Management of Project Interdependencies in a Project Portfolio

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Summary

In the contemporary business environment multiple projects are a common way of organising work and they are usually implemented and managed as a portfolio of projects. It is widely recognised that effective project portfolio management delivers a range of strategic benefits and significantly contributes to overall organisational success. However, project portfolio management is acknowledged by both theory and practice to be a highly challenging task which is even amplified by the presence of project interdependencies. Managing project interdependencies is found to be an area of weakness for contemporary portfolio management, which so far remains under investigated but emergent field within general portfolio management theory. Therefore this study presents an empirical investigation that aims to uncover why and how organisations from the Information and Communication Technology (ICT) industry manage project interdependencies.

In order to answer why organisations manage project interdependencies the study examines the benefits of project interdependency management, the negative effects of failed project interdependency management and the related challenges. In order to investigate how project interdependencies are managed this study focuses on the hard and soft practices that portfolio practitioners use. The study is based on cross-case analysis of two case organisations operating within the ICT industry in Italy. The ICT is chosen as an excellent ground for studying project interdependency management since it is of significant importance for the contemporary world's economy where project and portfolio management is practiced intensively. Qualitative data is collected via semi-structure interviews.

The key findings apply to both case organisations demonstrating their similar reasons and manner of managing project interdependencies. The research findings show that there are various types of project interdependencies in the project portfolios that practitioners need to account for and that effective management of these interdependencies delivers significant benefits contributing to the portfolio success, while failed interdependency management distorts the portfolio success. The study indicates potential challenges that project interdependency management may encounter and confirms that comprehensive consideration of project interdependencies is a rather complex task within a project portfolio management. In order to manage issues arising from interdependent projects and leverage related benefits, organisations implement the following hard practices: web application platforms and tracking tools; and soft practices: formal and informal PM meetings, creation of a cooperative culture, leadership, negotiation and convincing and sacred cow. These practices are examined along with their benefits, limitations and context of their application. Although both hard and soft practices are found to be important in the case organisations, the preference is given to soft ones, mainly because of the benefits that soft practices offer over hard ones and the fact that the indicated hard practices allow only identification of project interdependencies, but do not provide managerial solutions per se. Therefore similar organisations operating within ICT industry may find it useful to devote attention to soft practices as they are found to be a prevailing mechanism for managing project interdependencies. The combination of hard and soft practices can also be seen beneficial for realisation of effective project interdependency management.

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1 Introduction

Contemporary organisations rely heavily on organising work around projects (Blomquist & Müller, 2006, p. 52; Browning & Yassine, 2010, p. 212; Newell et al., 2008, p. 34; Reyck et al., 2005, p. 524; Voss & Kock, 2012, p. 567). Multiple projects are usually implemented and managed as a portfolio of projects with the aim of achieving the strategic goals of an organisation (PMBOK 2013, p. 9; Cooper et al., 1999, p. 334). It is recognised that managing such a portfolio is challenging per se, but it is amplified by the presence of project interdependencies (PIs) (Collyer & Warren, 2009, p. 358). Majority of early researches in the field of Project Portfolio Management (PPM) were focused largely on the resource and risk management as well as on traditional for project portfolio management literature topics of project selection and prioritisation (De Reyck et al., 2005, p. 524; Young & Conboy, 2013, p. 1). However, managing interdependencies is found to be an area of weakness for PPM (Elonen & Artto, 2003, p. 398) that deserves further investigation (De Reyck et al. 2005, p. 525; Teller et al. 2012, p. 597). Rungi and Hilmola (2011, p. 147) confirm this by saying that the project interdependency (PI) concept is less investigated but an emerging field.

