience with the software development methodology.
  - Project team's structure.
- Customer related factors:
  - User/customer involvement.
  - End user support.
  - Training and education of the customer.
  - Customer experience in IT.
  - Insufficient end user experience with IT.
- Project related factors:
  - Technical sophistication.
  - Suitable development methodology.
  - Technological ambiguity.
  - Size of project.
  - Extent of urgency.
  - Changes in requirements.
  - Criticalness of project.

Further, the authors develop a contingency fit model linking CSFs, project characteristics, project success criteria and project management methodologies (traditional or agile). In this model, the project related factors are viewed as moderating variables affecting the influence of independent variables of organizational, team and

customer factors on the dependent variable of project success. Finally, the authors claim that each project is unique and that selection of an appropriate methodology, whether it is traditional plan-based or agile, should be based on a thorough examination of the identified twenty-eight CSFs building up the project profile.

Ashja et al. (2015) investigate CSFs of large information systems (LIS) implementation projects. LIS is defined as an integrated software package facilitating processing of one or more major facets of information flows of the organization. Based on an extensive literature review and a survey, the authors identify the following factors listed below in the order of their relative importance:

- Support from senior management.
- Careful choice of a suitable LIS solution.
- Well-oiled project management process.
- Training.
- A comprehensible and precise project mission.
- Gaining support from the supplier.
- Clear corporate vision and mission.
- Corporate culture.
- Management of associated organizational changes.
- Efficient communication.
- Tailoring business structures and processes to LIS not the other way around.
- Involving an outside consultant into the project.
- Reengineering of existing business processes.
- Presence of the project's champion.
- Trustful relationships between project stakeholders.
- Suitable legacy business and IT systems and structures (in terms of their effect on the amount of IT and organizational effort required for successful LIS implementation).

Günsel and Açikgöz (2013) study how emotional intelligence and flexibility of software development teams impact the outcomes of software projects. The authors find that team autonomy, team diversity and emotional recognition are positively associated with software project success. Team autonomy refers to the degree, to which the team members have freedom to make project-related decisions and to perform tasks as they deem suitable without being influenced by senior management from outside of the project. Team diversity is the structure of the team in terms of the competencies and functional expertise of its members. Finally, emotional recognition is defined as an ability of team members to recognize both personal emotions and emotions of their peers. Each of the three variables affects project success as follows:

- Team autonomy correlates with commercial success of a software product, the time to market, and the functionality of a developed software.

- Team diversity is positively related to the time to market and the functionality of a developed software.
- Emotional recognition positively influences the time to market and the functionality of a software product.

Nicholas and Hidding (2010) investigate management principles associated with IT project management success. Through one-year long collaboration with a panel of experts in IT project management, the authors build a list of thirteen management principles under an umbrella term VDCM – Value-Driven Change Management. The overarching motivation behind the principles can be expressed as "Firms invest in IT to create value, not software." Further, the authors validated these principles together with the principles listed in the PMBOK (Project Management Body of Knowledge) by conducting structured interviews with project managers who handled both successful and failed projects. As a result, they compiled a list of the following key principles associated with project success:

- From PMBOK:
  - Managing project scope.
  - Managing project plan and required resources.
  - Commencing a project with a clear business case and a project charter.
  - Managing project risks.
  - Maintaining project sponsorship from top management.
- From VDCM:
  - Concentrating on achieving objectives of the project's business case.
  - Reserving a timeslot for reflection and lessons learned.
  - Creating and assessing final product architecture alternatives and the design of associated business processes in the early phase of the project.
  - Specifying the architecture of the final product by its initial release.
  - Including the final product architecture in the plan of the project.

Aier et al. (2011) explore critical success factors in service-oriented information systems projects. According to the authors, service orientation is a broad notion applicable to domains from value chain to software development. In the article, the concept is viewed as a design approach to engineering of information systems. The goal of service orientation is to ensure that information systems are flexible so that they facilitate permanent and efficient realignment between business and technology in response to changing business needs and emerging technological innovations (Aier et al. 2011, 77).

The authors distinguish between the following CSFs:

- Integration strategy: service orientation should be a part of a strategic organizational effort.

- Momentum, resources and managerial support: integration of service orientation should gain necessary momentum, should be supplied with required resources and supported by top management.
- Instilling rigorous corporate governance of service orientation directed towards service reuse and decrease of costs.
- Organizational culture supporting the adoption of service orientation – an IS design paradigm drastically different from traditional approaches.
- Efficient communication of service orientation benefits to all stakeholders including supporters and opponents.
- Adherence to service orientation design guidelines including loose coupling of services, detachment from technical realization and business/IT alignment.
- Thoughtful selection of pilot service-oriented IS projects as prerequisites to gain appreciation and support from stakeholders doubting about the new paradigm.
- Clarity and visibility of the most important design artefacts, such as IT applications, business processes, information artefacts and services.

Remus and Wiener (2009) investigate critical success factors of software development in offshore settings. The authors describe a model of CSFs in offshore software development (OSD) comprising the following four categories:

- Internal suitability factors related to the readiness of the client to engage in offshore projects.
- Internal managerial factors pertaining to project planning by the customer.
- External suitability factors concerning careful selection of an offshore supplier.
- External managerial factors related to the execution of offshore software development projects.

Further, Remus and Wiener (2009) conduct a review of the state-of-the-art literature on CSFs in OSD projects that lead them to identifying twenty-nine success factors. Subsequently, they analyze the relevance of these factors with a help of mean analysis based on Likert scale. As a result, they obtain the following list of top seven CSFs (with mean greater than 4.5):

- Setting clear project objectives.
- Ongoing control over project outcomes.
- Assuring uninterrupted communication.
- High level of competence of offshore team members.
- Sufficient language skills of offshore team members.
- Formation of a project team suitable to project needs.
- Producing a comprehensive specification of the project.

According to the analysis of the results, Remus and Wiener (2009) discover that external and internal managerial factors have a significantly higher importance (4.35

and 4.10 respectively) than external and internal suitability factors (3.87 and 3.73). The authors also analyze the importance of the identified CSFs depending on such dimensions as company role (supplier, client, consultancy), size, geographical location and others. An interesting finding is that suppliers and consulting organizations tend to rate CSFs substantially higher than customer organizations. Finally, an important remark from the authors is that not all the identified 29 factors are critical at any given moment and therefore, they should be considered as potentially critical factors that actualize their criticality depending on a context.

Chauhan et al. (2012) conduct a qualitative study with the purpose to identify key success factors of offshore ERP implementation projects from the perspective of the supplier and the customer. Consequently, they compile a list of the following CSFs categorized per party:

- Provider-specific CSFs:
    - Offshoring partnership that is an umbrella term encompassing several sub-factors ensuring efficient collaboration between the supplier and the customer:
        - Cooperating with clients from the same geographical region, alignment of technological specialization with the client's technological needs, business domain expertise, financial stability, contractual arrangements tailored to offshoring needs, a solid pool of human resources, firm immigration capabilities (onsite scalability).
    - Enabling infrastructure comprising stable connectivity, database backups, and project management, communication and other technical tools.
- Customer-specific CSFs:
    - Clear project goals.
    - Support from top management.
    - Management of associated organizational changes.
- CSFs related to both the supplier and the customer:
    - Well-oiled project management process.
    - Assembling a project team fitting project needs.
    - Efficient management of human resource issues, for example, mutual cultural understanding and lack of trust between remote teams.
    - Establishing robust communication between remote teams.
    - Setting thoughtful onsite offshore norms in terms of appropriate distribution of project tasks and the provider's personnel between onsite and offsite.

Bhoola (2015) investigates success factors of software project management in India. The author classifies success factors into the following four groups: project related, environment related, personnel related factors, and corporate culture factors (a so-called PHRENTO framework based on the first letters of each of the groups). Further, the author conducts a survey of 302 IT project managers in India with a purpose to estimate the influence of individual factors within these categories. As a result, Bhoola statistically validates that the following eight factors indeed contribute to IT project success:

- Project related:
  - Thorough project planning.
  - Well-oiled project management process.
  - Fulfilling customers' expectations by meeting project deadlines.
- Personnel related:
  - Strong leadership and team management.
  - Flexible policies in personnel management.
- Corporate culture related:
  - Deployment of cutting-edge technology.
  - Appealing bonus and reward system.
  - Professional work settings with clearly defined roles and responsibilities.

Interestingly, in this research, environmental factors, such as technology advancements, political, economic and social settings, subcontractors' performance and competition activities, were not found to be statistically significant to overall software projects success.

Biehl (2007) uses both qualitative and quantitative methods to recognize factors conducive to the success of global ISs (GIS). GISs are defined as IS supporting multinationals in managing their value chains, communicating with partners and managers, and supporting well-grounded managerial decisions. The author distinguishes between the following success factors:

- Support from senior management:
  - Maintaining a sense of urgency around the project.
  - Comprehension by and a buy-in from senior management.
  - Ensuring than an embarked project is disruptive to the organization.
- Securing the engagement of a sufficient number of employees.
- Early involvement of end users.
- Ensuring participation of affected organizational functions
  - Forming cross-functional teams.
  - Establishing robust cross-functional communication.
- Careful project planning.
- Close examination of key business processes.

- Assigning suitable personnel and monetary resources.

Rai et al. (2009) examine the role that social embeddedness and differences in interpersonal and corporate culture play in the success of offshore IT projects. The perspective of social embeddedness implies that the structure of an exchange mechanism fixed between the client and the provider substantially impacts the economic outcome of the exchange. More specifically, embedded relationships bring more economic value comparing to transaction-based arm-length exchanges. In its turn, the cultural differences perspective considers the effects on project success, which are brought about by differences in the client's and the supplier's work-place culture as well as by differences in national cultures between the client representative on a project and the offshore team's project leader. The authors hypothesize that these two groups of relational factors are critical success factors along with project characteristics and agency factors that have already been acknowledged in the literature. The results of a study of 155 offshore IT projects handled by 22 project managers support the relationship between relational factors and the two measures of project success – project budget overspend and customer satisfaction. The authors compile the following list of relational factors contributing to successful accomplishment of offshore projects:

- Ensuring the presence of a client representative in the project team.
- Facilitating information and knowledge exchange by adopting customer visits to the supplier's premises.
- Trust-based governance in client-supplier cooperation.
- Ensuring that partnering organizations exhibit shared workplace norms.
- Safeguarding shared or similar cultural norms of the customer representative and the supplier project leader in terms of such dimensions as uncertainty avoidance, individualism or collectivism, long- or short-term orientation, and masculinity or femininity.

In line with Robertson and Williams (2006), one of key success factors is maintaining lessons learned throughout projects. The authors elaborate by providing the following remarks:

- It is crucial for managers to learn the influence of their decisions on a project.
- Learning sessions should take place regularly and after considerable events.
- Straightforward lessons-learned activities are suitable in case of simple projects but are not recommended for complex projects as they might result in lessons that are difficult to follow.

Petter, Delone and Mclean (2013), where Delone and Mclean are famous for their multidimensional IS success model comprising the dimensions of system quality, information quality, use, user satisfaction, individual impact, and organizational impact, proceed with the research in the IS success field with the identification of antecedents of IS project success, or in other words, critical success factors. Based on a literature

review of six hundred articles devoted to IS success, the authors integrate the findings of 140 studies eventuating in identifying 15 CSF that have been systematically associated with either IS success overall or a specific dimension of IS success. They structure these CSFs in the four categories as described below:

- Task:
  - Task-IS compatibility.
  - The difficulty of the task for the user.
- User:
  - The user's attitudes towards technology in general.
  - Enjoyment an individual receives while using technology.
  - The user's self-efficacy in the usage of technology overall.
  - Trust of the user to IS in terms of the technology being utilized, first and foremost, for the user's advantage.
  - Fulfilment of user expectations about the IS with the actual IS.
  - Previous experience of the user with technology.
  - The user's position in the organization (for example, blue collar, manager, top executive and so on).
- Project:
  - User involvement in the process of the IS development and deployment.
  - The nature, or proximity, of the relationship between the users and developers.
  - Expert knowledge in the domain of an implemented IS.
- Organizational:
  - Senior management support of an IS.
  - Corporate policies and processes aimed at achieving business/IT alignment or observing the usage and deployment of IS in the organization.
  - Managerially driven extrinsic motivation of end users in the form of monetary incentives, increased recognition or enhanced reputation that promotes more active usage of an IS.
  - Organizational IT capability in terms of the organization's knowledge about the application and utilization of technology.
  - IT Infrastructure reflecting the level of sophistication of the IT infrastructure organization-wide.

Following the literature review above, the reviewed CSFs have been summarized in Table 1 presented below. It is noteworthy that in case there are different interpretations and definitions of the same success factor, they are linked to a corresponding umbrella factor. Similarly, those factors that are closely related to each other are also grouped under an aggregated umbrella factor. For example, the "Top management support" CSF

depending on a source is defined as “Top management support”, “Required resources and authority are present”, “Top management commitment to ensure provision of resources, authority and influence”, “Maintaining project sponsorship” and so on. Each of the factors is supplemented by a number of citations where it is explicitly or implicitly mentioned. Finally, the factors identified and described above are grouped into nine high-level factors: project management, project team, business analysis, technical implementation, organization, stakeholder, supplier and product.

Table 1 Literature review on critical success factors in IS projects

Top-level critical factor	Critical factor	References
1. Project management.	1.1. Project planning processes.	Sudhakar (2012), Sudhakar (2013), Bhoola (2015), Rosacker and Olson (2008), Ahimbisibwe et al. (2015), Biehl (2007), Ashja et al. (2015), Bhoola (2015), Nicholas and Hidding (2010), Ashja et al. (2015), Remus (2007), Chauhan et al. (2012)
	1.2. Clear project goals and objectives.	Rosacker and Olson (2008), Remus (2007), Ahimbisibwe et al. (2015), Ashja et al. (2015), Remus and Wiener (2009), Chauhan et al. (2012), Sudhakar (2012), Doherty et al. (2012), Nicholas and Hidding (2010)
	1.3. Project monitoring and control.	Rosacker and Olson (2008), Remus (2007), Sudhakar (2012), Ahimbisibwe et al. (2015), Remus and Wiener (2009), Sudhakar (2013), Bhoola (2015), Nicholas and Hidding (2010)
	1.4. Project cooperation (internal and external).	Remus (2007), Biehl (2007), Sudhakar (2012), Sudhakar (2013), Ashja et al. (2015), Chauhan et al. (2012), Rai et al. (2009)
	1.5. Project leadership.	Sudhakar (2012), Sudhakar (2013), Remus (2007), Bhoola (2015), Ahimbisibwe et al. (2015)
	1.6. Risk management.	Nicholas and Hidding (2010), Sudhakar (2013)
	1.7. Maintaining lessons learned.	Nicholas and Hidding (2010), Robertson and Williams (2006)
2. Project team.	2.1. Project team's expertise, skills, capabilities and experience (including business and technical).	Rosacker and Olson (2008), Remus (2007), Sudhakar (2012), Ahimbisibwe et al. (2015), Sudhakar (2013), Remus and Wiener (2009), Ashja et al. (2015), Bhoola (2015), Günsel and Açikgöz (2013), Chauhan et al. (2012)
	2.2. Project team composition.	Sudhakar (2012), Ahimbisibwe et al. (2015), Günsel and Açikgöz (2013), Remus and Wiener (2009), Chauhan et al. (2012), Biehl (2007), Rai et al. (2009), Ashja et al. (2015), Biehl (2007)
	2.3. Project team empowerment and autonomy.	Ahimbisibwe et al. (2015), Günsel and Açikgöz (2013), Bhoola (2015)
	2.4. Teamwork.	Sudhakar (2012), Ahimbisibwe et al. (2015), Remus (2007)

3. Business analysis.	3.1. Project requirements preparation.	Ahimbisibwe et al. (2015), Remus (2007), Biehl (2007), Remus and Wiener (2009)
	3.2. Adaptation of business processes to implemented IS.	Remus (2007), Ashja et al. (2015), Nicholas and Hidding (2010)
	3.3. Expert business understanding and business acumen.	Petter, Delone and Mclean (2013), Ahimbisibwe et al. (2015)
	3.4. Careful choice of a suitable IS solution.	Remus (2007), Ashja et al. (2015)
4. Technical implementation.	4.1. Software development or implementation methodology.	Ahimbisibwe et al. (2015), Remus (2007)
	4.2. Technological ambiguity and technical complexity.	Sudhakar (2012), Ahimbisibwe et al. (2015)
	4.3. IS solution design.	Remus (2007), Nicholas and Hidding (2010)
	4.4. Flawless IS solution configuration.	Sudhakar (2012)
5. Communication	5.1. Project communication processes.	Rosacker and Olson (2008), Remus (2007) Sudhakar (2012), Ashja et al. (2015), Sudhakar (2013), Aier et al. (2011), Chauhan et al. (2012), Bhoola (2015), Petter, Delone and Mclean (2013), Remus and Wiener (2009), Ahimbisibwe et al. (2015), Rai et al. (2009)
	5.2. Communication tools and infrastructure.	Sudhakar (2013), Chauhan et al. (2012)
	5.3. A communication strategy.	Chauhan et al. (2012)
6. Organization.	6.1. Top management support.	Rosacker and Olson (2008), Ahimbisibwe et al. (2015), Nicholas and Hidding (2010), Biehl (2007), Sudhakar (2012), Aier et al. (2011), Remus (2007), Petter, Delone and Mclean (2013), Ashja et al. (2015), Chauhan et al. (2012), Doherty et al. (2012)
	6.2. Enabling IT infrastructure.	Rosacker and Olson (2008), Sudhakar (2012), Petter, Delone and Mclean (2013), Chauhan et al. (2012), Remus (2007), Ashja et al. (2015), Bhoola (2015)
	6.4. Corporate policies, processes and structures aiming at achieving business/IT alignment.	Petter, Delone and Mclean (2013), Remus (2007), Doherty et al. (2012), Ashja et al. (2015)
	6.5. Organizational IT capability in terms of	Petter, Delone and Mclean (2013), Rosacker and Olson (2008), Sudhakar

	knowledge about the application and utilization of technology.	(2012)
	6.6. Alignment of project management methodology with characteristics of corporate culture.	Ahimbisibwe et al. (2015)
7. Stakeholder.	7.1. Organizational change management.	Remus (2007), Ahimbisibwe et al. (2015), Ashja et al. (2015), Sudhakar (2013), Chauhan et al. (2012), Doherty et al. (2012), Petter, Delone and Mclean (2013), Aier et al. (2011)
	7.2. User adoption.	Rosacker and Olson (2008), Remus (2007), Sudhakar (2012), Petter, Delone and Mclean (2013), Ahimbisibwe et al. (2015)
	7.3. User involvement.	Sudhakar (2012), Ahimbisibwe et al. (2015), Biehl (2007), Petter, Delone and Mclean (2013), Doherty et al. (2012)
8. Supplier.	8.1. Trust between customer and supplier.	Ashja et al. (2015), Sudhakar (2013), Chauhan et al. (2012), Rai et al. (2009)
	8.2. Cultural differences between customer and supplier.	Sudhakar (2013), Chauhan et al. (2012), Rai et al. (2009)
	8.3. Ability to work with remote team.	Sudhakar (2013), Chauhan et al. (2012)
	8.4. Supplier selection procedure.	Sudhakar (2013), Chauhan et al. (2012)
	8.5. Supplier's financial stability.	Chauhan et al. (2012)
9. Product.	9.1. Quality of output information.	Sudhakar (2012)
	9.2. Promptness of output information.	Sudhakar (2012)
	9.3. Systems and processes documentation.	Sudhakar (2012)
	9.4. The product's fit for purpose.	Petter, Delone and Mclean (2013)
	9.5. Difficulty of the automated task for the user.	Petter, Delone and Mclean (2013)

2.3 Reasons for failure

De Bakker et al. (2010) point out that although there is a significant body of research available on IT project failure, there is a little evidence that this knowledge is applied in IT project risk management. The authors pick out poor project requirements as one of the main reasons for failure.