PIs are argued to refer to the effects that projects might have on each other and to their mutual contribution to the benefits of the company (Thiry, 2004, p. 249). Teller et al. (2012, pp. 597, 604) contend that a project portfolio complexity measured in terms of PIs is a matter of a particular importance in the field of PPM as it frames portfolio manageability and in turn affects overall portfolio success. Nevertheless many authors claim that projects in practice are usually considered in isolation. Canonico and Söderlund (2010, p. 803) in one of their case studies discovered that the exploitation of PIs is not considered at all. On the other side Ward et al. (2007, p. 7) found out in their study of 102 companies from UK and Benelux that the frequency with which the PIs are taken into consideration by contemporary organisations is only 44%. Rungi (2010b, p. 5) similarly found that companies are aware of the interdependency issues, but consider it irregularly. Among the most dominant reasons for neglecting consideration of PIs by practitioners as this author indicates are lack of knowledge and time for implementing interdependency management processes and unclarity about achieved benefits from PIs. The literature recognises that failure in considering PIs frequently leads to set of negative effects such as schedule slippage, cannibalisation of resources and markets, resource misuse and shortage (Engwall & Jerbrant, 2003, pp. 406, 407; Dooley et al., 2005, p. 471; Formentini & Romano, 2011, p. 545; Hossain & Ruwanpura, 2008, p. 2421; Lycett at al., 2004, p. 294; Rungi & Hilmola, 2011, p. 156). This may in turn lead to intracompany competition and reduction in synergy effects expected from the project portfolio (Lycett et al, 2004, p. 294). In order to manage these arising issues as Padovani et al. (2008, p. 20) state, “the company should be able to choose the best set of available methods in order to address its singular needs in portfolio management”.

Project interdependency management (PIM) received relatively little attention in the literature (Eilat et al., 2006, p. 1020) and it is considered to be an under investigated, emerging area of enquiry (Rungi & Hilmola, 2011, p. 150). Rungi and Hilmola (2011, p. 150) complement this statement by arguing that the practical investigation of PIs is scarce

as well. There is a need for explorative studies that will discover how PIs are managed in real-life and how much the PIM is influenced by the characteristics of the companies and their context (Martinsuo, 2012, p. 802; Rungi & Himola, 2011, p. 158; Rungi, 2010a; Reyck et al., 2005, p. 525). Engwall and Jerbrant (2003, p. 404) also contend that there are only few studies that report on the management of multiple projects and allocation of resources in practice. Combined with the findings of Teller et al. (2012, p. 597) and Elonen and Artto (2002, p. 398) that management of PIs is a challenging area for PPM, these arguments provide a further indication of the need for studying the PIM in PPM practice.

In regard to practical methods of PPM many rational practices have been indicated in the literature, especially from authors ascribing to positivist philosophy that consider practices that are efficient, expert-led, with stringent control against goals and well-defined structure (Pollack, 2007, p. 267). These practices are hereby referred as "hard" practices. Only some of them take PIs into consideration such as some optimisation models and visual tools (Dickinson et al., 2006; Killen, 2013, p. 805; Killen & Kjaer, 2012, p. 554; Lee & Kim, 2001, p. 111). The hard practices provide accuracy and precision, but as several authors acknowledge, the implementation of these rational models is difficult (Archer & Ghasemzadeh, 1999, p. 208; Chen & Cheng, 2009, p. 390). Therefore, Martinsuo (2013, p. 799) indicates that in practice managers are often using "soft" practices such as bargaining and negotiation. These soft practices are characterised with learning, participation, facilitated exploration of projects, and interest in social process (Pollack, 2007, p. 267). The arguments of Killen and Hunt (2010, cited in Killen & Kjaer, 2012, p. 556) that emphasize structure, culture and people for successful PPM, seem in line with these views. **Therefore, this study focuses on exploring the way PIs are managed in practice, paying particular attention to the practices, both hard and soft, that are implemented by the organisations**. For this purpose two case organisations from the information and communications technology (ICT) industry are investigated. The ICT industry is found to be an area where the PPM is widely practiced (Rungi, 2009, p. 1509; Soderlund & Maylor, 2012). It is also the industry where the researchers have data access to.

1.1 Research question and objectives

The research problem identified in the literature relates to the lack of research on how PIs are managed in real-life and the reasons for their management (Rungi & Hilmola, 2011, p. 158; Rungi, 2010a; Rungi, 2010b, p. 9; Reyck et al., 2005, p. 525; Martinsuo, 2012, p. 802). Therefore the research question that our study is addressing is stated as follows: **Why and how organisations from the ICT industry manage PIs in a project portfolio?**

The corresponding objectives of this study are:
- To investigate possible PIs types in a project portfolio and to examine the related PIM benefits, issues and managerial challenges. In doing so, we aim to answer the first part of the question that asks for the reasons of managing PIs.
- To identify hard and soft practices for managing PIs and examine their benefits, limitations and contextual conditions for application. In doing so, we aim to answer the second part of the question that asks for the way in which PIs are managed.

Qualitative research methods are used in this study since the theory lacks qualitative and case study approaches to better understand the complexity of PPM (Kilen et al. cited in Pedersen & Nielsen, 2011, p. 7). Two Italian organisations from the ICT industry are examined as a multiple case study. This is an exploratory study with explanatory elements.

1.2 Structure of the study

In Section 1, *Introduction*, the theoretical background of the area of enquiry of this study is established and the need for this research is identified. Based on this, the research question is presented, and objectives of the study are specified. Section 2, *Literature Review*, presents the theoretical framework which underpins the established study propositions. Firstly, the notion of PPM is introduced, which is the general field in which PIM is positioned. Next, details are provided on several aspects of PIM crucial for answering the research question such as: theories related to PIM, PIs types, benefits of an effective PIM, negative effects of failed PIM and challenges of PIM. Further, hard and soft practices for PIM suggested in theory are outlined and their benefits, drawbacks and context of application are discussed. The section ends with a summary of the theoretical framework presented in a graphical manner. Section 3, *ICT Industry,* provides an overview of the industry in which this study is undertaken, and highlights the rationale of its selection.

Section 4, *Methodology*, discusses the philosophical viewpoints that underlie this study and presents the rationale for the selected qualitative methods and case study research strategy, accompanied by acknowledgment of their limitations. The section concludes with an outline of the employed research approach and perspective. Section 5, *Research Design*, starts with a discussion on the method used to select the reviewed literature. Next, the units of analysis and the criteria of their selection are presented, followed by a description of the data collection method. The method of data analysis is presented into details. The quality criteria that the study is adhering to and the mechanisms employed to fulfil them are also presented. The section concludes with an overview on the ethical considerations.

Section 6, *Data Analysis and Display*, presents the empirical data according to the main themes and categories derived from employing the template analysis technique. Section 7, *Discussion,* elaborates the main findings, compares them with the previous studies and draws conclusion on the validity of the study's propositions. It concludes with a revision of theoretical framework. The Section 8, *Conclusions,* revisits the research question and the objectives and relates them to the main findings of the study. Hereby, the managerial and theoretical implications of the study are presented as well as the limitations of the study accompanied by the suggestions for further research.

2 Literature Review

This section presents the theoretical framework within which this study is positioned by concentrating on the areas that help in answering the research question. It starts with an overview on the PPM field as a background of PIM. It continues with the definition of PI and PIM and discussion on the issues related to the first study objective: PIs types, benefits of an effective PIM, negative effects of failed PIM and challenges of PIM. The section provides an overview on the theoretically suggested hard and soft practices of PIM, and highlights their benefits, drawbacks and context of application, which is related to the second study objective. Six propositions are derived and presented based on this framework. The section concludes with graphical summary of the theoretical framework.

2.1. Project portfolio management

This section presents an overview on the PPM area within which PIM is practiced. The definitions of project, portfolio and PPM concepts are provided. The importance of PPM for organisations in general is discussed, and the importance of PIM within this area is highlighted. The section closes with identification of project portfolio success dimensions.

2.1.1 Project, project portfolio and project portfolio management

In the contemporary business environment projects became a common way of organisational functioning (Browning & Yassine, 2010, p. 212; Newell et al., 2008, p. 34; Reyck et al., 2005, p. 524; Voss & Kock, 2012, p. 567; Shenhar et al., 2001 p. 699). PMBOK (2013, p. 3) defines project as a "temporary endeavour undertaken to create unique product, service or result". This definition conveys project as an instrument for delivering value. There are other definitions in literature that reflect a wider view, e.g. whereby projects are considered as a "temporary organisations to which resources are assigned to deliver a benefit for the parent organisation" (Morris & Jamieson, 2005, p. 234). This suggests the ultimate essence of projects to be result-oriented organised entities, efficiently utilising resources in order to create value for organisations. These entities are characterised by such beneficial traits as team-work, flexibility, less bureaucracy and innovativeness (Cicmil & Hodgson, 2006, p. 113; Partington, 1996, p. 13; Räisänen & Linde, 2004, p. 102). Furthermore in the modern business world projects are widely recognised as effective vehicles for strategy realisation, creation of competitive advantage for organisations and delivery of significant benefits for project stakeholders (Morris & Jamieson, 2005, p. 5; Pellegrinelli, 2011, p. 233; Shenhar et al., 2001, p. 700; Winter et al., 2006, p. 701). A broad awareness of the strategic benefits that could be delivered through effective project implementation led to popularisation of project initiatives and to practice of running multiple projects in organisations. A set of projects managed together as a group with the purpose of achieving strategic goals of an organisation can be called a project portfolio (PMBOK 2013, p. 9; PMI, 2006, p. 4). Necessity to manage that collection of multiple projects effectively (Blomquist & Müller, 2006, p. 52) invoked greater interest to the field of PPM over the last two decades.