Bartis and Mitev (2008) examine an interesting case of an information system that was perceived as success by the project committee and top management whereas it was never used as intended and thus, the project goals were not fulfilled. The authors use this case study to demonstrate how IS success or failure is socially constructed. They distinguish the following set of reasons for failure of a new IS:

- Lack of fit between the IS and corporate culture.
- Insufficient managerial support for a new business process enabled by the IS.
- No practices of learning from failure due to a culture of blame adopted in the organization.
- Withholding from conducting of a pilot project.
- Corporate power and politics leading to the recognition as a success of a malfunctioning system not fulfilling its objectives.

Nelson (2007) performs a meta-retrospective study based on nighty-nine retrospectives of IT projects from 74 different organizations over the seven years preceding the year of publication. Project retrospectives, also known as project post-mortems or post-implementation reviews, are crucial to organizations because they allow to learn from the past with the aim to improve project processes and decision making so that similar problems are prevented in future. Nelson (2007) reuses a classification suggested by Steve McConnell in his book "Rapid Development" (1996) that comprises thirty failure factors under four categories – Process, People, Product and Technology. Nelson (2007) compiles a list of twenty-one most common failure factor that happened in more than ten percent of the projects under investigation:

- Process:
    - Faulty estimation and/or scheduling.
    - Inadequate risk management.
    - Lack of planning.
    - Insufficient effort in quality assurance.
    - Poor project requirements.
    - Subcontractor failure.
    - Lack of managerial control.
    - Time wasted on confirmation and budgeting processes prior to a project start.
    - Code-like-hell programming.
- People:
    - Inefficient management of stakeholders.
    - Low-skilled team and/or team problems.
    - Lack of top management support.
    - Disregard for politics.
    - Insufficient user involvement.

  - Unfeasible expectations.
  - Impaired motivation.
  - Wishful thinking.
  - Disputes between developers and clients.
  - Heroics.
- Product:
  - Project requirements creep.
  - Development oriented rather on research than on result.

Cecez-Kecmanovic et al. (2014) take a performative perspective on IS project success and failure. This perspective implies that success or failure of IS are inherently undetermined. This means that IS project and IS itself as entities to assess are not given and established but performed by the agency of assessment together with actual assessment. Therefore, according to the perspective, IS success and failure are perceived as relational effects performed by practices of IS project agent networks such as managers, developers, methodologies and others.

Keil et al. (2014) investigate the reasons for project status misreporting and provide recommendations on how to minimize misreporting. Obviously, one of key reasons for project failure, according to the authors, is status misreporting. In addition, they mention the following failure factors:

- Lack of a clear project direction.
- Frequent changes in requirements.
- Shortened testing phase.

Narayanaswamy et al. (2013) address the problem of software development project failure from a control-loss perspective. According to this perspective, loss of control has a negative effect on project performance and thus, can lead to project failure. In its turn, loss of control is caused by the following two factors:

- Failure to reconcile values possessed by manifold project participants under conditions of uncertainty due to changing requirements (as the authors call it, communication congruence).
- Failure to reach collaboration between multiple project partakers bearing partially reconciled objectives (perceptual congruence).

Finally, the authors mention unreliable performance measures for project progress tracking as a factor contributing to project failure.

Kappelman et al. (2007) introduce the concept of early warning signs (EWSs). An EWS is an event or indication that anticipates or cautions about one of possible or upcoming problems. EWSs happen during the first 20 percent of a project's life cycle. In a nutshell, EWSs are project risks that realized themselves early in a project lifetime. Thus, EWSs are potential reasons for project failure. The authors identify the following prominent EWSs grouped into two categories:

- People:
  - Insufficient senior management support.
  - Low-skilled project manager.
  - Lack of stakeholder involvement.
  - Low commitment of project team.
  - Overbooking of subject matter experts.
- Process:
  - Poor documentation of requirements and/or success criteria.
  - Lack of change management process.
  - Inefficient planning, scheduling and/or management.
  - Disruptions in communication between stakeholders.
  - Loss of resources that are reallocated to a higher-priority project.
  - Project execution without a business case.

Robertson and Williams (2006) investigate reasons behind the failure of a major software development project using a cognitive mapping technique. They identify the following failure factors:

- Underestimating of complexity of the project by the software services provider.
- Implementation of critical parts of the project (design and programming) simultaneously that led to a major rework.
- Excessive usage of overtimes.
- Acceptance of the developed application without the completion of a testing phase.
- Amendment of the software design during the project.
- Thoughtless reduction of the project scope without proper understanding of the consequences for the business outcomes.

Based on a literature review, Al-Ahmad et al. (2009) identify the following six generic root causes, or categories, of IT project failure (listed with examples of specific reasons for failure):

- Project management:
  - Lack of user involvement.
  - Unclear and/or volatile scope and objectives.
- Senior management:
  - Absence of a project sponsor.
  - Insufficient commitment of senior management.
- Technology:
  - Technical competence and skills of the project team.
  - Insufficient commitment of the project team.
- Organization:
  - Culture / structure.

    - Conflicting stakeholders' interests.
- Project complexity / size:
    - Large-scale and versatile project.
    - High level of project complexity and intricacies.
- Process:
    - Lack of or inappropriate project management process.
    - Conflicting stakeholders' interests.

Devos et al. (2008) investigate reasons for failure of outsourced IS projects in small and medium enterprises based on a multiple case study. They use the agency theory as a theoretical framework and find a strong support for the theory. According to the authors, the agency theory has been used by scholars to explain IS failure as mostly caused by the supplier's actions. Yet in line with the findings the theory seems to have a valid explanatory power in both directions – on the side of the provider and principal. In addition, the authors uncover lack of trust as one of key failure factors. Upon the whole, based on the agency theory and own findings, the authors mention the following reasons for failure:

- Different goals of the customer and the provider.
- Different risk behaviors and attitudes to risk of the customer and the provider.
- Customer/provider asymmetry in information on the quality of IS.
- Lack of trust between the customer and the provider.
- Unclearly defined contractual outcomes in terms of measurable performance criteria.
- Low level of IT maturity of the customer.

Wright (2011) conducts a survey of IT project performance. According to the results, one of main reasons for exceeding time and cost constraints (so-called "runaway" projects) is managerial over-commitment to a project. These results demonstrate that most of large projects both in public and private industries exceeded their initial schedule and budget by over fifty percent. In light of the above, project managers should cancel projects showing signs of over-commitment as soon as possible so that the organization's limited resources are not wasted on such projects. Interestingly, the survey's respondents rated project management factors higher than top management factors and organizational factors higher than social and psychological factors.

Cerpa and Verner (2009) analyze seventy failed IT projects to investigate key factors that led to these failures. For their research, the authors selected a sample of regular projects that are not prominent to have been reported in the literature. According to the authors, all the analyzed projects were affected by multiple interrelated failure factors that resulted in the escalation of problems. Furthermore, it appears that regular IT projects failed from exactly same reasons as prominent ones described in the literature.

The authors compiled the following list of CFFs where factors are listed in the order of importance:

- Effect of the delivery date on the development process.
- Underestimation of the project: estimation is performed by wrong people without involving the project manager.
- Lack of risk reassessment, control, or management throughout the project lifecycle.
- Insufficient acknowledgement of overtime work done by the project team.
- Making a delivery decision without collecting sufficient requirements.
- An unpleasant experience of the project team (such as inadequate staff on the project).
- Lack of participation customers and/or users in scheduling.
- Omitting risk section in the project plan.
- Lack of monitoring and control over changes, lack of efficient change management.
- Unfeasible expectations from customers and/or users.
- Lack of time for reviews at the end of each project phase.
- Unsuitable development methodology.
- Undermining project team motivation by an aggressive schedule.
- Requirements changes during the project.
- Adverse impact of the project schedule on the team members' lives.
- Inadequate staff to meet the project deadlines.
- Adding staff late in the project to fulfil an aggressive schedule.
- Allocating insufficient time for requirements gathering by customers and/or users.

Jeet et al. (2011) create a model to assess the effect of low productivity of project personnel on the schedule of a software development project. The authors argue that low productivity is a CFF that adversely affects one of the project success criteria – schedule. Low productivity of IT professionals can be caused by the following four factors:

- Relying on a few key team members.
- Using a new and unseasoned technology in a project.
- Insufficient support from the customer side in discussing specifications during the course of development.
- A low-competent contact person on the client side.

Dalal and Chhillar (2013) conduct a study of failures in software development projects using the Root Cause Analysis method. Based on case studies of severe project failures and a questionnaire of one-hundred forty-six employees from 27 organizations, the authors have gained the following results:

- The key reason for a software development failure is insufficient or poor-quality testing (31 percent of software failures).
- Software upgrades without proper customer support (20 percent of software failure).
- Poor coding (17 percent of all failures).
- Errors in software implementation (12 percent of failures).
- Finally, incomplete or equivocal requirements (12 percent of software project failures).

The list below represents all the failure factors identified by the authors and grouped by software development project phase:

- Project planning, requirements and design:
    - Incomplete or incorrect requirements.
    - Lack of communication about requirements change to the project team.
    - Repeated requirements change and permitting changes close to deadlines.
    - No change management process in place.
    - Software prototypes and architecture are not self-explanatory.
    - Missing formal estimation process.
    - Lack of estimates adjustment in case of requirements change.
    - Insufficient experience in business field and lack of training.
- Development:
    - Lack of the team's training in required technology.
    - No adherence to coding standards.
    - Lack or poor application of configuration management tools.
    - Absent or poor unit testing by developers.
- Software testing and implementation:
    - Improper functional testing.
    - No performance testing.
    - Lack of testers' training in functional and performance testing tools.
    - Missing validation of visual layout in all browsers and with all settings.
    - Missing preparation of test cases for all requirements.
    - Test management tools are not applied effectively to leverage their full potential.
    - Insufficient application of review procedure, such as peer review, internal review or external review.
    - Insufficient regression testing and test cases.
    - No continuous update of test cases together with requirements change.
    - Lack of availability of varying test data sets.
    - Improper implementation and upgrade testing.

- Frequent environment and configuration problems at customer side.

In line with DeMarco (2011) many IT projects fail because they are completed late in terms of business or competition. As the author aptly remarks, such projects have one thing in common: they were all started late. There are three key reasons for a late start:

- The management was not decisive enough to initiate a project until the competition proved the project feasible and desired. Thereafter, the project had to catch up with the competition and had to be completed in a hurry.
- If a project had to be started well before to be completed by the deadline, then the management would have to face the fact that from the onset the project would cost a way more than the management was ready to invest.
- The management missed the window of opportunity for a project.

Buschmann (2009) distinguishes the following two key reasons for software projects:

- Insufficient or incorrect scope of the system, or feature creep.
- Ambiguous, redundant, or excessive nonfunctional requirements.

Emam and Koru (2008) conducted a replicated survey of IT project failure in 2005 and 2007. As it was demonstrated in the section on project failure definitions, projects are considered failed if they do not meet project success criteria or are cancelled on the way, which means they do not deliver any workable functionality by the first release. Based on the survey, the authors revealed the following key reasons for project cancellations (in the order of importance):

- Lack of involvement from top management.
- Excessive number of scope and requirements changes.
- Insufficient management expertise.
- Exceeding budget.
- Insufficient technical expertise.
- The project is not relevant business-wise any longer.
- Exceeding schedule.
- Immature technology used in the project.
- Lack of personnel.
- Serious issues with software quality.

Gulzara et al. (2012) examine the effects of employees' commitment to IT projects in Pakistan. Based on their qualitative study, the authors found out that the effects of commitment are twofold in IT organizations. Thus, one of IT project failure factors is lack of commitment on behalf of the project team to project activities. One more failure factor is lack of commitment on behalf of organizational management to employees: if the organization does not deliver what was promised to an employee, then this situation leads to reduced moral, motivation and therefore, commitment of the employee. According to Montequin et al. (2014), who investigate critical success and failure factors of IT projects in Spain, the top five failure factors are:

- Imprecise, deficient or unspecified requirements.
- Ongoing or radical requirement changes.
- Inaccurate time estimations.
- Inaccurate cost estimations.
- Lack of or poorly compiled specifications at the onset of project work.

Folkerd and Spinelli (2009) study the problem of user exclusion and inadequate requirements gathering in a public IT project. The authors reveal how the aforementioned factors led to the following problems and an overall project failure:

- Project overruns.
- Poor and illogical user interfaces.
- Inability to develop a mental model of the IS function by users.
- Unforeseen impact on business processes.
- No user ownership and adoption.
- Poor or missing systems integration.

Furthermore, user exclusion and poor requirements capture can be caused by the following reasons:

- No business process reengineering together with IS development.
- No efficient stakeholder identification method.
- Severe schedule, politics and technology constraints affecting the development team.

According to Pan et al. (2007), inefficient or insufficient learning from projects' post-mortems is a reason for failure in subsequent projects. Basically, ineffective post-mortems lead to repeating of the same mistakes in future over again. Thus, these mistakes can last so that it can become more difficult to rectify them. The authors cite the attribution error as one of the reasons behind inefficient learning from post-mortems.

Perkins (2006) explains that the key factor for project failure is lack of knowledge of project managers. The author distinguishes between the following knowledge-related failure factors:

- Project managers do not possess enough knowledge to handle the project.
- Project managers miss on applying a project management rule.
- Project managers let constraints imposed by management preclude them from doing what they are aware they should do.
- Project managers do not consider the application of a project management rule beneficial and thus, do not appropriately apply their expertise.
- Project managers consider a project management rule is faulty and thus, do not appropriately apply their expertise.
- The project manager's objectives are misaligned with project success.

- Politics or legislation prevent project managers from doing what they are aware they should do.
- The used project management rule might be incorrect.

Ramosa and Motaa (2014) use a combined qualitative/quantitative study to investigate perceptions of success and failure factors in IT projects in Brazil. According to their findings, failure to realize such traditional success factors as scope, budget, schedule and quality is a key determinant of project failure. Furthermore, the authors mention poor communication as a failure factor and point out that determinants of success and failure differ per organization. Stoica and Brouse (2013) also refer to poor communication a failure factor.

Whitney and Daniels (2013) examine reasons for failures of large-scale mission-critical projects characterized by high levels of uncertainty (so-called complex adaptive projects). The root cause for such projects' failure is the complexity of an IS being developed in the project. In addition, the following factors contribute to failure of complex adaptive projects:

- Inefficient project management.
- Insufficient or low-level soft skills of the project manager (including empathy, influence, group support and so on).
- Underdeveloped emotional and spiritual intelligence.

Ahonen and Savolainen (2010) use multiple case studies to analyze five cancelled software engineering projects. Four projects were external (carried out for customers) and one was internal (a product development). The authors revealed that the four projects contracted out to clients were cancelled due to mistakes that happened prior to the start of each of these projects. These mistakes are the represented in the following list:

- Making an unrealistic proposal or deal caused by lack of comprehension of the customer's real needs.
- Unsuitable project staff (lacking experience) was selected for the project.
- Accepting the customer's requirement for a short schedule.
- Engaging for the expansion of an existing product's functionality without thorough technical analysis.

In the internal product development project the mistake was made during the course of the project:

- Selection of inappropriate software architecture that led to subsequent system performance issues and eventual project cancellation.

Jørgensen (2014) investigates reasons for failure in small-scale outsourced software projects performed through a freelance job platform vWorker.com. The analysis is based on more than seven hundred thousand projects implemented using the platform. As a result, the author comes up with a prediction model that can accurately enough

predict the risk of failure of a small outsourced project based on variables available at the outset of the project. Namely, the author identifies the following factors that increase the risk of project failure:

- A low-skilled provider.
- A high extent of previously failed projects carried out by the provider.
- Lack of the provider's technical knowledge assessment prior to the project.
- Lack of overall provider satisfaction with the customer based on prior projects.
- A high extent of previously failed projects outsourced by the customer.
- No history of previous cooperation between the customer and the provider.
- The customer is focused on lower price rather than on stronger provider skills.
- The provider is from a geographical region with a high extent of previous project failures.
- A large project size budget-wise.

Lehtinen et al. (2014) use a multiple case study of failed software projects in four product companies to identify reasons for these failures, their interrelations and process areas where the reasons occur. Fifty percent of the reasons connected several process areas (so-called bridge causes). The most commonly cited bridge causes are:

- Insufficient cooperation.
- Poor task backlog (incorrect priorities and features/quality tradeoffs, vague requirements).
- Lack of resources dedicated to quality assurance.

According to the authors, generally acknowledged process areas leading to failures are the following ones:

- Management.
- Requirements compilation.
- Software implementation.
- Quality assurance.

Finally, the most general types of failure causes are:

- Rules and competence.
- Values, norms and accountabilities.
- Work processes.
- Activity output.
- Activity complexity
- Product.
- Collaboration.
- Resources and planning.

The examined failure factors are summarized in the Table 2 outlined below. Table 2 is populated using an approach similar to the one used for Table 1. The factors identified and described above are grouped into the same nine high-level factors as in

Table 1: project management, project team, business analysis, technical implementation, organization, stakeholder, supplier and product. Each of the individual factors is supplemented by citations where it is explicitly or implicitly mentioned.