Although in general project management (PM) theory and practice there is a distinction between the terms of PPM, programme management and multi-project management (Blomquist & Müller, 2006, p. 53), they are acknowledged to be closely related (Elonen & Artto, 2003, pp. 395, 396). PMI (PMBOK, 2013, p. 7) defines PPM as a broader concept and states that it comprises the processes of selection, prioritisation and resource allocation for programmes and independent multiple projects. Therefore, we believe that by referring to the term of PPM in the following text we demonstrate a wider view which includes aspects of portfolio, programme and multi-project management studies.

Various scholars have discussed the subject of PPM, its definition, benefits and scope. Blichfeldt and Eskerod (2008, p. 358) define PPM as the managerial activity related to the "initial screening, selection and prioritisation of project proposals, the concurrent reprioritisation of projects in the portfolio, and the allocation and reallocation of resources to projects according to priority". The three main goals of PPM are determined in literature as value maximisation, balance across projects and strategic alignment (Young & Conboy, 2013, p. 4; Cooper et al., 1999a, p. 29). PPM aims to choose the most beneficial, projects and by linking them to the organisational strategy it contributes to creation of competitive advantage (Elonen & Artto, 2003, p. 395). The portfolio is considered to be balanced if there is a reasonable equilibrium between project risks, return on investments, time requirements and available resources (Archer & Ghasemzadeh, 2007, p. 95; Cooper et al., 1999, p. 335).

2.1.2 Importance of project portfolio management

The essential importance of PPM is traditionally seen in literature as providing assurance of doing the right projects (Petit, 2012, p. 539). The verification that the undertaken project is seen by organisation and its stakeholders as a "right thing", i.e. as capable to create "value for money", is an ultimate condition for a project success (Cooke-Davies, 2007, p. 234). Thus effective PPM delivers a benefit of avoiding wasteful endeavours and increases project success rate in organisation. These and other advantages of efficiently implemented PPM within organisations are widely discussed in the literature. Some of them are briefly outlined in this section. According to Laslo (2010, p. 609) strong practice of PPM within organisation allows not only to avoid not beneficial investments but also to maintain agility in a turbulent environment. Apart from helping companies manoeuvre within changing environment PPM enables organisations to stay sustainable in a long-term (Elonen & Artto, 2003, p. 395). De Reyck et al. (2005, p. 526) state that comprehensive adoption of PPM practices in organisations has a significant positive effect on the return on the projects in the portfolio and decreases number of problems related to projects execution and management, such as late project deliveries, disappointment with final project benefits, shortage of available human and financial resources, lack of coordination between projects, etc. It eventually increases the organisational efficiency (Müller et al., 2008, p. 29). PPM ultimately aims to "deliver benefits, which would not be possible if the projects were managed individually" (Platje et al., 1994, p. 100).

2.1.3 Project interdependencies within Project Portfolio Management

The literature recognises that projects are not implemented in isolation but have relationships with other projects in the portfolio that need to be considered and understood (Killen & Kjaer, 2012, p. 554; Rungi & Hilmola, 2011, p. 147; Engwall & Jerbrant, 2003, p. 406; Hamidovic & Krajnovic, 2005, p. 679). Similarly, Hossain and Ruwanpura (2008, p. 2421) argue that projects are not only affected by their own uncertain environment but also by the uncertainties pervading projects they are related to. This demands project managers to adapt to the evolving needs of the concurreent projects that they are not directly involved with (Bendoly et al, 2010, p. 385). These types of portfolios with complex interdependent projects are particularly challenging for decision makers (Killen, 2013, p. 804) and therefore effective management has to be exercised (Verma & Sinha, 2002, p. 463).

De Reyck et al. (2005, p. 525) suggest that PPM scope should include consideration of interdependencies between projects and incorporation of constraints on shared resources. The authors state that this consideration allows efficient prioritisation and reprioritisation of selected projects and ensures accountability and effective governance of portfolio. Standard in PPM and PM such as PMBOK (2013, p. 6) also recognise the importance of PIM. It is argued that by controlling the interdependencies companies can realise their intended benefits. Teller et al. (2012, p. 597) argue that a project portfolio complexity measured with PIs is a matter of a particular importance in the field of PPM as it conditions portfolio manageability and in turn affects overall portfolio success. They outline that a set of interlinked projects requires coordination and argue that resource conflicts become more frequent and the allocation of resources becomes more challenging. Furthermore as stated by Zika-Viktorsson et al. (2006, p. 392) "by increasing linkage between projects, by integrating parts and by increasing interdependencies, the organisation becomes less predictable". This draws additional challenges for managing risks arising in portfolios characterised by presence of various interdependencies.

Thereby it is recognised that managing portfolio is challenging per se, however it is even amplified by the presence of PIs in a dynamic environment (Collyer & Warren, 2009, p. 358). Majority of early researches in the field of PPM in ICT industry in particular were focused largely on the resource and risk management as well as on traditional for PPM literature topics of project selection and prioritisation (De Reyck et al., 2005, p. 524; Young & Conboy, 2013, p. 1). However PIs is found to be an area of weakness for PPM (Elonen & Artto, 2003, p. 398; Teller et al., 2012, p. 597) that deserves further investigation (Reyck et al., 2005, p. 525; Teller et al., 2012, p. 597). Although management of PIs is recognised as under investigated field of PPM, authors in literature agree that in the complex environment of multi-project organisations comprehensive consideration of PIs within effective PPM execution is vital for the project portfolio success (Rungi & Hilmola, 2011, p. 147; Rungi, 2010a, p. 103).

2.1.4 Project portfolio success

Project portfolio success is stated to be difficult to measure "because of its inherent characteristic as a dynamic, multiple interdependent system that constantly changes and

develops over time" (Jonas et al., 2013, p. 215). There is no unified view on portfolio success definition in literature. PMBOK (2013, p. 8) states that portfolio success is measured "in terms of the aggregate investment performance and benefit realisation of the portfolio". On the other scholars many scholars suggest that success can be determined through success dimensions. Table 1 displays some of the views on portfolio success dimensions identified through the literature review.

Author	Project portfolio success dimensions
Teller et al. (2012)	Average single project success
	Strategic fit
	Portfolio balance
	Maximization of the portfolio value by the use of synergies
Teller & Kock (2012)	Average project success
	Average product success
	Strategic fit
	Portfolio balance
	Preparedness for the future
	Economic success
Dietrich & Lehtonen (2005)	Projects objectives – strategy fit
	Resource allocation – strategy fit
	Ongoing projects – strategy fit
PMBOK (2013)	Aggregate investment performance
	Benefit realisation of the portfolio
Voss & Kock (2012)	Average project success
	Strategic fit
	Portfolio balance
	Preparedness for the future
Jonas, Kock, & Gemünden (2013)	Average project success
	Exploitation of synergies
	Strategic fit
	Portfolio balance

Table 1: Portfolio success dimensions

Authors in literature refer to the notion "average single project success" (Teller & Kock, 2012, p. 819; Teller et al., 2012, p. 600), which can be defined through classical success criteria of the "Iron triangle" (Atkinson, 1999, p. 338) (cost, time and quality) and customer satisfaction (Teller & Kock, 2012, p. 819). Teller and Kock (2012, p. 819) also suggest considering "average product success" when defining portfolio success, which comprises commercial success in terms of product market share and some typically used financial indicators as return-on-investment, profit and others. On the portfolio level these authors suggest to consider "economic success" as for commercial benefits of portfolio at the corporate level and their short-term effect on business performance on the market.

Dietrich and Lehtonen (2005, p. 388) identify three statement-type indicators of success: "the objectives of the projects are aligned with the strategy of the organisation", "resource allocation to different projects is aligned with the strategy of the organisation", "the current portfolio of projects implements the strategy of the organisation". These all relate to the "strategic fit" dimension as referred by Teller and Kock (2012, p. 819) and Voss and Kock (2012, p. 571). "Portfolio balance", as explained earlier in this work, means adequacy of various risks, projects durations and resource requirements towards expected benefit

realisation (Archer & Ghasemzadeh, 2007, p. 95; Cooper et al., 1999, p. 335; Teller & Kock, 2012, p. 819; Voss & Kock, 2012, p. 517). Jonas et al. (2013, p. 218) suggests that enhancing synergies of knowledge and competence development, sharing technological platforms, managing customers, or resolving marketing issues, is an important dimension of portfolio success. It allows leveraging opportunities arising from the PIs and avoiding duplication of work (Teller et al., 2012, p. 600). The "preparedness for the future" dimension is defined as provision of long-term benefits (e.g. creation of new markets, technological innovations, amplification of brand recognition, etc.) and ability to leverage opportunities arising from project portfolio realisation (Shenhar et al., 2001, p. 700; Teller & Kock, 2012, p. 820; Voss & Kock, 2012, p. 848).