Table 2 Literature review on critical failure factors in IS projects

Top-level critical factor	Critical factor	References
1. Project management.	1.1. Poor project planning processes.	Nelson (2007), Kappelman et al. (2007), Dalal and Chhillar (2013), Montequin et al. (2014), Bartis and Mitev (2008), Robertson and Williams (2006), Cerpa and Verner (2009), Lehtinen et al. (2014), Ahonen and Savolainen (2010), Pan et al. (2007)
	1.2. Requirements changes.	Keil et al. (2014), Al-Ahmad et al. (2009), Cerpa and Verner (2009), Dalal and Chhillar (2013), Emam and Koru (2008), Montequin et al. (2014), Nelson (2007), Buschmann (2009), Robertson and Williams (2006), Kappelman et al. (2007)
	1.3. Poor project cooperation (internal and external)	Narayanaswamy et al. (2013), Lehtinen et al. (2014), Nelson (2007), Al-Ahmad et al. (2009), Cerpa and Verner (2009), Folkerd and Spinelli (2009), Kappelman et al. (2007), Jeet et al. (2011), Dalal and Chhillar (2013)
	1.4. Poor project monitoring and control.	Nelson (2007), Cerpa and Verner (2009), Wright (2011), Pan et al. (2007), Kappelman et al. (2007), Lehtinen et al. (2014)
	1.5. Poor quality assurance.	Nelson (2007), Dalal and Chhillar (2013), Emam and Koru (2008), Lehtinen et al. (2014), Keil et al. (2014), Robertson and Williams (2006)
	1.6. Lack of clear project goals and objectives.	Keil et al. (2014), Narayanaswamy et al. (2013), Kappelman et al. (2007)
	1.7. Poor risk management.	Nelson (2007), Cerpa and Verner (2009)
	1.8. Lack of or poor project post-mortems.	Nelson (2007), Pan et al. (2007)
2. Project team.	2.1. Project team's lack of skills (hard and soft) and experience.	Nelson (2007), Al-Ahmad et al. (2009), Ahonen and Savolainen (2010), Dalal and Chhillar (2013), Emam and Koru (2008), Whitney and Daniels (2013), Jeet et al. (2011)
	2.2. Poor hard and soft skills of project manager.	Kappelman et al. (2007), Emam and Koru (2008), Perkins (2006), Whitney and Daniels (2013)
	2.3. Poor project team composition.	Cerpa and Verner (2009), Kappelman et al. (2007), Jeet et al. (2011)
	2.4. Low commitment of project team.	Kappelman et al. (2007), Al-Ahmad et al. (2009), Gulzara et al. (2012)
	2.5. Teamwork	Nelson (2007), Cerpa & Verner (2009)

3. Business analysis.	3.1. Poor project requirements.	De Bakker et al. (2010), Nelson (2007), Dalal and Chhillar (2013), Buschmann (2009), Montequin et al. (2014), Folkerd and Spinelli (2009), Lehtinen et al. (2014), Cerpa and Verner (2009)
	3.2. Lack of understanding of the customer's real needs.	Ahonen and Savolainen (2010)
4. Technical implementation	4.1. Unsuitable software development methodology / processes.	Nelson (2007), Robertson and Williams (2006), Cerpa and Verner (2009)
	4.2. Underestimation of complexity of project.	Robertson and Williams (2006), Ahonen and Savolainen (2010)
	4.3. Poor or volatile software architecture/design and prototypes.	Dalal and Chhillar (2013), Ahonen and Savolainen (2010), Robertson and Williams (2006)
	4.4. Poor programming.	Nelson (2007), Dalal and Chhillar (2013)
	4.5. Poor technology choice.	Jeet et al. (2011), Emam and Koru (2008)
	4.6. Errors in IS solution configuration.	Dalal and Chhillar (2013)
5. Communication	5.1. Poor project communication.	Kappelman et al. (2007), Ramosa and Motaa (2014), Stoica and Brouse (2013)
6. Organization	6.1. Lack of top management support.	Bartis and Mitev (2008), Nelson (2007), Kappelman et al. (2007), Al-Ahmad et al. (2009), Emam and Koru (2008), Emam and Koru (2008)
	6.2. Unsupportive organizational culture.	Bartis and Mitev (2008), Al-Ahmad et al. (2009)
	6.3. Late start of project business- or competition-wise.	DeMarco (2011), Emam and Koru (2008)
	6.4. Lack of commitment of management to employees.	Gulzara et al. (2012), Cerpa and Verner (2009)
	6.5. Low level of IT maturity.	Devos et al. (2008)
7. Stakeholder.	7.1. Lack of user involvement.	Nelson (2007), Al-Ahmad et al. (2009), Cerpa and Verner (2009), Folkerd and Spinelli (2009)
	7.2. Corporate power and politics.	Bartis and Mitev (2008), Nelson (2007), Al-Ahmad et al. (2009), Perkins (2006)
8. Supplier	8.1. Difference between customer's and supplier's goals.	Devos et al. (2008)
	8.2. Different risk behaviors and attitudes to risk of customer and supplier.	Devos et al. (2008)
	8.3. Customer/supplier asymmetry in information on quality of IS.	Devos et al. (2008)

	8.4. Lack of trust between customer and supplier.	Devos et al. (2008)
	8.5. Poorly defined contractual outcomes.	Devos et al. (2008)
	8.6. Customer focus on lower price rather than on stronger supplier skills.	Jørgensen (2014)
9. Product	9.1. Lack of fit between IS and corporate culture.	Bartis and Mitev (2008)

2.4 Summary of literature review on critical success and failure factors

As a result of the literature review, in the cases of both success and failure factors, the same nine high-level factors emerged, namely: Project management, Project team, Business analysis, Technical implementation, Organization, Stakeholder, Supplier and Product. It is noteworthy that for a given high-level factor individual critical success and failure sub-factors can refer to the same thing, can overlap or differ. Thus, under the high-level factor "Project management", the sub-factor "Project monitoring and control" was identified as critical both to success and to failure. At the same time, the sub-factors "Requirements change" and "Quality assurance" were identified as failure-only critical factors with no match from the literature review on success factors. The diagram on Figure 3 overviews the emerged top-level critical factors.

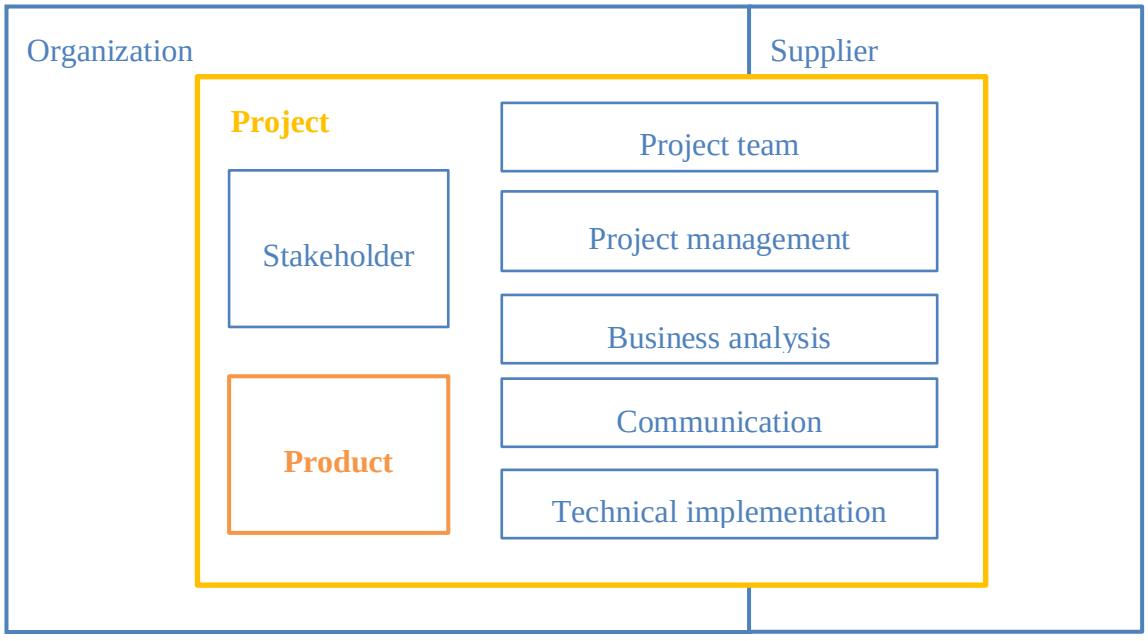

Figure 3 High-level critical success and failure factors in IT project management

3 RESEARCH PROCESS

3.1 Research approach overview

Similar to positivists, realists view the world and events as objective reality. Yet they also recognize the subjectivity of research and the role that values of the researcher play in it. Realists are inclined to infer generalizations but they are less likely than positivists to provide predictions. Due to a subjective nature of realist research and the role of values in it, it is possible that there are several competing or supplementary theories that explain the same phenomena. Nonetheless, theories suggested by realists are still a valid piece of social science because they are interim in nature and they prompt to be examined and validated by other researchers (Fisher, 2010, 20-21). The author of the dissertation holds a realist methodological stance and believes that there is an objective reality of failed and succeeded IT projects.

Usually, realists deploy qualitative research methods that can be potentially supported by some quantitative techniques (Fisher, 2010, 21). This Master's research has a qualitative theoretical drive. The qualitative research was chosen due to the availability for in-depth interviews of the author's colleagues and acquaintances directly involved in IT projects either as project managers or as IT professionals. The research comprised the following seven phases:

- Literature review of critical success and failure factors.
- Analysis and classification of identified factors in groups (or high-level factors).
- Validation of the identified factors and collection of additional factors through interviews with PM/IT professionals.
- Analysis and classification of the aggregated factors per theme.
- Grouping of the factors according to the criteria: success-only critical factors, failure-only critical factors and factors critical both to success and to failure.
- Analysis of the classification and derivation of recommendations.
- Making conclusions.

The interviews are semi-structured: the interview guide lists questions to be covered per topic but at the same time the respondent has freedom to answer these questions in a manner that seems reasonable to them (Fisher, 2010, 175). Overall, there are nine topics in each of the interviews reflecting high-level critical factors: project management, project team, business analysis, technical implementation, organization, stakeholder, supplier and product. The interviews were divided into two rounds: one is about critical success factors and the other one – about critical failure factors. The critical success and failure factors where the respondents had to express their agreement or disagreement

were identified through the literature review from above. Due to an overall high number of identified CSFs and CFFs only top factors – based on the number of references – were included in the interview guides. A complete list of questions from the interview guide on critical success factors is provided in Appendix 1, from the interview guide on critical failure factors – in Appendix 2.

First, the respondents had to answer basic demographics questions and then the next two primary questions for each of the interview topics:

- Do you agree that a given factor is critical to success/failure of an IT project?
- What are other critical success/failure factors related to the topic that you could add?

If a respondent disagreed that a certain factor is critical, they were asked to justify their viewpoint by providing a short explanation or bringing an example. During the analysis of the interviews, the following three types of answers emerged:

- "Strongly yes": the interviewee expressed a strong consent ("Yes, absolutely", "I strongly agree" etc.) that a factor is critical.
- "Yes": the interviewee considered a factor critical.
- "No": the interviewee either explicitly disagreed that a factor is critical or considered the factor important but not critical ("Nice to have"). When the respondent first replied that a factor is critical but afterwards made a remark that actually it is not always the case, the factor was not considered critical and thus, the answer was recorded as "No".

The author recorded the interviews using a voice recorder application. Further, the author transcribed the recordings and coded the data. The processes of data analysis, summarizing and additional factors collection were based on a thematic approach (Folkerd and Spinelli, 2008, 40-41). A thematic analysis of the data was conducted using the classification of CSFs and CFFs developed in the literature review section in order to filter and group the collected factors. Most of the data matched with the classification from above that served as the taxonomy's validation. Yet in case a strong new theme emerged, the existing classification was expanded. More specifically, the author undertook the following actions:

- Whenever the interviewee suggested a factor that had already been explicitly included in the guide elsewhere, no new factor was recorded and the existing factor received one more supporting reference by way of the interviewee code (SR1, … SR7, FR1, … FR7).
- Whenever the interviewee mentioned a factor that had already been identified in the literature review but had not been included in the interview guide, no new factor was added and the existing factor received extra support.
- When an extra factor specified by the respondent was not explicitly identified through the literature review but could be logically encompassed by an already

existing factor, the extra factor was dismissed and the existing factor gained one more supporting reference.

- Sometimes it became apparent that some of the factors identified by the interviewees and/or in the literature review were related to each other and could be merged. In such cases, an emerging theme was jotted down and the authors/interviewees supporting individual factors were listed to support this new aggregated factor.

By analyzing the interview data and combining factors from the interviews with the factors from the literature review, the author answers the first research question: "What are the critical factors of success and failure in IT projects?". Subsequently, the author classifies the identified factors by distributing them into the three main groups: factors critical to success only, factors critical both to success and to failure, and factors critical only to failure. This categorization helps answer the second research question "How do CSFs and CFFs correlate with each other?". The following section provides a summary of the interviews phase and outlines extra factors that emerged from the interviews.

3.2 Interviews phase results

The author conducted seven interviews on critical success factors and seven interviews on key reasons for failure. As interviews progressed, the author slightly altered the interview guides based on a feedback received from the interviewees. More specifically, some topics were renamed, some questions were reformulated to become less ambiguous and more comprehensive, some questions were moved to other topics, and finally, a few questions were completely removed.

In each round, the author interviewed different people with no overlaps. Most of the respondents are the author's current or former colleagues. One of the respondents (code name is FR7) is the author's former fellow student with eight years of experience in software development who has participated in a range of software development projects managed in an agile way. It is also noteworthy that one of the interviewees (SR6) answered the questions based on his experience in the capacity of a project researcher partaking in research and development (R&D) projects. The rest of the interviewees contemplated the questions in the context of management or participation in IT projects of IS implementation or software development.

Nine respondents are male and five are female. The age of the interviewees in the critical success factors round ranges from 27 to 35 years old, and in the round on key reasons for failure – from 28 to 46 years old. Most of the respondents work in Belgium with the exception of the three who work in Germany, Finland and Belarus respectively. Most of the respondents work for medium-size enterprises, five people work for large

ones and just one works for a small enterprise. Five respondents hold the title of project manager, four of them are software developers and analysts, two respondents are consultants, two respondents are the heads of implementation and IT departments of the company the dissertation's author works for and finally, one is a project researcher. Project management experience of the respondents varies from three to ten years and experience in IT in general – from 3.5 to 25 years. Educational background is diverse: from accounting and finance to engineering and mathematics to political science. Six of the respondents possess professional certifications: four of them hold a PRINCE2 Foundation certificate, one participant obtained a Project Management Professional (PMP) certification and one is a Microsoft Certified Professional Developer (MCPD). The demographics of the interviewees is summarized in Table 3 below.

A recap of the interview rounds is introduced in the next two sections. A factor is confirmed to be critical if the majority of the respondents answered to whether they agree "Yes" or "Strongly yes". Thus, in each round the minimum number of respondents required to support a factor's overall criticality is four out of seven. If most of the interviewees deemed a factor as critical by answering "Yes" or "Strongly yes" and maximum one respondent disagreed, then the factor was strongly confirmed as critical. As for extra critical factors revealed by the respondents, only those factors were included in the summary that were not included explicitly in one of the subsequent topics of the interview.

Table 3 Demographics of interviewees

ID	Age / Sex	Country	Org. size	Role	PM	IT	Education	Certifications
SR1	35/F	Belgium	Micro	Consultant	7	-	Accounting	-
SR2	31/F	Belgium	Medium	Senior Project Manager	5	-	Engineering	-
SR3	27/M	Belgium, Netherlands, Luxembourg	Medium	Consultant	4	-	Engineering and Management	-
SR4	29/F	Belgium	Medium	Project and Implementation Department Head	5	-	Finance and Economics, International Management	-
SR5	35/M	Belgium	Medium	Senior Implementation Project Manager	10	-	Software Development, IT Project Management	PRINCE2 Foundation
SR6	27/M	Finland	Large	Project Researcher, Scientific Coordinator, Lecturer	-	7	Applied Mathematics	-
SR7	27/M	Belgium	Medium	Analyst, Developer	-	3.5	Applied Mathematics	PRINCE2 Foundation
FR1	42/M	Belgium	Large	Finance Project Manager	8		Accounting	PRINCE2 Foundation and Practitioner, Chartered Global Management Accountant (CGMA)
FR2	38/F	Germany	Medium	Senior Consultant, Project Manager	10		Languages, Business Administration	Project Management Professional (PMP)

FR3	31/M	Belgium	Large	Senior Software Developer	-	8	Computer Science	-
FR4	31/M	Belgium	Medium	Implementation Manager, Project Manager	3	9	Political Science	PRINCE2 Foundation, ITIL Foundation
FR5	46/F	Belgium	Large	Solution analyst (technical and financial analysis)	-	25	Information Technology	-
FR6	30/M	Belgium	Medium	Head of IT and Service Delivery	-	6.5	Information Technology, Mathematics and Management	-
FR7	28/M	Belarus	Large	Senior Software Developer	-	8	Software Engineering	Microsoft Certified Professional Developer (MCPD)

3.2.1 Critical success factors interview round

In the project management topic, processes of planning and project monitoring and controlling are confirmed to be critical success factors. Further, the factor of project goals and objectives is strongly confirmed as critical. Finally, the respondents indicated the following CSFs:

- Project management processes should be tailored to a given project considering its environment, size, goals and constraints (SR2 and SR5).
- Project management processes should be adaptable during a project (SR2).
- Clear definition of roles and responsibilities (SR3, SR4, and SR7).
- Clarity upon project budget (SR4).
- Clarity upon project stakeholders (SR4).
- Expectations management (SR4, SR7).
- Maintaining and using lessons learned practice (SR5).
- Availability of resources suitable to a project (SR7).

In the project team topic, the factor of a project team's expertise, skills and experience were strongly confirmed as critical and the factor team CSF was indicated as

overall critical. As for additional project team related CSFs, the respondents detected the following factors:

- Motivation and involvement of project team members (SR1, SR2, SR3, SR5, SR6).
- Having a "hybrid" (business / IT) manager on a project team (SR1).
- Having critical thinkers on a project team who can challenge project requirements (SR3).
- Good in-team atmosphere and supportive environment (SR5).
- Making a project visible in the organization and defending the interests of the project team (SR5).
- Having core team members who do not change throughout the project (SR5).
- Having of a business domain expert in a project team (SR7).
- Commitment to project activities and following commitment (SR4).

As for the business analysis topic, the factors "Project requirements" and "Business knowledge and acumen of a domain" expert were strongly confirmed as critical. At the same time, the factor "Adaptation of business processes to implemented information system" was not supported as critical. The reasons for not tagging the factor as crucial are as follows:

- Core processes should stay the same in order to help users embrace a change (SR1).
- The feasibility of adaptation depends on a position of the customer and the supplier's ability to challenge the customer. Balance in flexibility and rigidity in accommodation of the customer's requirements is important (SR3).
- If the project goal is to implement a new software, then the software should match existing processes (process improvements are possible though). If the project goal is to change an existing process, then there should be both a new process and a new software implemented (SR5).
- It is better to have a configurable system so that it can be adapted to an existing process (SR6).

The respondents identified the following additional CSFs related to the topic of business analysis:

- Keeping core processes untouched as an anchor helping users embrace the change (SR1).
- Understanding of the customer's values, purpose, and mission (SR1).
- Reserving enough time for business analysis (SR2).
- A business analyst should know the basics of an information system being implemented (SR3).
- A business analyst should possess an analytical and critical background (SR3).

- Following best practices in business analysis including customer-oriented templates and examples for requirements gathering (SR4).
- Preparing test scenarios (SR4).
- Identifying dependencies (SR4).
- Identifying critical parameters: what should happen, what may happen and what should not (SR4).
- A project manager should ensure that business analysis is accurate and is understood by all stakeholders in the same way (SR5).

As for the technical implementation topic, the factors "Software development / implementation methodology" and "Technological uncertainty and technical complexity" were supported to be critical. As for additional CSFs, the respondents identified the following factors:

- Technology choices should suit project needs and goals (SR1).
- Ensuring understanding of technical tasks by a technical expert through clear definition, proper documentation and communication (SR3).
- Understanding of risks including technical risks and risks in availability of resources (SR4).
- Understanding of the customer's culture and IT ecosystem (SR5).
- Knowing key people on the supplier and customer sides and maintaining a good relationship with them (SR6).

As for the communication topic, project communication factor was strongly supported as a CSF. In addition, the interviewees identified the following CSFs:

- Communication should be tailored to a target stakeholder group: to whom, what, how, when and how frequent to communicate (SR1, SR4).
- Communication should be regular enough, concise and clear including clearly stated purpose and expected reaction (SR1, SR4, SR5).
- Efficient change management communication (SR1).
- Being able to skip a hierarchy in communication or to change communication means in case of impaired communication (SR2).
- Escalating when something goes wrong and it cannot be solved by a project manager (SR3, SR5).
- Communication tools (SR7).
- Trust and honesty in a project team (SR6).
- Initiative and willingness to discuss and accept new ideas (SR6).

In the organization topic, the respondents strongly confirmed the factor of change management and IT infrastructure, and considered the factor "Top management support" as overall critical. As for additional factors, the interviewees identified the following ones:

- Project goals should be aligned with an organizational strategy (SR1).

- A visibility of a project on all organizational levels (SR2).
- Having a decision maker who can make key project related decisions (SR2).
- Clear roles and responsibilities (SR3).
- A good rollout plan (SR3).
- Culture of knowledge and experience sharing (SR4).
- Having a product manager in the organization who has a long-term vision of a product (SR4).
- Organizational processes should be well thought over in the beginning and should not be reactive (SR4).
- Having a project manager on the customer side who is accountable for the project (SR5).
- Good atmosphere and relationship between people in the organization (SR6).

As for the project stakeholder topic, both the user acceptance and stakeholder involvement factors were confirmed strongly to be crucial to project success. There was just one additional CSFs identified:

- Holding a session with end users to understand better their daily tasks and issues, how they work, what can be improved and what is already good (SR5).

Interestingly, but none of culture related CSFs identified through the literature review was confirmed as critical by the respondents. Only mutual cultural understanding was supported as a CSF by SR2. The rest of the respondents disagreed that mutual cultural understanding and management of cultural differences are factors critical to project success. The overall perception about the importance of the factors was “nice to have” but not “must have”. As for additional factors identified by the respondents, they are listed below:

- Defining boundaries in communication between team members during the initiation of a project (SR1).
- General culture: team members should be respectful (SR2).
- Criticism should be about the subject not about a person (SR2).
- Sharing positive feedback and fair and measured praise (SR5).

As for the supplier topic, the factor of the supplier’s financial position was confirmed strongly. At the same time the factor of the supplier’s pool of human resources was neither confirmed nor rejected (three respondents agreed and three disagreed, for one (SR6) the factor seemed irrelevant due to the specifics of R&D projects). Thus, this factor is accounted as not critical. There were several additional CSFs identified by the respondents:

- The quality of the supplier's human resources (SR1, SR3, SR4).
- Appreciation of employees by the supplier and established talent retention policies (SR1).
- Avoiding a lock-in effect in cooperation with a supplier (SR2).

- The supplier should have a license to perform work activities (SR4).
- The supplier should have proper references (SR4, SR6).
- The supplier should be able to introduce a project team right away (SR4).
- The supplier should provide statistics on how the service is rendered, what kind of measures are used, how success is measured, what their market share is, how internal processes are measured (SR4).
- Knowing what kind of challenges the supplier has in delivering their product or service and what their critical success factors are (SR4).
- Reviewing examples of projects where the supplier failed and obtain the explanation from the supplier on why they failed (SR4).
- A feeling of confidence about a supplier (SR5).
- Matching work ethics of the customer and the supplier (SR7).
- Sharing objectives between the customer and the supplier (SR7).

As for the last topic – product – the factor "High quality of information produced by product" was confirmed strongly as critical by all respondents. The factor "Documentation of systems and processes" was confirmed as overall critical. The factor "Complexity of task automated by product" was not confirmed as critical to project success. The overall perception of the factor is that low complexity of a product is not a must for the project to be success. The level of complexity of a task automated by the product is determined by project goals (SR4 and SR5) or by a target market (SR6): normally niche products are more elaborated than mass-market products. In addition, the interviewees identified the following CSFs:

- A product should be easy, clear and intuitive for users to use (SR1, SR4, SR6, SR7).
- The product should be maintainable in post-implementation (SR2).
- A product itself (SR4).
- Focusing on the customer's issue: your solution should solve the customer's problem (SR4).
- Having a standard best-practice solution fulfilling needs of a market (SR5).
- Customer relationship management: the best feedback from the customer is when the customer recommends your product (SR4).

The findings presented above are aggregated in Table 4 below.

Table 4 Critical success factors based on interviews

Critical success factor	Sub-factor	Confirmed / Interviewees
1. Project management	1.1. Planning.	Yes
	1.2. Project goals and objectives.	Strongly yes
	1.3. Project monitoring and control.	Yes
	Additional CSFs	
	Project planning.	*SR2, SR3, SR5, SR6*
	Clear roles and responsibilities.	*SR3, SR4, SR7*
	Project monitoring and control.	*SR3, SR5, SR6*
	Tailoring project management processes to a given project context (environment, size, goals and constraints).	*SR2, SR5*
	Expectations management.	*SR4, SR7*
	Adaptability of project management processes during a project.	*SR2*
	Maintaining lessons learned.	*SR5*
	Risk management.	*SR4*
	External project cooperation.	*SR5*
2. Project team	2.1. Project team's expertise, skills and experience.	Strongly yes
	2.2. Project team composition.	Yes
	Additional CSFs	
	Motivation, involvement and commitment of project team members.	*SR1, SR2, SR3, SR4, SR5, SR6*
	Project team composition.	*SR1, SR4, SR7*
	Project team's knowledge, skills and experience.	*SR3, SR4, SR6*
	Supportive atmosphere and trust in project team.	*SR3, SR5, SR6*
	Keeping core team members in the team throughout the project.	*SR5*
	Project team autonomy.	*SR6*
	Initiative and willingness to discuss and accept new ideas.	*SR6*
3. Business analysis	3.1. Project requirements.	Strongly yes
	3.2. Adaptation of business processes to an implemented information system.	No

	3.3. Business knowledge and acumen of a domain expert.	Yes
	Additional CSFs	
	Business understanding (values, purpose, mission) and business acumen.	*SR1, SR5*
	Keeping core processes untouched as an anchor helping users embrace the change.	*SR1*
	Gathering and analyzing customer requirements.	*SR4*
	Preparing project requirements.	*SR4*
	Ensuring accuracy of business analysis and uniform understanding of the results by all stakeholders.	*SR5*
4. Technical implementation	4.1. Software development / implementation methodology.	Yes
	4.2. Technological uncertainty and technical complexity of an IT project.	Yes
	Additional CSFs	
	Technology choice.	*SR1*
	Ensuring understanding of technical tasks by a technical expert.	*SR3*
	Understanding of the customer's IT ecosystem.	*SR5*
5. Communication	5.1. Project communication.	Strongly yes
	Additional CSFs	
	Regularity, conciseness and clarity (including clearly stated purpose and expected reaction) of communication.	*SR1, SR3, SR4, SR5*
	Tailoring communication to a target stakeholder group (such as to whom, what, how, when and how frequent to communicate).	*SR1, SR4, SR5*
	In-team communication.	*SR3, SR5*
	Communication methods and tools.	*SR2, SR7*
	Efficient change management communication.	*SR1*
6. Organization	6.1. Change management.	Strongly yes
	6.2. IT infrastructure.	Strongly yes
	6.3. Top management support.	Yes
	Additional CSFs	
	Top management support	*SR2, SR3, SR4, SR5, SR7*
	Alignment of project goals with an organizational strategy.	*SR1*
	Culture of knowledge and experience sharing.	*SR4*
	Corporate policies, processes and structures aiming at achieving business/IT alignment.	*SR4*
	Having a project manager on the customer side who is accountable for the project.	*SR5*

	Enabling IT infrastructure.	*SR6*
	Good atmosphere and relationships between people in the organization.	*SR6*
	Customer relationship management: the best feedback from the customer is when they recommend the product.	*SR4*
7. Stakeholders	7.1. User acceptance.	Strongly yes
	7.2. Stakeholder involvement.	Strongly yes
	Additional CSFs	
	Understanding end users' work processes with their pros and cons.	*SR5*
	User involvement.	*SR6*
	Clarity upon project stakeholders.	*SR4*
8. Supplier	8.1. Supplier's financial position.	Strongly yes
	8.2. Supplier's human resources pool.	No
	8.3. Mutual cultural understanding between customer and supplier.	No
	8.4. Management of cultural differences.	No
	Additional CSFs	
	The quality of the supplier's human resources.	*SR1, SR3, SR4*
	A structured and comprehensive supplier selection procedure.	*SR4, SR6*
	The supplier's established talent retention policies.	*SR1*
	Avoiding a lock-in effect in cooperation with a supplier.	*SR2*
	Matching work ethics of the customer and the supplier.	*SR7*
	Sharing objectives between the customer and the supplier.	*SR7*
	Sharing positive feedback and giving fair and measured praise.	*SR5*
9. Product	9.1. High quality of information produced by product.	Strongly yes
	9.2. Documentation of systems and processes.	Yes
	9.3. Complexity of task automated by product.	No
	Additional CSFs	
	An easy-to-use, clear and intuitive product.	*SR1, SR4, SR6, SR7*
	The product maintainability in post-implementation.	*SR2*
	The product should be a fit for purpose.	*SR4*
	Having a standard best-practice solution fulfilling needs of the market.	*SR5*
	Long-term product vision.	*SR4*
	Product marketing	*SR6*

3.2.2 Critical failure factors interview round

It is worthwhile mentioning that one of the respondents – FR1 – preferred to skip answering questions about key reasons for failure found in the literature (except for the only question from the product topic). Instead he reflected upon the topics of the interview and identified key reasons for failure in each of them. Taking this into account, the author defined whether a certain factor was confirmed as overall critical if at least four out of six respondents confirmed its criticality (either by answering "Yes" or "Strongly yes" to a corresponding question). In case a factor scored three answers "Yes" and three answers "No", it was considered as non-critical. A factor was strongly confirmed as critical if maximum one respondent disagreed by answering "No" to a corresponding question. The summary of this interview round is represented in Table 5 below.

Interestingly, in this round, there was a higher percentage of factors that were not confirmed as critical comparing to the same percentage in the success factors round. More specifically, fifteen out of twenty-six (57.7% or more than a half) failure factors were not confirmed as critical whereas just five out of twenty-four (20.8%) critical success factors were not supported in the first round. Let us go through the factors that were not considered critical to failure and examine the reasons respondents specified to justify their disagreement.

In the project management topic, the factors of project monitoring/control and changes in requirements were not considered crucial to project failure. As for the former, the explanations were as follows:

- Micromanagement has an adverse effect on project success (FR3).
- If a project team is experienced, works cohesively and follows the processes (FR7) or to put it simply, everyone is doing their job (FR5), then there is no need in project monitoring and control.

As for the latter, the respondents expressed the following viewpoints:

- Although changes in requirements are definitely an issue from a project management standpoint, agile methodologies can be applied to alleviate it (FR3, FR4, FR7).
- FR6 mentions other techniques that can be used to accommodate frequent requirement changes, for example, Continuous Improvement Plan (CIP) and a Plan-Do-Check-Act development cycle.

As for the topic of technical implementation, the factor "Underestimation of project complexity" was not considered critical by the respondents for the following reasons:

- According to FR2, this factor is more related to poor scoping and time management than to complexity: if a project manager has a complete scope at hand, he or she cannot underestimate the complexity.

- FR3 is convinced that potential underestimation of complexity should be taken into account during the planning stage of a project: usually estimations given by technical specialists are overly optimistic and a project manager should multiply them by a factor 2, 3 etc. to arrive at more realistic values. Such estimations account for potential problems of technical implementation including underestimation of complexity.
- FR4 thinks that complexity is normally well understood but might not be correctly analyzed due to lack of experience and/or skills.
- In line with FR5's opinion, a feasibility study and involvement of IT should prevent or mitigate underestimation of complexity.
- FR6 thinks that the criticality of the factor depends on circumstance and what is more critical is when underestimation is realized too late.

As for the factor of poor programming, the respondents mentioned the following reasons for not considering it as critical:

- Based on their professional experience, both FR2 and FR4 believe that even a poorly coded product can be a success as long as it fulfills its customer's needs. However, poor code can become a factor of failure with growing complexity of a software (FR2) or can hamper the product scalability (FR4).
- According to FR7, poor coding is acceptable in case of development of extra "nice to have" features. However, if low-quality code of the core functionality is pushed to production regularly, the factor becomes critical to failure.

Finally, none of the respondents agreed that the factor "Immature technology" is critical to project failure. Here are the justifications the respondents used to support their disagreement:

- FR2: The project can still be a success regardless of a technology used.
- FR3: Immature technology is a risk rather than a failure factor.
- FR4: In case of immature technology, refactoring and maintenance can be difficult but as long as the technology fits project needs, it is acceptable.
- FR5: Testing can help uncover problems caused by immature technology. Then these problems should be fixed.
- FR6: The criticality of the factor depends on the area of applicability of technology: each technology choice should be preceded by a consideration of whether a more reliable technology is needed or a new technology should be preferred due to its additional value.
- FR7: It is not a critical factor. Rather, a lack of knowledge and skills in the technology used on a project is critical to failure.

Surprisingly but in the "Organization" topic, only one factor was reaffirmed as critical – "Commitment from organizational management to employees". What is even more interesting is that the factor of top management support was not supported:

whereas the respondents of the first interview round considered top management support as critical to project success, the respondents of the failure factors round did not perceive lack of top management support as critical to failure. The reasons justifying this opinion are presented below:

- FR2: The factor is not critical, if influence of top management is low, which means that a project manager can work independently in terms of budget and timeframe.
- FR3 thinks that excessive attention from top management is harmful for a project especially when a sponsor does not have a good understanding of IT issues.
- FR4: the criticality of the factor is mitigated by the level of maturity of an organization: the higher the level (the more processes are streamlined) the less top management support is needed.
- FR6 never experienced a lack of support from senior management.

As for the factor of organizational culture, the respondents provided the following reasons for not considering it critical:

- FR3 acknowledges that the factor can affect delivery in a negative way but overall the respondent does not perceive it as critical.
- FR5 also thinks that unsupportive organizational culture can lead to lack of usage of a project product. Yet FR5 does not see the factor as critical.
- FR6 believes there is always a possibility for a workaround.
- Finally, FR7 thinks that organizational culture and values are declared mainly for marketing purposes and it is a question whether a given company actually follows the values it claims to adhere to.

The last factor of the topic that was not supported by the respondents is “Late start of a project business- or competition-wise”. The reasons for not recognizing it as critical are as follows:

- In FR3’s view, the criticality of the factor depends on circumstances and there is no clear answer.
- Both FR5 and FR6 think that it is still possible to work on a project in a catch-up mode and succeed (and even become the first in the market). According to FR6, success in such cases depends on how well a project is managed. At the same time in general, FR5 does not expect such a mode of work to produce great results.
- Lastly, FR7 considers being late as an advantage because it provides a business with an opportunity to see drawbacks of first movers, listen to what customers would like to be improved so that in the end the business would come up with a more successful solution. However, such an approach might not be suitable for each enterprise and its applicability depends on a strategy.

In the "Stakeholder" interview theme, the factor of corporate power and politics was overall perceived as not critical. The interviewees specified the following reasons for this:

- FR3 considers the factor irrelevant to the context of work of a software developer. Although political games might indeed affect a project, normally developers do not experience too much of such influence. It is a responsibility of a project manager to shield team members from top management in such cases.
- In FR4's opinion it is one of reasons for failure but it is not a key reason. Streamlines project processes should alleviate the degree of influence of the factor.
- Finally, FR6 believes that there are always a limited number of people standing against a project and thus, they exert a limited impact so that workarounds are possible.

One of the most fascinating findings from the failure interviews round is that none of the factors related to a project supplier were confirmed by the respondents as crucial to failure. Let us go over each of these factors and examine the explanations that the respondents gave for not considering them as critical:

- Difference between customer's and supplier's goals:
  - According to the experience of FR3 and FR7, there is always a difference in goals between the customer's and the supplier's goals in outsource (offshore) projects. The customer is interested in developing a product whereas the supplier's primary objective in the collaboration is financial gains. As a result, remote team do what they are asked to do by the customer but nothing on top of it. This discrepancy has to be addressed by customers by making project requirements detailed enough.
  - FR4 does not think there is a difference in goals between the customer and the supplier as both are aiming at profit (money as a "gold" standard).
- Different risk behaviors and attitudes to risk of the customer and the supplier:
  - According to FR3, this question is too broad but the factor can potentially affect a project's chances for success. Overall, FR3's answer implies that the factor is not crucial.
  - Both FR5 and FR6 believe that this factor is "a part of life" and something that customers can live with.
  - FR7 thinks the factor might adversely influence relationship between the customer and the supplier. Upon, FR3's response implies that the factor is not critical.
- Customer/supplier asymmetry in information on quality of project products:

  - FR3 thinks that having comprehensive requirements, efficient project communication and a technical supervisor on the customer side would prevent the factor from occurring. Further, FR7 supports this view by stating that the customer should be involved in the process, should understand and control it. In this case, the factor is not critical.
  - FR4 believes that in case of proper project management, this factor should not become an issue. In case of asymmetry, there is a risk of losing autonomy in conducting IT projects with time. Yet, in such cases, the price of projects might become higher but projects do not necessarily fail because of this.
  - FR5 considers that proper quality assurance should mitigate the criticality of this factor.
  - FR6 is convinced that it is impossible to fake quality as lack of quality is always visible.
- Trust between the customer and the supplier:
  - FR3 thinks that contractual terms mitigate lack of trust although certain amount of trust is certainly required.
  - According to FR5, lack of trust is not a factor of failure. Rather, intentionally telling lies is a failure factor.
  - FR7 believes that if work processes are executed smoothly, then lack of trust is not critical.
- Definition of contractual outcomes in the cooperation supplier/provider:
  - According to FR2, when people work closely together in a project, contractual agreements do not lead their work. If there is a good project manager on a project, then the factor is not critical. FR4 supports this view by stating that if a project is well managed then the factor is not critical.
  - FR5 does not perceive the factor as critical but could not come up with a specific explanation or an example.
  - Lastly, FR7 believes that involvement of key stakeholders and efficient expectations make this factor irrelevant. This is because when development (or a product) solves the customer's problem, it is a success for the customer despite what is written in the contract.
- Last but not least, customer emphasis on lower price rather than stronger supplier skills:
  - Both FR2 and FR7 disagree because in their view, pricing and quality do not necessarily correlate. A perfect situation to aim to is hiring a supplier whose services are both cheap and high quality. Yet, if pricing is the only

criterion without consideration of quality, then it definitely leads to failure.