The above presented definitions of project portfolio success discovered through literature review can be consolidated in the following six success dimensions: "average project success", "commercial success" (combining "average product success" and "economic success"), "exploitation of synergies", "strategic fit", "portfolio balance" and "preparedness for the future". In this study we see PIM to be directly related to "exploitation of synergies" (following the above stated suggestions of Jonas (2013, p. 218) and Teller et al. (2012, p. 600) and three more success dimensions: "average project success", "commercial success" and "portfolio balance". As found by Rungi (2010c, p. 101) in his empirical study, organisations that consider interdependencies within their PPM practice have higher project success rate over their portfolios and this relates to "average project success" dimension. Failure to consider interdependencies may lead to market cannibalisation as stated by Rungi and Hilmola (2011, p. 156) that in turn may negatively affect 'commercial success' of a project portfolio. Furthermore neglect of interdependencies in PPM execution may lead to schedule overlaps (Formentini & Romano, 2011, p. 545) and unforeseen risk transferences (Sanchez et al., 2009, p. 20) that can destabilise portfolio balance between estimated projects durations, risks and expected benefits. Therefore all these arguments provide a rationale to consider management of PIs to be related to the four aforementioned portfolio success dimensions.

2.2. Project interdependency management

PIs are indicated in the literature as an important area of PPM and they are the main focus of this study. This section provides definition of the concept of PIs, typology of PIs, the benefits of an effective PIM, negative effects of failed PIM and related managerial challenges. Furthermore, the theories that are related to PIs are also presented.

2.2.1 Project interdependencies and management definition

The concept of interdependencies is defined in the literature from different points of view. Some on the first scholars to discuss interdependencies are Wenigartner and Reiter (1963) who refer to the area of capital budgeting (Santhanam & Kyparisis, 1996, p. 383; Reiter, 1963, p. 32). Thomson (2003, cited in Rungi, 2010, p. 117) sees interdependencies "as a contingent relationship among tasks and activities". Rungi (2010a, p. 117) on the other hand indicates that analysis of interdependencies between countries, alliances, firms and teams have been prominent for decades. However, even though these interdependencies are similar to the project ones, they are not the same (ibid). Thiry (2004, p. 249) observes

interdependency in a project context specifically by arguing that it refers to the effects that projects might have on each other and to their mutual contribution to the benefits required by an organisation. Killen (2013, p. 805) and Killen and Kjaer (2012, p. 556) argue that interdependent projects are the one which success depends upon other projects and therefore a portfolio-level perspective is needed to reveal the effects that exist between projects. Rungi (2010b, p. 2) is more specific by stating that interdependencies refer to issues such as human resource sharing, modularity, knowledge diffusion among projects and cannibalisation of existing products. The phenomenon of interdependency is seen as multifaceted (Rungi, 2010, p. 118) and varying with time due to the continuous changes in goals and requirements (Verma & Sinha, 2002, p. 452). Therefore we take the broader view on PIs and adopt the definition stated by Thiry (2004, p. 249).

PIM is about managing interdependencies and interactions between projects (Patanakul & Milosevic, 2008, p. 124). Killen and Kjaer (2012, p. 556) and Rungi and Hilmola (2011, p. 147) acknowledge that PIM is importnant during both portfolio selection and portfolio reviews stages for enhancing performance of the entire organisations. Hamidovic and Krajnovic (2005, p. 679) even propose refined project success criteria that will account for the interdependencies between projects. This demonstrates the extent to which PIM became important for PM and PPM. An effective exercise of PIM, meaning that all types of PIs are considered and measures to leverage their advantages or mitigate the potential issues are taken, brings benefits to organisations. These are disscussed into more details in the section 2.2.4. Failed exercise of PIM defined in this study as inability to deliver expected benefits of PIs and/or avoid their detrimental consequences, brings negative effects that are presented in section 2.2.5.

2.2.2 Theories related to interdependencies

The PI phenomenon as argued by Rungi (2010a, p. 117) and Rungi and Hilmola (2011, p. 148) can be observed through several theories such as the contingency theory, decision-making, resource-based, network theory, PPM and interdependency theory. Staudenmayer (1997, p. 31) adds information-processing theory; whereas Aritua et al. (2009, p. 73) observes PIs through the complexity and system theory. Our study ascribe to several of these theories: PPM, complexity, contingency and resource-based theories. These theories are considered to be closely related to the PIs and the research question posed in our study. PPM and PM theories discussed in section 2.1 are given a particular attention in this study since PIM is mostly associated and discussed within these two theoretical fields (Rungi & Hilmola, 2011, p. 147; Rungi, 2010a, p. 119). The complexity, contingency and resource-based, theories are briefly discussed in this section.

Complexity theory treats organisations as collections of structures which consist of a large number of elements enteracting dynamically and non-linearly between each other and which are adaptive to the changes in the environement (Cillier, 2000, pp. 24-25). Aritua et al. (2009, p. 78) and Sanchez et al. (2009, p. 27) suggest applying the concepts of complexity theory to multi project environments. The complexity theory suits well the area of PPM and PIM since the situations that portfolio managers usually face are with ill-defined and ambiguous goals, messy, unpredictable, non-linear and context-dependent (Aritua et al., 2009, p. 78; Santhanam & Kyparisis, 1996, p. 381; Studenmayer, 1997, p.

50). Within the complexity theory, Aritua et al. (2009, p. 76) and Teller et al. (2012, p. 599) discuss the systems theory in particular. They see the multi-project environment as a complex adaptive system. Aritua et al. (2009, p. 76) stress that one of the main characteristics of this system are the interrelationships that exist between the components, projects being one of them. Rungi (2010, p. 118) seems to agree with this when stating that "projects have contingencies with each other and other contexts". Studenmayer (1997, p. 31) also seems in line with this view and describes the information-processing theory that sees organisations as open systems that must process information in order to accomplish tasks, coordinate diverse activities and understand external environment,. These theories confirm the existence and the importance of PIs. They also stress the importance of considering contextual aspects of interdependencies which is discussed next.

The contingency theory seems to be closely related to the abovementioned complexity and system theory. It acknowledges that most of the relationships that exist between any two variables are influenced by other variables and it is closely associated with the "It depends" answer to many of the strategic management research questions (Boyd et al, 2012 pp. 278-279). According to Martinsuo (2012 p. 798) the acknowledgement of the need for contextual application of various PPM practices has its roots in the contingency theory. This author indicates that some of the studies in the literature look at the business or geographical context of the organisations and the general dynamics of the portfolio environment. This in Donaldson's (1987, p. 2) terms refers to the environmental context. However, emphasis is recently given to the project types, information available, organisational complexity, degree of innovativeness, organisational governance type or the managerial style i.e. to the intra-organisational context (Donaldson, 1987, p. 2). It can be implied from this theory that there should be certain contingencies that will influence the way companies manage interdependencies and the usage of the soft or the hard PIM practices in particular. Therefore this aspect should be taken into consideration as suggested by Rungi and Hilmola (2011, p. 158).

Resource-based theory suggests that organisations' source of sustainable competitive advantage lays in the unique configuration of valuable, rare, imperfectly imitable and not substitutable resources (Barney, 1991, pp. 105-106). Having interdependent projects that share human and financial resources, technologies and know-how creates a unique composition of such resources which if properly managed, i.e. effective PIM is exercised, contributes to portfolio success that is seen in literature as a matter of strategic importance (Pellegrinelli, 2011, p. 233; Shenhar et al., 2001, p. 700; Winter et al., 2006, p. 701).

2.2.3 Project interdependency typologies

The multifaceted nature of the PI phenomenon in general, is proved by the multiple typologies and taxonomies that have been developed withinh the literature (Rungi, 2010, p. 118; Staudenmayer, 1997, p. 35-36, 82; Rungi & Hilmola, 2011, p. 149). Several typoligies constructed on the base of different rationales are demonstrated in Table 2.

Based on the description and the comparisons between the different typologies, it seems that the typologies based on nature are the most common in the literature. They discuss five common types**:** resource, market, knowledge, outcome and benefit. Therefore these five

types are adopted in this study. Resource interdependencies arise from the need of resource sharing between projects (Killen & Kjaer, 2012, p. 560; Verma & Sinha, 2002, p. 451; Schmidt, 1993, p. 404; Santhanam & Kyparisis, 1996, p. 383), including technology sharing (Santhanam & Kyparisis, 1996, p. 383). Staudenmayer (1997, p. 50) argues that they appear because of three conditions: presence of resource demand, limited availability of the resources and unequal allocation. The resource-related PIs are found to be the dominant issue in PPM (Blichfeldt & Eskerod, 2008, p. 360) that usually receives the greatest attention from management when compared to the other types of interdependencies (Sanchez et al, 2007, p. 30). It seems that this interdependencies stem from the resource-based theory that regards interdependencies as arising from "shared access or/and use of a common stock of resources" (Staudenmayer, 1997, p. 50).