- FR4 believes that client organizations should make conscientious decisions. Therefore, the factor is not a key reason for failure, rather, incompetence of decision makers allocating budget is a problem.
- FR5 does not consider the factor critical as it only leads to more time and financial resources required to train the supplier's resources to achieve a desired level of quality in their work.

Table 5 Critical failure factors based on interviews

Critical failure factor	Sub-factor	Confirmed / Interviewees
1. Project management	1.1. Planning.	Yes
	1.2. Project monitoring and control.	No
	1.3. Changes in requirements.	No
	1.4. Internal and external project cooperation.	Strongly yes
	Additional CFFs	
	Poor planning.	*FR1, FR2, FR4, FR5*
	Poor or insufficient quality assurance.	*FR3, FR4, FR5, FR6*
	Lack of tailoring and adaptability of a project management methodology to the changeable project context (environment, type, size, goals and constraints).	*FR1, FR6*
	Poor expectations management.	*FR5, FR7*
	Requirements changes.	*FR2, FR3, FR5, FR6*
	Poor project initiation.	*FR1, FR2*
	Poor internal and external project cooperation.	*FR5, FR6, FR7*
	Unclear roles, responsibilities and boundaries of authority.	*FR1, FR5*
	Poor project monitoring and control.	*FR1*
	Unclear or missing overall project goals.	*FR2*
2. Project team	2.1. Project team's expertise, skills and experience.	Yes
	2.2. Hard and soft skills of a project manager.	Strongly yes
	Additional CFFs	
	The project team's lack of expertise, skills and experience.	*FR1, FR5, FR6, FR7*
	Poor project team composition.	*FR1, FR2, FR5, FR6*
	The project manager's lack of expertise, skills and experience.	*FR1, FR2, FR4*
	Lack of commitment, motivation and involvement of project team members.	*FR3, FR4, FR7*
	Lack of or poor management of in-team conflicts.	*FR2*
	Lack of empowerment and autonomy of a project team.	*FR4*
	Lack of mentoring / coaching / setting a direction by the organization's management.	*FR4*
	Poor teamwork.	*FR7*

3. Business analysis	3.1. Project requirements.	Strongly yes
	Additional CFFs	
	Poor project requirements.	*FR1, FR2, FR3, FR7*
	No business case justifying a need for the project.	*FR1*
	Long and verbose business analysis.	*FR6*
	Lack of understanding of the customer's real needs or ignoring the customer's suggestions.	*FR6*
4. Technical implementation	4.1. Underestimation of project complexity.	No
	4.2. Software development methodology.	Strongly yes
	4.3. Software design.	Yes
	4.4. Poor programming.	No
	4.5. Immature technology.	No
	Additional CFFs	
	Poor technology choice.	*FR4, FR5, FR6, FR7*
	Lack of or unsuited software development methodology / processes.	*FR4, FR6*
	No internal expertise for post-implementation management.	*FR1*
	An allocated task does not match the experience level of the employee.	*FR2*
	No feasibility study conducted.	*FR5*
	Underestimation of project complexity.	*FR6*
5. Communication	5.1. Project communication.	Strongly yes
	Additional CFFs	
	A missing or poor communication strategy.	*FR1, FR2, FR5*
	Unclear roles and responsibilities in communication.	*FR1, FR4*
	Lack of or unsuited communication methods and tools.	*FR3, FR7*
	Poor communication between the customer and the supplier.	*FR6, FR7*
	Lack of communication tailoring depending on a recipient.	*FR5*
	Communication tardiness.	*FR5*
6. Organization	6.1. Top management support.	No
	6.2. Organizational culture.	No

	6.3. A late start of a project business- or competition-wise.	No
	6.4. Commitment from organizational management to employees.	Strongly yes
	Additional CFFs	
	Lack of top management support.	*FR2, FR5, FR6*
	Poor human resources management.	*FR1, FR4, FR5*
	A low level of IT maturity in the organization.	*FR3, FR4*
	Lack of commitment from organizational management to employees.	*FR3, FR6*
	Lack of trust between the project steering committee and the project manager.	*FR1*
	The organizational culture is not supportive to application of project management methodologies.	*FR2*
	Unhealthy social environment.	*FR3*
	No proper market analysis before starting a project.	*FR5*
	A hierarchical organizational structure.	*FR7*
7. Stakeholders	7.1. Stakeholder involvement.	Strongly yes
	7.2. Corporate power and politics.	No
	Additional CFFs	
	Lack of stakeholder management (categorization, register and communication).	*FR1, FR2, FR5*
	Poor or insufficient organizational change management.	*FR4, FR5*
	Lack of stakeholder involvement and buy-in.	*FR1, FR7*
8. Supplier	8.1. Difference between the customer's and supplier's goals.	No
	8.2. Different risk behaviors and attitudes to risk of the customer and the supplier.	No
	8.3. Customer/supplier asymmetry in information on quality of project products.	No
	8.4. Trust between the customer and the supplier.	No
	8.5. Definition of contractual outcomes in the cooperation supplier/provider.	No
	8.6. Customer emphasis on lower price rather than stronger supplier skills.	No
	Additional CFFs	
	Lack of a structured and comprehensive supplier selection procedure.	*FR1, FR2, FR3*
	Poor capability to work with a remote team.	*FR3, FR7*
	A poorly defined contract.	*FR2*
	Lack of consideration of cultural differences and specifics.	*FR3*
	Project team members are switched on the supplier	*FR5*

	side (senior profiles are requested but juniors are provided).	
9. Product	9.1. Fit between the product and corporate culture.	*Yes*
	Additional CFFs	
	The product is not a fit to purpose or does not work as expected.	*FR1, FR5, FR7*
	Lack or poor post-implementation support of the product.	*FR3, FR5*
	The customer is not immediately interested in solving the problem that is a motivation for developing the product.	*FR7*
	The product is not maintainable.	*FR3*
	Lack of long-term product vision.	*FR4*
	Low stability of the product.	*FR5*
	Lack of balance between flexibility and rigidity of the product (a product should be customizable enough but the core framework should be kept untouched).	*FR6*

3.3 Classification of identified critical success and failure factors

As outlined in the second research question, one of the goals of the dissertation is to group the identified factors into the three categories: “Factors critical to success only”, “Factors critical to both success and failure” and “Factors critical to failure only”. In order to do this, only unique factors found in the literature and through interviews were considered. Their classification was guided by the immediate correspondence in names and by the direct correlation in meanings. For example, the CSF “Project planning” directly corresponds to the CFF “Poor project planning”, the CSF “Top management support” corresponds to the CFF “Lack of top management support”, the CSF “Maintaining lessons learned” directly relates to the CFF “Lack of or poor project post-mortems” and so on. Those factors identified both under the success and failure themes go to the group of factors critical both to success and failure. Names of such factors are chosen to be generic enough, thus, words like “poor” or “lack of” are removed from their names.

Factors unique only to one of the topics are placed under a corresponding category of success-only or failure-only factors. For instance, the factor of “Quality assurance” emerged only under the topic of failure and thus, it is placed under the factors critical to failure only. Table 6 below represents the results of this analysis. The factors are grouped as a matrix with rows representing high-level factors (“Project management”, “Business analysis” and so on) and columns corresponding to the three categories from above. The names of the factors are supplemented by the abbreviations “SL”, “FL”, “SI” and “FI” in parenthesis reflecting the source where a given factor was identified.

Thus, “SL” corresponds to the literature review on success factors, “FL” – to the literature review on failure factors, “SI” – to the interview round on success factors and finally, “FI” – to the interview round on failure factors.

Table 6 Classification of factors critical to project success and/or failure

High-level factor	Factors critical to success only	Factors critical to both success and failure	Factors critical to failure only
1. Project management.	Project leadership (SL).	Project planning (SL, FL, SI, FI). Project monitoring and control (SL, FL, SI, FI). Clarity of project goals and objectives (SL, FL, FI). Internal and external project cooperation (SL, FL, SI, FI). Expectations management (SI, FI). Tailoring and adaptability of project management processes to a changeable project context (SI, FI). Risk management (SL, FL, SI). Maintaining lessons learned (SL, FL, SI). Clarity of roles and responsibilities (SI, FI).	Requirements changes (FL, FI). Quality assurance (FL, FI). Project initiation (FI).
2. Project team.	Keeping core team members in the team throughout the project (SI). Atmosphere and trust in the project team (SI). Initiative and willingness to discuss and accept new ideas (SI).	The project team's expertise, skills and experience (SL, FL, SI, FI). The project team composition (SL, FL, SI, FI). Motivation, commitment and involvement of project team members (FL, SI, FI). The project team empowerment and autonomy (SL, SI, FI). Teamwork (SL, FL, FI).	The project manager's expertise, skills and experience (FL, FI). In-team conflict management (FI).
3. Business analysis.	Business processes reengineering or adaptation (SL). Business understanding and business acumen (SL, SI). Careful choice of a	Project requirements (SL, FL, SI, FI).	Understanding of the customer's real needs (FL, FI). Maintaining the business case (FI). Verbosity of business analysis (FI).

	suitable IS solution (SL). Ensuring accuracy of business analysis and uniform understanding of the results by all stakeholders (SI). Understanding end users' work processes with their pros and cons (SI).		
4. Technical implementation.	Ensuring understanding of technical tasks by a technical expert (SI). Understanding of the customer's IT ecosystem (SI).	Software development / implementation methodology and processes (SL, FL, FI). Technological ambiguity and technical complexity (SL, FL, FI). The IS solution design (SL, FL). The IS solution configuration (SL, FL). Technology choice (FL, SI, FI).	Quality of programming (FL). Internal expertise for post-implementation management (FI). Feasibility study (FI). Task allocation (FI).
5. Communication.		Project communication (SL, FL, SI, FI). Communication methods and tools (SL, SI, FI). Communication strategy (SL, FI). Tailoring of communication to a target stakeholder group (SI, FI).	Clarity of roles and responsibilities in communication (FI).
6. Organization.	Enabling IT infrastructure (SL, SI). Alignment of project goals with the organizational strategy (SI). Customer relationship management (SI). Having an accountable project manager on the customer side (SI). Business/IT alignment expressed	Top management support (SL, FL, SI, FI). Organizational IT capability (SL, FL, FI). Organizational culture (SL, FL, SI, FI). Social environment (SI, FI)	Commitment of management to employees (FL, FI). Timing of project start-up business- or competition-wise (FL). Trust between the project steering committee and the project manager (FI). Human resources management (FI). Market analysis before starting the

	in corporate policies, processes and structures (SL, SI).		project (FI). Organizational hierarchy (FI).
7. Stakeholder.	User acceptance (SL).	Organizational change management (SL, SI, FI). Stakeholder involvement (SL, FL, SI, FI). Stakeholder management (SI, FI).	Corporate power and politics (FL).
8. Supplier.	Quality of the supplier's human resources (SI). The supplier's financial stability (SL). The supplier's established talent retention policies (SI). Avoiding a lock-in effect in cooperation with the supplier (SI). Matching work ethics of the customer and the supplier (SI). Sharing objectives between the customer and the supplier (SI).	Supplier selection procedure (SL, FL, SI, FI). Mutual understanding and consideration of cultural differences and specifics (SL, FI). Trust between the customer and the supplier (SL, FL). Ability to work with a remote team (SL, SI, FI).	Contracting (FL, FI). Difference between the customer's and the supplier's goals (FL). Different risk behaviors and attitudes to risk of the customer and the supplier (FL). Customer/supplier asymmetry in information on quality of the IS (FL). Switching project team members on the supplier side (FI).
9. Product.	User experience (SL, SI). Quality of output information (SL). Promptness of output information (SL). Systems and processes documentation (SL). Having a standard best-practice solution for the market (SI). Product marketing (SI).	Product maintainability (SI, FI). The product's fit for purpose (SL, SI, FI). Long-term product vision (SI, FI).	Post-implementation support (FI). Fit between the product and corporate culture (FL). The customer's interest in solving a problem, for which the product is developed (FI). Stability of the product (FI). Balance between flexibility and rigidity of the product in terms of configuration / customization (FI).

4 RESEARCH FINDINGS AND DISCUSSION

As shown in Table 6 from above, the majority of the identified factors are found to be critical to both IT project success and failure. The sections below discuss the categorization from Table 6 in relation to each of the high-level factors and outline practical implications in for each factor.

4.1 Project management

According to the definition provided by Kerzner (2009, 4), "Project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives." Thus, as projects are not undertaken by themselves, good project management is at the core of any project success. Not surprisingly, the top-level factor of project management is crucial both to IT project success and failure. The findings suggest that for project success, it is essential that management concentrates on the following areas:

- Project planning.
- Project monitoring and control.
- Clarity of project goals and objectives.
- Internal and external project cooperation.
- Expectations management.
- Tailoring of a project management methodology to the project context.
- Risk management.
- Maintaining lessons learned.
- Clarity of roles and responsibilities.

These are the key factors in project management because satisfactory performance in these areas would guide project success whereas poor performance would lead to failure. Thus, project management should strive to ensure satisfactory results in these aspects to maximize the probability of success of a given project. It is interesting to observe that considering Kerzner's definition of project management from above, several of the critical factors directly correspond to core elements of project management, namely Project planning corresponds to "planning", Clarity of roles and responsibilities – to "organizing", Project monitoring and control – to "directing and controlling", and Clarity of project goals and objectives – to "specific goals and objectives".

The factors Project planning, Project monitoring and control, Clarity of project goals and objectives, Internal and external project cooperation, Risk management, and

Maintaining lessons learned were identified both in through the literature review and interviews. At the same time, the factors Expectations management, Tailoring and adaptability of project management processes to a changeable project context, and Clarity of roles and responsibilities were found in the interviews.

At the same time, such factors as Requirements changes, Quality assurance and Project initiation were found to be critical to failure but not to success. Requirements changes and Quality assurance were identified as critical failure factors both in the literature review and interviews, whereas the factor of Project initiation cropped up in the interviews only. As for Requirements changes, although this factor is strongly supported in the literature as leading to failure, it was not confirmed to be critical by most of interviewees. Those interviewees who disagreed with the factor's criticality mentioned agile methodologies and adaptability of work processes to the client's way of work as countermeasures to cope with scope changes. Yet agile methodologies are not applicable in each and every case, for example, in large enterprise projects. Furthermore, even if an agile method mitigates the impact of changes, there should be an end-product vision, otherwise, development activities driven by chaotic change requests would not lead to success. Thus, steering changes in project requirements is a crucial factor overlooked by both academics and IT professionals. One possible reason why this factor is neglected is the attribution error. As explained by Standing et al. (2006), people tend to explain success or failure of events involving them by assuming responsibility for success and attributing failure to actions of external forces. In this vein, changes in requirements coming from an external context – the customer – might first and foremost be associated with failure than with success. It is important to establish a structured and well-grounded approach to requirements change management that would consider the context of a given project prior to starting an active phase of a project. This approach should be built based on internal expertise/best practices or inspired by a sound project management methodology. Finally, it should be clearly communicated to all involved parties – especially to the customer – and a common understanding should be achieved.

Negligence of testing and other key quality assurance activities is a common problem in many project organizations. According to the study by Dalal and Chhillar (2013), a key reason for software development failure is insufficient or poor-quality testing that explains thirty-one percent of software project failures in their sample. In addition, Robertson and Williams (2006) point out that one of key reasons for failure of a massive project was acceptance of the development without completing the testing phase. Finally, three out of seven respondents in the failure interviews round mentioned lack of testing as an additional failure factor. Based on his professional experience, the author can confirm that more often than not software testing is performed on a residual basis and even sometimes completely cut off. In some product companies, there is even

no internal expertise on quality assurance, testing is outsourced and there are no stringent guidelines, proper documentation, and established controls on how and what should be tested. In light of the above, it is crucial that organizations carrying out IT projects emphasize the importance of quality assurance and approach it proactively through sufficient resource allocation and careful planning.

As for the failure-only factor of Project initiation, project managers should not overlook it as it implies several crucial activities that guide the rest of project execution and thus, if not performed or yield poor results, are a prerequisite of project failure. Thus, during the initiation phase of a project, the ground rules for project management are established, the project charter and the business case are created. If some of these activities are not properly handled, then the project is jeopardized. Upon the whole, in order to prevent project failure, the factors of Requirements changes, Quality assurance, and Project initiation should receive sufficient attention and resources, and should be carefully planned, monitored and controlled by project management.

As for the CSF of Project leadership identified in the literature review, the findings suggest that it might be a little overemphasized in research and practice. Perhaps, in the ideal world, project managers are strong leaders and visionaries directing and inspiring project team members throughout achieving project goals. At the same time, in reality, self-organized and experienced project teams might not require a strong leader, and leadership roles might emerge and disappear throughout a project depending on its phase and circumstances. In line with the findings, this factor does not contribute to failure. Yet certainly management should pay significant attention to it as proactive project leadership should elevate overall probability of project success.

4.2 Project team

In a nutshell, it is a project team who is responsible to perform all the essential activities required to deliver a given project. Thus, to ensure these results are what is expected, the factors from this top-level factor should be treated properly. Similar to project management, most of the factors belonging to the high-level factor of Project team are recognized by researchers and professionals as critical to both success and failure. Namely, the following factors are recognized as critical to both project success and failure:

- The project team’s expertise, skills and experience.
- Project team composition.
- Motivation, commitment and involvement of project team members.
- Project team empowerment and autonomy.
- Teamwork.

These factors were identified both in the literature review and in the interview rounds. Project and senior managers should make sure that these aspects are properly cared about, namely: there should be a balance in terms of senior and junior profiles in the team; the mix of technical/business expertise should suit the project's goals; and team members should possess relevant social skills facilitating teamwork. The project manager should also monitor and help maintain high levels of motivation, commitment and involvement of individual team members. At the same time, the project manager should also refrain from micro-management and let the team be self-organized and decide on the best course of action given the project frame. Finally, project managers should strive to foster as efficient teamwork as possible. These are the top five factors from the Project team top-level factor since satisfactory performance in these areas would both enhance the chances for success and minimize the probability of failure.

Yet there are two CFFs that are recognized by research and practice as critical to failure but not to success – The project manager's lack of expertise, skills and experience and In-team conflict management. The former was mentioned both in the literature and by interviewees, whereas the latter was found in the interviews only. Thus, organizations should not underestimate this factor and hire or train a project manager possessing not only suitable competence and experience but also developed soft skills. Soft skills are especially important since project managers do not do all the job by themselves but rather rely on people to get things done. This factor is tightly related to the factor In-team conflict management for the following reason. A project manager would often act as a team leader and thereby would be a mediator and negotiator in case of any internal conflicts. Thus, in a case of conflict, a project manager's soft skills and experience would play a vital role to alleviate and resolve a confrontation. Further, effective conflict management is critical as clashes can seriously undermine the levels of motivation, commitment and involvement of team members, as well as teamwork overall, thereby diminishing performance. Finally, yet importantly, the skills, competence and experience of a project manager determine how well they can choose suitable resources for a project and keep team spirit and engagement high, how wisely they can monitor and control the team's work to benefit from the team's being empowered and self-organized, let alone other means they can could deploy to perfect teamwork. All in all, these factors should not be neglected as otherwise, they would significantly increase the probability for project failure.

The findings also unveil that the critical factors Atmosphere and trust in project team, Initiative and willingness to discuss and accept new ideas and Keeping core team members in the team throughout the project are deemed critical to success but not to failure. These critical areas were found in the interview round on success factors. The presence of these factors would significantly increase project chances for success. Thus, supportive and trustful in-team environment, initiative and welcoming new ideas would

significantly improve teamwork and thus, team performance. Keeping core team members throughout the whole project is crucial as they possess significant knowledge and experience of work in a specific context and enable team cohesion and synergy effects. In addition, replacing core team members might prolong a project and bear extra cost as their substitutes might have to be trained and even hired. Upon the whole, although a project should not necessarily fail given these factors are missing, it is wise to ensure these are in place so that there is a greater probability to succeed.

4.3 Business analysis

Business analysis is a key phase in every IT project because it should answer such crucial questions as “What does the customer want to achieve?” and “How should the customer’s requirements be translated into project work?” Providing correct answers is essential for project success and wrong answers would guide project failure. There is only one factor related to this top-level factor that is found to be critical both to success and failure – project requirements. This factor was identified both in the literature review and in the interviews. The project requirements factor aggregates such areas as requirements soliciting and analysis, preparation of requirement specification, and communication of requirements to the project team. Indeed, the requirements are the cornerstone of any development and/or implementation project as they should clearly define what actually should be done in the project. Therefore, in order to guide project success, project management should strive to achieve good results in each of the activities related to requirements preparation.

At the same time, such factors as Understanding of the customer’s real needs, Maintaining the business case and Verbosity of business analysis were found to be failure-only factors. As for the first factor, it was recognized both in the literature review and in the interviews. No matter how well requirements are gathered and specifications composed, if they do not convey what the customer really wants to achieve, these documents are useless. Furthermore, it is important to keep in mind the factor of the business case maintenance that was distinguished by the interviewees only. A business case is used for ongoing business justification of a project and to continually reassess if the project is still viable and capable to deliver planned benefits. Finally, the factor of verbose business analysis, which was found in the interviews, relates both to the factor of project requirements and to the factor of understanding of the customer’s real needs. According to FR6, the more verbose the analysis, the less precise it is as natural languages are generally less accurate than diagrams and flowcharts. In addition, the customer might not be motivated to properly review voluminous text, thus, either delaying decisions or making subsequent development risky. All in all, project

managers should secure that resultant project requirements are succinct and reflect the customer's real needs and that the business case is created and maintained throughout the project. These actions would minimize the probability for project failure.

As for the factors of Business process reengineering, Business understanding and business acumen, Careful choice of a suitable IS solution, Ensuring accuracy of business analysis and uniform understanding of the results by all stakeholders, and Understanding end users' work processes with their pros and cons, they appeared in the success-only factor group. The factor of Business process reengineering was not found in the literature on reasons for failure and none of the interviewees in the failure factors round mentioned it either. The interviewees that did not confirm this factor as critical to success gave the following explanations:

- It is important to keep a core process or policy untouched so that it would be easier for the users to embrace the change. Thus, a complete redesign of business processes is not advisable (SR1).
- SR3 believes that there should be a balance between accepting customer requests for customizations and keeping functionality of an implemented system standard. The answer implies that lack of reengineering of the customer's processes is not a factor critical to failure.
- SR5 differentiates between process change and software change. In his view, if a given project is only about new software implementation, then existing processes should be touched by it. Thus, the software should be adapted to the processes, not the other way around. Yet implementing a new piece of software is a good opportunity to change existing processes altogether. Following this line of thought, a complete redesign of business processes is neither a success nor failure factor and actual value of redesign depends on a specific project context.
- Finally, SR6 believes that it is more important to have a configurable system that adapts to existing processes rather than to tailor processes to a given system.

Thus, the factor of Business process reengineering might be overemphasized as critical in the literature whereas its criticality always depends on a project context: if an existing business process should be automated with a help of software, then no reengineering is required and the software should be customized as much as possible to fit the process, but if a project goal is to rethink and optimize existing processes with support of software, then the processes should be reengineered and the software might not need extensive customizations.

The success-only factor of Business understanding (values, culture and purpose) and business acumen was found both in the literature review and in the interviews, whereas the factor of Ensuring accuracy of business analysis and uniform understanding of the

results by all stakeholders was identified by one of the interviewees (SR5). The contribution of these factors is as follows:

- Better comprehension of the customer's real needs leading to overall higher quality of produced project requirements.
- Reviewing and discussing the gathered requirements together with the client would ensure that the project manager/business analyst and the client are on the same page and the requirements reflect exactly what is needed to be achieved.
- A uniform understanding is crucial as it assures that the interpretation of the requirements by the client, by the project manager, the project team and by the supplier is the same. This prevents wasting project resources on developing/implementing of something that is not actually expected by the customer.

As for the factor Understanding of end users' work processes with their pros and cons, it was identified through the interviews. The factor can significantly improve the quality of business analysis thereby increasing the chances for success as it enables a business analyst or a project manager to see how end users work currently, what they like and what they do not like in the work process. This knowledge would enable better understanding of how the project should accomplish its goals: what processes/features should be kept as they are now and what processes/features should be changed or eliminated with the introduction of the new IS.

Last but not least, the factor of Careful choice of a suitable IS solution is critical as it is at the core of any IS implementation or development project. It was identified in the literature review only. The factor is tightly linked to the factor of Business process reengineering or adaptation as it implies choosing an alternative of whether to develop required software from scratch or to purchase, customize and configure an existing commercial system. If the latter is the case, then the next question is what software would be the best match for a given context. Putting an effort to ponder these questions thoroughly well before is critical to success of the subsequent project as answers to these questions would have a direct effect at least on the cost and time dimensions of the project. In light of the above, although the success-only factors would not affect the probability of failure, it is important for a project manager not to overlook them and to plan corresponding activities and invest sufficient resources so that a project's chances for success elevate.

4.4 Technical implementation

Technical implementation is a key phase in each IT project especially in case of software development projects. During this phase, a key project deliverable – a product

– is being developed and/or implemented. It is a project's product, mainly a software, that enables future benefits derived from the project. Evidently, things should go right in this aspect of project work for a whole to succeed. In this top-level factor, the following factors are found to be critical both to success and failure:

- Software development / implementation methodology and processes.
- Technological ambiguity and technical complexity.
- IS solution design
- IS solution configuration.
- Technology choice.

The factors Software development / implementation methodology / processes, Technological ambiguity and technical complexity, and Technology choice were recognized by both academics and the interviewees, whereas IS solution design and IS solution configuration were only identified through the literature review. These five factors are crucial to guarantee success of the technical implementation phase of an IT project and thereby, of a project as a whole. Therefore, organizational and project management should make sure that:

- A software development or implementation methodology is well thought over prior to a project initiation. Ideally, there should be established guidelines and processes that have already been used in other projects.
- Technical complexity should be estimated and accounted for during planning. A work breakdown structure could be used to mitigate the effect of complexity.
- Technological ambiguity is tightly linked to the choice of technology. It should be mitigated by careful upfront analysis of available technology in relation to project needs and by maintaining a balance between the value of new technology and reliability of established technology. Project management should also make sure to reserve reasonable buffers should there happen any possible technology-related issues.
- IS solution design should be carefully crafted in the beginning of the execution phase of a project. Changes should be foreseen and the design should be flexible enough to allow for them. At the same time, the core design elements should not be allowed to change during a project as such changes might lead to a complete rework of the solution and failure to meet project success criteria.
- Finally, the configuration of a developed or implemented IS solution should be performed properly in order to make the solution ready to be used and avoid problems for the customer. This is especially the case in financial or accounting systems where misconfiguration can lead to actual financial losses by businesses.

At the same time, the factors of Quality of programming, Internal expertise for post-implementation management, Feasibility study and Task allocation were found to be

critical to failure only. As for Quality of programming, which is the factor identified in the literature only, some of the interviewees acknowledged that poor coding does not necessarily lead to failure because even poorly coded software can be a success as long as it fulfills its purpose (FR2, FR4). At the same time, when it comes it scalability (FR4), support and maintainability (FR2), this factor together with poor or volatile software design becomes critical. Thus, in case of massive software projects, such as enterprise software development or implementation, managers and team leaders should not overlook this factor and be scrupulous in the questions of software architecture and extensibility, coding guidelines and refactoring. Furthermore, even in smaller projects, what can be a success today, might turn into a failure in a long run.

During the interviews, FR1 mentioned Internal expertise for post-implementation management as a factor critical to failure. Indeed, it is critical for managers deploying a software solution not to neglect this factor for one simple reason: if there is no internal knowledge on how to manage implemented software, that is what configuration and workflows are in place, what kind of issues to expect and how to handle them, then the value of the software utilization night decrease with time. Since benefits expected from software are realized usually over a long term (Doherty et al., 2012), this factor can potentially result in unsatisfactory ROI (Return on Investment). In light of the above, project managers and sponsors should make sure they build internal expertise on post-implementation product management during the project.

As for the factor of Feasibility study mentioned by FR5, it is crucial to account for it before in most of projects, especially in large-scale ones, for the following reason. A feasibility study helps an organization to estimate if the project they are about to begin can actually be successfully accomplished. Thus, this kind of study might potentially save tremendous amounts both for the customer and the supplier, if it demonstrates that a project is too risky to undertake within a given context. For example, feasibility study can rectify the factor of technological ambiguity and technical complexity as it can clearly show upfront that project requirements are too complex and/or include technology choices ambiguous to the project team in a given organizational context. Initiating a project like this might lead to serious problems in future and eventual failure.

The factor of Task allocation, which was identified through interviews becomes crucial to project failure when tasks are allocated to project team members without the consideration of their experience level. Thus, when a junior profile receives a task requiring significant experience, it can take them a disproportionate amount of time to complete, let alone the level of quality. At the same time a senior member would handle the same task more efficiently. Therefore, it is important that in allocation of tasks, project managers/team leaders should estimate tasks' complexity and match it with a suitable profile. In case of concerns, they should involve a senior team member to

estimate the complexity of a given task and the level of knowledge/experience required to complete it efficiently. Nonetheless, it is important that project managers give gradually more complex tasks to junior profiles to facilitate their professional growth. All in all, the factors of Quality of programming, Internal expertise for post-implementation management, Feasibility study and Task allocation should be accounted for by project and top management in order to minimize the probability of project failure.

As for the success-only factor of ensuring understanding of a technical task by a technical expert, its criticality to project success might be overemphasized due to the following reason. Although indeed it is critical that technical expert, such as software developers, understand clearly what has to be accomplished, the criticality of the factor decreases over time as technical specialists are always in a learning mode and should grasp new tasks increasingly faster so that the intervention of a project manager / business analyst is less and less needed. As for the success-only factor of Understanding of the customer's IT ecosystem was identified in the interviews. It is crucial to the supplier of an IS solution or IS services as it helps align the delivery with the IT environment of the customer thereby making it as smooth as possible. These factors should be kept in mind as they would increase the probability of project success.

4.5 Communication

Communication is a key element in each project: there is in-team communication, project manager / team communication, communication with top management, users, service providers and so on. It is no wonder that the factor of Project communication was strongly confirmed as critical to both project success and failure by all interviewees. Interestingly, there is also almost complete uniformity in critical factors belonging to this top-level factor: most of communication factors were identified as critical both to success and to failure. Namely, the following factors belonging to this high-level factor were recognized as critical to both success and failure:

- Project communication.
- Communication methods and tools.
- Communication strategy.
- Tailoring communication to a target stakeholder group.

The first three factors were found both in the literature and in the interviews whereas the fourth one about communication tailoring was only identified via the interviews. Communication is a critical component in project work and professionals should pay significant attention to communication processes. Thus, when starting up a project, project management should develop a communication strategy (what, to whom and how

often to communicate) and decide upon the most suitable communication tools in a given project context (how to communicate). Project managers and ideally project team members should also tailor the message depending on a target recipient: for example, a report for a project sponsor from top management should be succinct and fact-based whereas a description of a technical task for a developer should be elaborate and example-based sometimes supplemented by a follow-up call to ensure understanding. Last but not least, project managers should strive to achieve excellence in project communication in any other ways possible. Success in these four areas would dramatically increase project chance for success and minimize its potential to fail.

Yet there is also a failure-only factor - Clarity of roles and responsibilities in communication – that was found in the interviews. It is crucial not to overlook it as otherwise it would increase the probability of project failure. This factor is about the delineation of responsibilities for communication: who should provide and who should receive what information. It is noteworthy that this factor can be embedded in the factor Communication strategy.

4.6 Organization

The Organization top-level factor is critical to project success and failure in IT projects because an organization provides conditions, within which a project is executed. Thus, if these conditions are favorable, then the chances for successful execution increase, otherwise, if they are unfavorable, the probability of failure is higher. There are several factors from this top-level factor that are found to be critical to both success and failure:

- Top management support.
- Organizational IT capability.
- Organizational culture.
- Social environment.

The first three critical factors were identified both in prior research and in the interviews. The factor of Social environment was found in the interviews only. Indeed, when an IT project is strongly supported by top management resourse-wise and executed in corporate settings that feature substantial internal competence in IT and established guidelines on software development/implementation, promote application of IT tools and are characterized by healthy social environment, this creates a favorable environment to run this project smoothly and drive it to success. Unhealthy social environment in an organization makes project team members feel uncomfortable or stressful thereby undermining their motivation and performance. Upon the whole, in case there is an issue in one of these areas, then there is a high probability that the project will fail. Therefore, these factors are the top priority for project and

organizational management in order to maximize the chances for project success and minimize the chance for project failure.

There is a number of factors that were only found as critical to failure. These factors should receive significant attention from project and top management to minimize the probability of project failure:

- Commitment on behalf of management to employees. The factor is found both in the literature and in the interviews. It is critical for organizational management not to overlook this factor since otherwise it undermines the commitment of employees to their duties leading to poorer performance and increasing the probability of failure.
- Timing of project start-up business- or competition-wise. The factor is identified through the interviews only. Late start of a project business-wise as suggested by DeMarco (2011) and Emam and Koru (2008) imposes serious time constraints on the project. As a result, its execution is in a catch-up mode leading to problems in quality of deliverables. Products developed in such a way might anyway lose the first-mover advantage.
- Market analysis before starting a project. This factor is identified through the interviews only. In case of lack or improper market analysis, a key project deliverable – the product – might not meet the need of the consumers. End users might not find the developed product useful and therefore, they might not pay for it. This leads to a situation when despite project management is a success, a developed product is a failure and thus, the project as a whole is a failure too.
- Trust between the project steering committee and the project manager. The factor is identified through the interviews. Lack of trust between project sponsors, key users, supplier representatives form a steering committee and the person in charge of the project – a project manager – would doom a project for failure due to the following reasons:
    - Most of decisions of the project manager would be questioned by the steering committee.
    - If they do not trust the project manager, top management would not provide required resources, such as people, money and equipment to the extent that is required by the project (if provide anything at all).
    - In case of lack of trust, key users might not support the project thereby threatening change management processes and user acceptance.
    - If the supplier does not trust the project manager, then they might delay the delivery of their services, under-deliver or deliver something else that is required.

- There might be a misalignment between organizational goals and the project manager's objectives.
- There would be tensions and uncomfortable atmosphere in the project team.

These are just a few examples of what can go wrong in case there is a lack of trust in a project management team. Thus, organizations should make sure upfront that the steering committee fully trusts an appointed project manager and the other way around, the project manager can trust and rely on a support from each of members of the committee. All the concerns from both sides should be made visible and resolved before the initiation of a project.

- Human resource management is an important topic where poor performance leads to project failure. The factor was identified through the interviews. It involves such activities as ensuring that people feel comfortable on a project (so that they see it through) as well as mentoring, coaching and setting a direction for employee development. If overlooked, the factor might lead to such detrimental consequences as lost motivation of key people and/or their leaving of an ongoing project thereby putting it under a serious threat. Project managers, sponsors and human resources specialists should keep this factor in mind and monitor if there are any tensions and how people feel on a project throughout its course. It is important not just to ask about this during formal team meetings or evaluations but also informally, every now and then, for instance over a cup of coffee or during a lunch break. According to FR4, lack of mentoring, coaching or setting of a direction for employees by organizational management might result in lack of increase or in gradual decline in productivity and/or motivation of staff. These consequences would inevitably translate into declining employee performance on a project ultimately leading to overall poorer project results. Thus, it is crucial for organizations to guide their staff through their daily work in order to gain the alignment between an employee's personal career goals and organizational objectives.
- The last failure-only factor is Organizational hierarchy. This factor was identified through the interviews only. As FR7 put it, the stricter the hierarchy in an organization, the less real impact employees perceive to make. Such conditions lead to loss in motivation and poorer performance.

There are also several factors that were identified as critical to success only. Interestingly, there are implicit connections between the three of these factors and factors critical both to success and failure:

- Enabling IT infrastructure is found both in the literature and interviews. It can be linked to an organizational IT capability. According to Ulrich (2014), an

organizational capability encompasses “the collective skills, abilities, and expertise of an organization” that “represent the ways that people and resources are brought together to accomplish work”. In order to capitalize on existing IT infrastructure, there should a solid IT capability in a given organization and on the other hand, in order to get the most out of an organization’s skills, abilities, and competence, there should be scalable IT infrastructure in place. These two areas go hand by hand. Interestingly, the factor of infrastructure was not mentioned as critical to failure neither in the literature nor by interviewees. This can imply that the factor is either overlooked during project post-mortems of failed projects or just overemphasized as critical to success.

- The factor of Alignment of project goals with the organizational strategy was identified through the interviews only. It is important not to overlook this factor as otherwise project outcomes would not facilitate overall organizational goals and objectives. Thus, project results would not make a positive difference for the organization and would simply mean lost resources. This factor is tightly linked to the factor of Business/IT alignment achieved through corporate policies, processes and structures.
- The factor of Business/IT alignment achieved through corporate policies, processes and structures was found both in the literature and in the interviews. In a nutshell, it relates to how well a business can exploit IT to achieve its strategic objectives and vice versa how well IT can support and guide the business. Business/IT alignment is supported by execution of IT projects whose goals are aligned with the organizational strategy. Having business/IT alignment in place would indeed increase project chance for success.
- As SR4 mentioned during the interview, customer relationship management is an important factor for success of IT projects for the following reason. When there is a continuous connection between the supplier and a customer, which involves resolving concerns and conflicts, clarifying contractual terms, offering new features or services and so on, there is a higher chance that the customer will be more willing to cooperate throughout a project, will longer be satisfied with the product/service and will readily recommend it to its partners. This a factor ensuring a long-term product success that is a part of the overall project success that is defined as project management success and product success (Baccarini, 1999). However, although the factor is important, it is more explicit in the post-implementation phase when the project as a temporary endeavor is already over. Therefore, given project processes are well set up and the customer is sufficiently involved, this factor becomes less important.
- The last success-only factor is Having a project manager on the customer side who is accountable for the project. It is important not diminish the importance

of the factor and strive to obtain a commitment from the client to appoint a project manager dedicated to the project. In case the project is blocked on the customer side (let us say, the testing phase is seriously delayed), there should be a single point of contact with enough authority who could unblock it and restore the progress. This factor substantially enhances project chances for success.

4.7 Stakeholder

According to Kerzner (2009, 6), "stakeholders are individuals or organizations that can be favorably or unfavorably impacted by the project". The author also points out that project managers have to deal with stakeholders and many of them can influence and pressurize the course of the project. Therefore, given the important role of stakeholders in projects, the high-level factor of Stakeholder is critical to both project success and failure. The following factors belonging to this high-level factor were found to be critical both to success and failure, namely:

- Organizational change management.
- Stakeholder involvement.
- Stakeholder management.

The factors of Organizational change management and Stakeholder involvement were found both in the literature and in the interviews whereas the factor of Stakeholder management was identified in the interviews only. When a project manager and/or team do not clearly identify key stakeholders, or when there is a lack of stakeholder involvement and or when the process of change management is ill-defined or poorly executed, there is a higher probability that the project will end up as a complete failure. On the contrary, when all the key stakeholders are properly identified and engaged and the processes of change management are elaborated, well planned and properly performed, there is a higher chance that the project will turn out as a success. Therefore, project managers and sponsors should ensure that these areas of project work are duly covered.

There is a factor identified as critical to failure only – corporate power and politics. It is identified through the literature review. The results demonstrate that project managers might underestimate the importance of this factor. As FR5 pointed out, this factor can become a tangible threat to a project when one of executives stands against the project and attempts to undermine its execution. For example, in the case described by FR5, a chief finance officer tried to disrupt a project by providing falsified data. Thus, especially in case of functional organizations, project managers and sponsors should

ensure a buy-in from the heads of each department prior to the onset and monitor and manage their attitudes throughout the course of development or implementation.

The factor of user acceptance was found to be critical to success only. It was identified through the literature. The factors of Stakeholder involvement and Organizational change management when planned and performed well should lead to a buy-in from key users and therefore, facilitate eventual user adoption. Nonetheless, it is important to keep an eye on challenges faced by end users after the implementation of a system and support them by answering questions and resolving issues, for example, through so-called hyper-care periods. This would contribute to end users' satisfaction and guide the acceptance as seamless as possible.

4.8 Supplier

The top-level factor of Supplier is critical to the success and failure of software implementation projects, outsourced and offshore projects. In these kinds of projects, well-oiled and efficient collaboration with an external supplier is a key factor for success. The following factors belonging to the Supplier top-level factor were found to be critical to both project success and failure:

- Supplier selection procedure.
- Mutual understanding and consideration of cultural differences and specifics.
- Trust between customer and supplier.
- Ability to work with a remote team.

The factors of Supplier selection procedure, Mutual understanding and consideration of cultural differences and specifics and Ability to work with a remote team were identified both in the literature review and by the respondents. At the same time, the factor of Trust between customer and supplier was only found through the literature review.

The factor of Supplier selection procedure assumes an elaborated procedure to evaluate and compare potential suppliers aiming at finding the most suitable one. The procedure should be unbiased and should deploy specific tools, such as a supplier selection matrix (FR1). A potential supplier should have a license to perform their professional activities, should have proper references, should be able to introduce a project tea, straight away, should be able to provide statistics on they render their services and measure their success, should be able to describe challenges that they face in delivering their product or service, should be able to describe and discuss examples of failed projects (SR4). In addition, a supplier should be financially stable, have a solid pool of human resources, their technological specialization should be aligned with the customer's needs and the supplier's country should have suitable and stable business

conditions (Chauhan et al., 2012; Sudhakar, 2013). Finally, the selection procedure should give the customer a feeling of confidence about a selected supplier (SR5). Given the procedure is reliable, the project's chance for success increase dramatically, given otherwise, the failure is almost imminent.

The factor of Mutual understanding and consideration of cultural differences and specifics gains importance in case of outsourced and especially offshore projects. When a project team comprises members from different national and corporate cultures, there can be shocks and clashes related to different positions of national cultures on such scales as scheduling, leadership, communication, decision-making, trust, evaluation and so on, let alone issues due to differences in organizational culture, values and purpose. Therefore, the factor should be taken into account and properly managed should a need arise. Thus, a project's chance for success would elevate otherwise, the probability of failure would increase. This factor is logically supplemented by another factor critical both to success and failure - Ability to work with a remote team. It comprises such important activities as time zone management, treating the supplier's people as an indispensable part of the customer team and sharing measured positive feedback with the supplier's team. This factor is crucial as helps get the most out of the cooperation with the supplier's team if handled properly and leads negative outcomes as poorer performance if neglected.

Finally, the factor of Trust between customer and supplier is critical both to success and failure. If neglected, the factor would exert adverse influence on the teamwork in a given project and on the cooperation in general. For example, it can lead to deterioration of the atmosphere in the joint team undermining the motivation of members from both sides. This could result in poor quality, delays and even in the abandonment of the project. If the factor receives proper attention, then the work processes have a higher chance to smooth out and become truly efficient guiding great performance, satisfaction and eventual project success.

At the same time, such critical factors as Contracting, Difference between customer's and supplier's goals, Different risk behaviors and attitudes to risk of customer and supplier, Customer/supplier asymmetry in information on quality of IS and Switching project team members on the supplier side were mentioned by academics and professionals as critical to failure only. Senior and project managers should not overlook the significance of the contracting factor, which was identified both in the literature and in the interviews. There should be clear and measurable performance outcomes specified in the contract in case of any potential disputes over the supplier performance (Devos, 2008; FR2, FR5). Measurable performance indicators specified in the contract should help rectify the influence of such factors as the differences between the customer and the supplier in terms of goals, risk behaviors, attitudes to risk, and asymmetry in information on real quality of the supplier's services. These three factors

were found to be critical only in the literature review. As for the factor of Switching project team members on the supplier side, as FR5 pointed out in the interview, when in an offshore arrangement, senior profiles are requested but juniors are provided, this can seriously undermine the performance of the joint project team and thus, jeopardize the project. Upon the whole, these factors should be properly taken care of in order to minimize the probability of project failure.

As for the factors identified as critical to success only, one of possible explanations why these factors were recognized as such is because their effects can be perceived as more long-term and thus, they might not be always visible as failure factors to professionals or academics given a specific project context. Success in these areas should ensure in a long run a consistent success of projects carried out between the customer and the supplier. Here it would make sense to refer to the classification of critical success factors suggested by Cooke-Davies (2002): the author explicitly distinguished between factors critical to success of an individual project and factors critical to consistently successful projects. Thus, lack of established talent retention policies does not necessarily lead to immediate failure. Indeed, the supplier's project team composed of specific professionals can successfully accomplish one or two projects and achieve teamwork's synergy effects that would help in upcoming projects of higher complexity. If some of key team members leave the supplier's organization in such circumstances, this could definitely jeopardize future projects. Anyways, the first few projects could still be a success. A contrary example is a hypothetical large-scale and lengthy project where losing key collaborators in the middle of it would most probably lead to failure. Therefore, the effect of good or poor talent retention policies might not always be visible. The same line of thought can be applied to other success-only factors in the group:

- Quality and the supplier's human resources might not be critical for several projects in a row and might become such in case of new and more sophisticated project types, larger-scale projects, or key performers leaving the supplier.
- The supplier's financial stability is a necessary ground for long-term successful project collaboration. However, it does not bear an immediate impact on the success of a specific project.
- Lock-in effects can definitely become detrimental to the customer as they lead to ever increasing costs. Yet lock-in might not affect the success of current projects given the supplier's rates are still acceptable.
- Lack of shared objectives might not lead to failure in early projects given existing extrinsic and intrinsic motivation of the remote team members. However, with time, this factor may indeed reveal itself by undermining the performance of the offshore team.

Perhaps, only the factor of Matching work ethics of the customer and the supplier would have an immediate influence on the success of a given project. Yet successful results in the areas of mutual cultural understanding, ability to work with a remote team and trust should either mitigate the effect of such a mismatch or equalize work ethics in a temporary project organization.

A final remark is that a careful and diligent procedure of supplier selection should assure success in such success-only factors as Quality of the supplier's human resources, Supplier's financial stability, and Supplier's established talent retention policies.

4.9 Product

As suggested by Baccarini (1999), overall project success is determined not only by the project management success but also by the success of the project's product. In a nutshell, a project aiming to develop a new product can be completed within the constraints of time, budget, scope and quality. However, if the product does not satisfy its target audience and is not sold well, then the product as well as the project itself is a failure. Therefore, the top-level Product factor is critical to both project success and failure. There three factors from this top factor that are found to be critical to both success and failure, namely:

- Product maintainability.
- Product's fit for purpose.
- Long-term product vision.

The factor of Product's fit for purpose was recognized both in the literature and in the interviews whereas the factors of Product maintainability and Long-term product vision were found through the interviews only. These factors should be properly accounted for and handled by project and product management to maximize the probability of success and minimize the probability of failure. Indeed, if the product neatly meets users' needs, then the users are satisfied and use the product. On the contrary, when there is a mismatch in what the intended users need to do and what the product enables them to, then the product would most likely be abandoned thereby yielding no benefits both to the supplier and to the customer. Even if the product fulfils the need but is not maintainable, then in case of any future exploitation issues, they would not be resolved either at all or at least in a timely manner. This would jeopardize the customer's operations and would potentially cause frustrations and motivate switching to another product. On the contrary, good maintainability together with good customer support would ensure that the customer's issues are being taken care of quickly and with a good quality. This would make the customer satisfied and contribute

to the ongoing usage of the product and continuous financial benefits of the supplier. Finally, there should be a long-term product vision assuming that the product continuously develops by building up on its strengths and rectifying its flaws so that it keeps satisfying existing clients and attracts new ones. If there is no long-term product vision, then the product might not catch up with the latest industry trends, might lose its gloss and the company might start losing its clients.

There are several factors that were recognized as critical to failure only. The following list presents these factors and attempts to draw the attention of management to them:

- Post-implementation support. The factor is identified through the interviews. It is crucial that the product is offered together with a comprehensive customer support. Based on the personal experience of the author who works for a Software-as-a-Service product company, timely and efficient post-implementation support not only resolves questions or issues thereby increasing customer satisfaction, but also creates opportunities to sell new functionalities and initiate other projects.
- Fit between the product and the corporate culture. This factor was identified in the literature review. It should not be overlooked by project sponsors while deciding upon starting an IS implementation project. If for example, a company starts implementing a knowledge-management system to promote knowledge and experience sharing, but the bonus system for employees is built around the number of completed tasks, then this implementation project has a high chance to fail. In such a case, not only should the management adapt the incentives to account for knowledge sharing activities, but also should the values of the company shift from prioritizing of individual achievements to appreciating teamwork.
- Customer's interest in solving problem, for which product is developed. The factor is found in the interviews. If the customer loses their interest in solving the problem, for which the product is developed, then it means that although the project itself might be executed within time, scope, budget and quality requirements, the product most probably will not be used at all. As a result, the business is not going to attain any benefits from the product, which literally means a waste of resources and a project failure. An example of situations like this happen in merger and acquisition project when an organization acquires a business and subsequently decides to get rid of silos and implement the same ERP system as in the headquarters. Such a project might take several years to finalize. If during this timeframe the organization decides to sell the subsidiary in the near future, then it automatically implies that the resources poured into the ERP implementation get wasted. Therefore, management should

continually reassess the need for a project using the business case and when they see that planned benefits are not desirable anymore, the project should be shut down immediately.

- Product stability. The factor is identified in the interviews. In case of low stability of a product, an implemented system crashes more often than not, there are some errors in the user interface occurring inconsistently, the output information is sometimes incorrect and so on. These factors might completely destroy the user experience and even a good customer support might not be capable to prevent eventual abandonment of such a system.
- Finally, the factor of Balance between flexibility and rigidity of the product in terms of configuration / customization was identified in the interviews and is a sensitive topic but of utmost importance. Indeed, lack of balance might either lead to lead to losing potential customers, especially big ones requiring that a new system is adapted to their existing processes, or on the contrary, continuous customizations especially affecting the system's core can eventually result in poor maintainability and low stability. Thus, the technical aspect of an extent, to which the system should be customizable, should already be incorporated in its architecture and the roadmap.

As for the success-only factors, an interesting observation is that the factor of User experience, identified in the literature and interviews, and the factor of Systems and processes documentation, found in the literature only, were not recognized as critical to failure. This prompts a question whether investing in superior user experience is always justified: as long as the product is a fit for purpose and culture, stable, maintainable, customizable and comes with quality customer support, the issues of the user interface experience becomes less topical. Even in case of a cumbersome interface, given the rest of the conditions are met, it can be a matter of a comprehensive user training and time needed to learn the product so that it can be used at its highest potential. As for the factor of Systems and processes documentation, the respondent who disagreed with its criticality (SR1), mentioned that a self-explanatory product is more important than extensive user documentation.

As for the factors of Quality of output information and Promptness of output information, both found in the literature, their importance is downgraded given the product is a fit for purpose, maintainable and shipped with good support. Further, these two factors should not be of critical value when the quality assurance factor receives enough attention during the project. As for the factor of Having a standard best-practice solution fulfilling needs of the market, identified in the interviews, this one seriously increases the chances for product success because a best-practice solution would streamline the configuration of the product and might even automate the entire process. This would enable fast, simplified and massive implementations resulting in higher

profits. Last but not least, the factor of Product marketing, recognized in the interviews, is an indispensable business function that affects the demand for a product. Although this area is not directly related to project management, it is linked to product management. Having the right marketing initiatives in place should help create a better demand and sell the product better to its target audience and thus, thus would ensure a higher return on the investments in the project.

4.10 Critical factors and project management methodologies

Interestingly, if one looks at the identified critical factors through a prism of a project management methodology, such as PRINCE2 or Project Management Professional (PMP), one will see that most of these factors correspond to key knowledge themes or principles of a methodology. Thus, the factor of planning relates to the Plans theme of PRINCE2, the factor of project monitoring and control – to the Progress theme, the factor of risk management – to the Risk theme, the factor of quality assurance – to the Quality theme of PRINCE2, the high-level factor of organization – to the Organization theme, the factor of "Maintaining the business case" – to the Business case theme, the factor of change management – to the Change theme, the factor of tailoring of project management methodology to a project context – to the principle of tailoring PRINCE2 to the project environment, the factor of maintaining lessons learned – to the principle "Learn from experience", and finally the factor of clear roles and responsibilities – to the principle of Defined roles and responsibilities (the names are taken from the official guide to PRINCE2 – "Managing Successful Project with PRINCE2", 2009 Edition). These relationships are outlined in Table 7 below.

Table 7 Relationship between critical factors and PRINCE2 themes/principles

Critical factor/sub-factor	PRINCE2 theme/principle
Project planning	Plans theme
Project monitoring and control	Progress theme
Risk management	Risk theme
Quality assurance	Quality theme
Organization	Organization theme
Project business case	Business case theme
Requirements changes	Change theme
Tailoring project management methodology to a project context	Tailoring PRINCE2 to the project environment principle
Maintaining lessons learned	Learn from experience principle
Clear roles and responsibilities	Defined roles and responsibilities principle

It appears that some of critical factors have been recognized as critical to project management success and embedded as best-practice guidelines in modern methodologies. Thus, certified PM professionals should be well aware of what constitutes successful project management and thorough following to the guidelines from PRINCE2 or PMP should indeed increase the likelihood of project success.

5 CONCLUSIONS

As a reminder, the following two research questions were supposed to be answered by the dissertation:

- RQ1: What are the critical factors of success and failure in IT projects?
- RQ2: How do critical factors correlate with each other? In particular, which factors are only critical to success and which ones only to failure? What are the factors critical both to success and failure?

As for the RQ1, the extensive literature reviews and the series of interviews with project managers and IT professionals helped identify critical success and failure factors in IT projects. The following nine top-level critical factors emerged:

- Project management.
- Project team.
- Business analysis.
- Technical implementation.
- Organization.
- Stakeholder.
- Supplier.
- Product.

These top-level factors are illustrated in Figure 2. These top-level factors are those key areas, or aspects, where project and senior management should ensure satisfactory results to augment the likelihood of project success. Given these factors are neglected, missing or results in these areas are poor, the chances for project failure are magnified. A complete list of factors grouped in the nine top-level factors is represented in Table 6.

As for the RQ2, the identified critical factors were classified into success-only, success-failure and failure-only factors. This classification is shown in Table 6 with the analysis followed in Chapter 4. The analysis demonstrates that most of the critical success and failure factors correlate with each other as they are consistently recognized in the literature and by practitioners as critical both to success and failure. From a practical perspective, it means that these factors exert a bidirectional influence. Thus, on the one hand, securing satisfactory results in the respective areas or ensuring that the respective conditions, circumstances or effects are present in the project environment, would significantly enhance the chances for overall project success. On the other hand, given poor performance in these key areas or missing critical conditions, circumstances and effects, the likelihood of project failure would increase dramatically. Therefore, these factors should always be a top priority for management while running an IT project, namely they should be recognized (ideally even embedded in project management guidelines), corresponding activities should be well planned, provided

with sufficient resources, carefully executed and controlled. These thirty-eight top-priority factors critical both to success and failure are compiled in Table 8.

Table 8 Top priority critical factors in IT projects

Top-level critical factor	Critical factor
1. Project management.	Clarity of project goals and objectives. Tailoring and adaptability of project management processes to a changeable project context. Project planning. Clarity of roles and responsibilities. Internal and external project cooperation. Project monitoring and control. Expectations management. Risk management. Maintaining lessons learned.
2. Project team.	Project team composition. Project team's expertise, skills and experience. Motivation, commitment and involvement of project team members. Project team empowerment and autonomy. Teamwork.
3. Business analysis.	Project requirements.
4. Technical implementation.	Software development / implementation methodology / processes. Technology choice. Technological ambiguity and technical complexity. IS solution design. IS solution configuration.
5. Communication.	Communication strategy. Communication methods and tools. Tailoring communication to a target stakeholder group. Project communication.
6. Organization.	Organizational culture. Social environment. Organizational IT capability. Top management support.
7. Stakeholder.	Stakeholder involvement. Stakeholder management. Organizational change management.
8. Supplier.	Ability to work with a remote team. Supplier selection procedure. Mutual understanding and consideration of cultural differences and specifics. Trust between customer and supplier.
9. Product.	The product's fit for purpose. Product maintainability. Long-term product vision.

Project managers could use Table 8 as a checklist for the initiation and execution of projects. With a help of this checklist, they would be able to see what areas in their daily work require a special attention, what aspects should be discussed with a project sponsor or top management. It is noteworthy that not all factors can be directly influenced by a project manager or can be influenced in a timely manner at all. For example, such Organization factors of Organizational culture, Social environment, Organizational IT capability and the Product factor of Long-term product vision are outside of the direct control of project managers. Yet they should anyway analyze the state in these areas to be able to make better grounded project decisions.

According to the classification from the RQ2, some factors were identified in the context of failure only. It means that given poor performance in the respective areas or critical conditions missing, the project's chances to fail substantially increase. At the same time, satisfactory performance in such areas should lower the probability of failure but might not heighten the likelihood of success. Thus, management should recognize these critical factors as potentially leading to project failure and devote considerable attention and resources to them in order to ensure good outcomes. For example, such factors as Quality assurance, Requirements changes, and Project manager's lack of expertise, skills and experience should be properly addressed prior to the commencement of a project. Appropriate guidelines, procedures and best practices should be established and resources allocated to guarantee that the results in these areas are satisfactory so that the overall probability of a given project to fail decrease. This group of factors should be treated by project and senior management as the second priority following the factors critical both to success and to failure.

At the same time, the classification from the RQ2 also revealed that there are certain factors found to be critical to success only. Given satisfactory performance in the respective areas, a project's chance for success increase significantly. However, poor results achieved in these factors do not necessarily translate into a higher probability of failure. During the course of a project, these factors should be considered by project and top management as the third priority after the factors critical to both success and failure and factors critical to failure only. The performance in success-only areas should be monitored and if possible improved. Table 9 below provides an overview of all failure-only, success and failure and success-only factors.

It is noteworthy that the identified factors are not critical at any given moment and therefore, they should be considered as potentially critical and actualizing their criticality depending on a context (Remus and Ulrich, 2009). In this regard, management should make sure to allocate enough attention and resources to the factors that were identified as critical to success and failure and to failure only whenever these factors are relevant to a given project context.

Table 9 Failure-only, success and failure and success-only critical factors in IT projects

Top-level critical factor	Failure-only factors	Success and failure factors	Success-only factors
1. Project management.	Requirements changes. Quality assurance. Project initiation.	Clarity of project goals and objectives. Tailoring and adaptability of project management processes to a changeable project context. Project planning. Clarity of roles and responsibilities. Internal and external project cooperation. Project monitoring and control. Expectations management. Risk management. Maintaining lessons learned.	Project leadership.
2. Project team.	The project manager's lack of expertise, skills and experience. In-team conflict management.	Project team composition. Project team's expertise, skills and experience. Motivation, commitment and involvement of project team members. Project team empowerment and autonomy. Teamwork.	Atmosphere and trust in project team. Keeping core team members in the team throughout the project. Initiative and willingness to discuss and accept new ideas.
3. Business analysis.	Understanding of customer's real needs. Maintaining the business case. Verbosity of business analysis.	Project requirements.	Business processes reengineering or adaptation. Business understanding and business acumen. Careful choice of a suitable IS solution. Ensuring accuracy of business analysis and uniform understanding of the

			results by all stakeholders.
4. Technical implementation.	Quality of programming. Internal expertise for post-implementation management. Feasibility study. Task allocation.	Software development / implementation methodology / processes. Technology choice. Technological ambiguity and technical complexity. IS solution design. IS solution configuration.	Ensuring understanding of technical tasks by a technical expert. Understanding of the customer's IT ecosystem.
5. Communication.	Clarity of roles and responsibilities in communication.	Communication strategy. Communication methods and tools. Tailoring communication to a target stakeholder group. Project communication.	
6. Organization.	Commitment of management to employees. Timing of project start-up business- or competition-wise. Trust between the project steering committee and the project manager. Human resources management. Market analysis before starting a project. Organizational hierarchy.	Organizational culture. Social environment. Organizational IT capability. Top management support.	Enabling IT infrastructure. Project goals should be aligned with an organizational strategy. Customer relationship management. Having a project manager on the customer side who is accountable for the project. Business/IT alignment achieved through corporate policies, processes and structures.
7. Stakeholder.	Corporate power and politics.	Stakeholder involvement. Stakeholder	User acceptance.

		management. Organizational change management.	
8. Supplier.	Contracting. Difference between customer's and supplier's goals. Different risk behaviors and attitudes to risk of customer and supplier. Customer/supplier asymmetry in information on quality of IS. Switching project team members on the supplier side.	Ability to work with a remote team. Supplier selection procedure. Mutual understanding and consideration of cultural differences and specifics. Trust between customer and supplier.	Quality of supplier's human resources. Supplier's financial stability. Supplier's established talent retention policies. Avoiding a lock-in effect in cooperation with supplier. Matching work ethics of customer and supplier. Sharing objectives between customer and supplier.
9. Product.	Post-implementation support. Fit between product and corporate culture. Customer's interest in solving problem, for which product is developed. Stability of product. Balance between flexibility and rigidity of product in terms of configuration / customization.	The product's fit for purpose. Product maintainability. Long-term product vision.	User experience. Quality of output information. Promptness of output information. Systems and processes documentation. Having a standard best-practice solution fulfilling needs of the market. Product marketing.

It further noteworthy that some of the identified critical were also recognized as critical to project management success and embedded in the best-practice guidelines by modern project management methodologies. It means that certified PM professionals should be well aware of what constitutes successful project management and following the guidelines described in PRINCE2, for example, should indeed boost the chances for project success.

It is also important to mention a theoretical contribution of the current research – the classification of critical factors into:

- Factors critical to both success and failure.
- Factors critical to failure only.
- Factors critical to success only.

This research enriches the literature on IT project success and failure by integrating both CSFs and CFFs to show a full picture of critical factors, not only factors critical to IT project success.

In addition, this classification enables a new view on factors critical to IT project success through the prism of the direction of their effect on success and failure:

- Factors critical both to success and to failure exert a bidirectional influence:
  - Satisfactory performance guides project success.
  - Poor performance leads to project failure.
- Factors critical to project failure only exert a unidirectional influence:
  - Poor performance leads to project failure.
- Factors critical to project success only exert a unidirectional influence:
  - Satisfactory performance guides project success.

This classification also helps establish priorities in allocation of effort by senior and project management: factors with bidirectional influence should be treated in the first place.

One of the final remarks worth attention is the limitations of this research. There are four main limitations: the assumption that success-only and failure-only critical factors exert unidirectional rather than bidirectional influence; IT projects as the scope of the research; the research methods; and the research sample. Thus, the classification of the critical factors collected through the literature reviews and the interviews was based on a hypothesis that failure-only critical factors increase the likelihood of project failure if the performance in the respective areas is poor but that they do not enhance the probability of success in case of satisfactory performance. In a similar vein, the author hypothesized that success-only critical factors elevate the probability of success in case of satisfying performance but do not affect the likelihood of failure in case of poor results. This assumption made it possible to distinguish the category of success and failure critical factors that reveal bidirectional influence by increasing the chances for success in case of good performance and increasing the probability of failure in case of poor outcomes. However, it is also possible that some of success-only and failure-only factors can also cause bidirectional effects and this possibility could be analyzed and validated in future research as suggested in the next paragraph. Furthermore, as the scope of the research was focused on IT projects as a whole, it might have been too broad. IT projects are very heterogeneous in nature: software development projects, software implementation projects, R&D projects, in-house, outsourced, offshore projects and so on. Thus, it is naturally difficult to come up with a list of critical factors applicable to all IT projects regardless of their type and therefore, the results of this study cannot be applied in each and every IT project without a proper analysis of its context. Perhaps, it would have been more reasonable to concentrate on a specific domain, for example, on software development projects only. As for the research

methods, the qualitative methods and tools deployed in this study might not have provided as rich results as it would have been possible to achieve should the mixed-method design be applied. According to Stoica and Brouse (2013, 734), the mixed-method design is used to combine qualitative and quantitative techniques in a single research to supplement the core method – either qualitative or quantitative – to provide the research with additional insights and clues. Thus, it would have made sense to add a quantitative method, such as a survey, to validate the findings from the qualitative part and possibly gain more insight into the topic of critical factors. Lastly, the research sample of fourteen interviewees might not have been representative enough: most of the respondents are the author's colleagues – project managers working exclusively on software implementation projects. There have been just three technical profiles engaged in technical analysis and/or software development. It would have been more logical to arrange approximately the same number of managerial and technical profiles for interviews, which would have made the results more balanced. All in all, having acknowledged these drawbacks, it is worthwhile to outline some of the directions for future research where they can be rectified.

Indeed, there are several potential avenues where the current study could be extended in future. First of all, it would make sense to conduct a quantitative research to investigate if the identified unidirectional factors can actually appear bidirectional. In particular, holding a questionnaire among project managers and IT professionals would show if some of the failure-only factors when performed properly are critical to success and if some of the success-only factors when performed poorly are critical to failure. Secondly, it would make sense to rate the relative importance of the identified critical factors. For instance, conducting a survey would enable a basic mean analysis and ranking of the factors according to the level of their criticality. The third direction for future research would be to examine how the importance of the identified factors is perceived depending on a project phase (start-up, initiation, execution, closing) or a stakeholder group (user, customer, and supplier, or top management, project managers, and project team, or project managers, software developers, software testers, and business analysts). Finally, it would make sense to extend the classification of critical factors developed in this dissertation (the nine high-level factors) with one or more existing categorizations found in the literature, such as the one from Cooke-Davies (2002). This would potentially provide more insight into the topic of critical factors in IT projects.

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APPENDICES

Appendix 1: Interview questions on critical success factors

1. Demographics section:
   1.1. Interviewee's gender.
   1.2. What age are you?
   1.3. What is the country you work in?
   1.4. What is the size of the organization you work for?
      a) Micro enterprise (less than 10 employees).
      b) Small enterprise (10-49 employees).
      c) Medium-sized enterprise (50-249 employees).
      d) Large enterprise (with 250 and more employees).
   1.5. What is your role in the organization?
   1.6. What is your experience in managing IT projects (in years)? OR What is your experience in working in IT (in years)?
   1.7. What is your educational background?
   1.8. Do you hold any professional certifications in project management, such as PRINCE2, CAPM, PMP etc.? If not, do you hold any professional certifications in IT in general?

2. CSFs related to project management:
   2.1. Do you believe that for a project success, it is vital that the processes of project planning are executed professionally and completely? If not, please shortly clarify why.
   2.2. Do you agree that in order for a project to succeed, there should be clear and measurable project goals and objectives specified? If not, please indicate why. Are you of the opinion that properly executed processes of project monitoring and control are imperative for the success of IT projects? If not, please explain why.
   2.3. Based on your experience, what other CSFs related to project management could you recall?

3. CSFs related to the project team:
   3.1. Are the project team's technical and business knowledge, skills and experience crucial to the success of an IT project? If not, please justify.
   3.2. Is project team composition critical to the success of a project? If not, please explain. Generally, a good *project team composition* implies that the project

team is cross-functional, team members have diverse backgrounds, there is a client/user representative in the team and so on.

3.3. Please specify any other CSFs related to the project team based on your own experience.

4. CSFs related to business analysis:
   4.1. Do you agree that for an IT project to succeed, project requirements should be properly gathered, thoroughly analyzed and a comprehensive project specification developed? If not, please explain why.
   4.2. Is it crucial for successful implementation of an Information Systems (IS) solution, to redesign or adapt existing business processes to fit the workflows realized in the solution? If not, please explain why.
   4.3. Do you agree that the levels of knowledge and business acumen of a project's domain expert are essential for the project success? If not, please shortly explain why.
   4.4. Based on your personal experience, please list additional factors related to business analysis that you deem critical to the success of an IT project.

5. Technical implementation CSFs:
   5.1. Do you hold an opinion that careful selection of a suitable software development (implementation) methodology is critical to the success of an IT project? If not, why?
   5.2. Are low levels of technological uncertainty and technical complexity of an IT project crucial to its success? If not, why?
   5.3. What are other possible CSFs related to technical implementation that you could name based on your experience?

6. Communication CSFs:
   6.1. Internal project communication should go well for the project to succeed, shouldn't it? If not, please elaborate why. Internal project communication mainly involves in-team communication and interactions with providers/subcontractors.
   6.2. Do you believe that efficient external project communication is critical for the success of an IT project? If not, why? *External communication* refers to interactions with senior management, customer and users
   6.3. What additional communication CSFs could you mention drawing upon your professional experience?

7. Organization related CSFs:

7.1. Is careful and thorough process of change management a prerequisite for an IT project success?
7.2. Is flexible and well-maintained IT infrastructure a crucial factor for the success of IT projects carried out in the organization? If not, please explain why.
7.3. Is an organization's top management support crucial for the success of projects executed in the organization? If not, please explain why.
7.4. What are other organizational CSFs that you might think of?

8. CSFs related to project stakeholders:
   8.1. For a project to succeed, the adoption of a new IS by end users should go smoothly. Do you agree with the statement? If not, please explain.
   8.2. For a project to succeed, user involvement in the project is critical. Do you believe the statement is true? If not, please state a reason.
   8.3. Could you please list any additional user related CSFs drawn upon your experience?

9. Cultural CSFs (culture in this context refers both to espoused and organizational kinds of culture):
   9.1. For an offshore IT project to succeed, it is essential to ensure a mutual cultural understanding between the customer and the supplier. Do you agree with the statement? If not, why?
   9.2. Management of cultural differences between the customer's and supplier's teams is a prerequisite for the success of an offshore IT project. Do you believe this is true? If not, please justify why.
   9.3. What are other CSF related to organizational and espoused culture that you could add?

10. CSFs related to project procurement:
   10.1. Do you agree that the supplier's financial position should be stable for an IT project to meet success criteria? If not, why?
   10.2. Do you agree that the supplier should have an extensive pool of human resources for an IT project to succeed? If not, why?
   10.3. What are other CSFs related to the selection of a software supplier that you might come up with?

11. CSFs related to an implemented product:
   11.1. High quality of information output of the produced system is critical to the overall success of the project. Do you agree? If not, why?

11.2. Do you think that produced systems and processes should be properly documented to ensure the overall IS project success? If not, why?

11.3. Do you agree that the level of complexity of the task automated by the produced system is crucial to the overall success of the project? If not, why?

11.4. Could you add a few more CSFs related to a project's product based on your experience?

Appendix 2: Interview questions on critical failure factors

1. Demographics section:
   1.1. Interviewee's gender.
   1.2. What age are you?
   1.3. What is the country you work in?
   1.4. What is the size of the organization you work for?
      a) Micro enterprise (less than 10 employees).
      b) Small enterprise (10-49 employees).
      c) Medium-sized enterprise (50-249 employees).
      d) Large enterprise (with 250 and more employees).
   1.5. What is your role in the organization?
   1.6. What is your experience in managing IT projects (in years)? OR What is your experience in working in IT (in years)?
   1.7. What is your educational background?
   1.8. Do you hold any professional certifications in project management, such as PRINCE2, CAPM, PMP etc.? If not, do you hold any professional certifications in IT in general?

2. CFFs related to project management:
   2.1. Do you agree that poorly executed processes of project planning are one of key reasons for IT project failure? If not, please shortly clarify why.
   2.2. Are poor project monitoring and control processes critical to project failure? If not, please explain.
   2.3. Do you agree that frequent and chaotic changes in requirements are a factor crucial to project failure? If not, please indicate why.
   2.4. Does poor internal and external project cooperation lead to project failure? If not, please explain why.
   2.5. Based on your experience, what other CFFs related to project management could you recall?

3. CFFs related to the project team:
   3.1. Is lack of skills and experience of team members crucial to failure of an IT project? If not, please justify.
   3.2. Do poor hard and soft skills of a project manager drive project failure? If you disagree, please explain why.
   3.3. Please specify any other CFFs related to the project team based on your own experience.
4. CFFs related to business analysis:
   4.1. Do you believe that poor or incomplete project requirements are one of key factors causing project failure? If not, please explain why.
   4.2. Based on your personal experience, please list additional factors related to business analysis that you deem critical to the failure of an IT project.

5. Technical implementation CFFs:
   5.1. Does underestimation of project complexity drive IT project failure? If not, why?
   5.2. Do you agree that an incorrect or unsuitable software development methodology is a factor crucial to project failure? If not, why?
   5.3. Do you agree that poor or volatile software design is one of key reasons for failure in software development projects? If not, why?
   5.4. Is poor programming a factor critical to failure in software development projects? If not, why?
   5.5. Do you believe that immature technology used in a project is a factor critical to its failure? If not, why?
   5.6. What are other possible CFFs related to technical implementation that you could name based on your experience?

6. Communication CFFs:
   6.1. Is poor internal and external project communication a prerequisite for project failure? If not, why?
   6.2. What additional communication CFFs could you mention drawing upon your professional experience?

7. Organization related CFFs:
   7.1. Is lack of top management support one of key reasons for project failure? If not, please provide a brief explanation.
   7.2. Is organizational culture a factor crucial to failure of IT projects carried out in the organization? If not, please explain why.

7.3. Is late start of a project business- or competition-wise a key reason for its failure? If not, please explain why.
7.4. Is lack of commitment from organizational management to employees a factor critical to IT project failure in the organization? If not, please explain why.
7.5. What are other organizational CFFs that you might think of?

8. Stakeholders related CFFs:
   8.1. Is lack of stakeholder involvement a key reason for failure of a project? If not, please explain.
   8.2. Is corporate power and politics one of key causes of IT project failure? If not, why?
   8.3. Could you please list any additional stakeholder related CFFs drawn upon your experience?

9. CFFs related to project procurement:
   9.1. Is difference between customer's and supplier's goals one of key factors contributing to IT project failure? If not, why?
   9.2. Different risk behaviors and attitudes to risk of the customer and the supplier drive project failure. Do you agree it is true? If not, please justify why.
   9.3. Is customer/supplier asymmetry in information on quality of project products one of key causes driving project failure? If not, why?
   9.4. Does lack of trust between the customer and the supplier drive IT project failure? If you disagree, please explain why.
   9.5. Are poorly defined contractual outcomes in the cooperation supplier/provider one of key reasons for project failure?
   9.6. Is the customer emphasis on lower price rather than stronger supplier skills a critical failure factor? If not, why?
   9.7. What are other CFFs related to cooperation customer/supplier that you could add?

10. CFFs related to the resultant IS product:
    10.1. Do you agree that lack of fit between the product and corporate culture drives project failure? If not, why?
    10.2. What are other CFFs related to a project product that you might come up with?