Authors	Typology	Basis	Description
Verma and Sinha (2002, p. 451)	Resource	Nature	Need for resource sharing
	Technology		Need to leverage knowledge created in other projects
	Market		New product enters a market of an already existing product or uses knowledge of the current market
Zuluaga et al. (2007, p. 2) **Santhanam and Kyparisis (1996)**	Resource		Sharing hardware and software between projects
	Benefit		Synergy of implementing interdependent projects
	Technical		Development of one ICT system necessitates development of another system
Teller et al. (2012, p.600)	Outcome		Project dependent on the results of another project
	Resource		Need for resource sharing
	Knowledge		Knowledge from one project used by other projects
Killen and Kjaer (2012, p. 560)	Outcome		Project dependent on the results of another project
	Learning		Knowledge from one project used by other projects
	Resource		Need for resource sharing
	Other		Other factors of interrelationships
Schmidt (1993, p. 404)	Resource		Need for resource sharing
	Benefit		Synergy of implementing interdependent projects
	Outcome		Project dependent on the outcomes of another project
Killen and Kjaer (2012, p. 560) **Newell et al. (2008, p. 36)**	Minor	Strength	Project is not significantly related to the other projects
	Important		Problems in other project can cause detrimental effects on the project
	Critical		Problems in other project can cause significant detrimental effects on the project
Bardhan et al. (2004)	Hard	Quality	Capability developed for one project is needed by another project/s
	Soft		Capability from one project supports capabilities required by other projects
Thompson (cited in Staudenmayer, 1997, p. 33)	Pooled/ generalised	Structure of links	Indirect dependence through a common pool
	Serial/ sequential		the output from one part in input to another
	Reciprocal		the outputs of each part become inputs for the other

Table 2: Project interdependency typologies

Knowledge interdependencies arise when knowledge and expertise generated by one project is used by other projects in a portfolio (Teller et al, 2012, p. 600). Teams from

concurrent projects for example can interact in order to solve problems that are shared by all projects. If knowledge diffusion in terms of technology does not take place, there is a risk that an organisation will be inventing the same wheel (Rungi & Hilmola, 2011, p. 149). Verma and Sinha (2002, p. 452) refer to this as technology interdependency whereas Killen and Kjaer (2012, p. 560) name it as learning interdependency.

Market dependencies occur in case when a new product enters a market of an already existing product or when the existing market knowledge is used for new products (Verma & Sinha, 2002, p. 452). Furthermore they occur when multiple projects compete because of same or similar objectives (Rungi & Hilmola, 2011, p. 150). Furthermore, Teller et al. (2012, p. 600) and Killen and Kjaer (2012, p. 560) introduce outcome interdependencies, meaning that a project is being dependent on the results of another project. Santhanam and Kyparisis (1996, p. 383) refer to this as a technical interdependency where development of one ICT system/project necessitates development of another. Santhanam and Kyparisis (1996, p. 383) and Zuluaga et al. (2007, p. 2) discuss benefit interdependencies that occur when the benefits for the organisation increase non-linearly due to the synergy of implementing two or more interdependent projects or decrease if the projects cannibalise each other.. This is similar to the definition of Schmidt (1993, p. 404). Therefore various types of interdependencies must be comprehended by organisations in order to make the best possible decisions considering potential flow-on effects between projects in a portfolio (Killen & Kjaer, 2012, p. 556)

The discussion presented in this section contributes to meeting the first research objective of the study and leads to formulation of the first proposition: *There are various types of PIs present in a project portfolio in an ICT organisation.*

2.2.4 Benefits of effective project interdependency management

Consideration and management of PIs are seen as a key prerequisite for developing a manageable and successful project portfolio where project selection and review process can become more effective (Rungi, 2010a, p. 117; Rungi 2010b, p. 2; Thiry, 2004, p. 250; Teller et al, 2012, p. 597; Archer & Ghasemzadeh, 1999, p. 210). Standard in PPM and PM such as PMBOK (2013, p. 6) also recognise the importance of PIM. Sanchez et al. (2009, p. 18) argue that it is strategic issue for organisations. When properly exercised and when all PIs are considered, projects that fit better are selected and the success rate of completions is usually increased (Rungi, 2010b, p. 1). These two benefits seem to contribute to “strategic fit” and “average project success” dimensions of portfolio success. Furthermore, the impacts between projects are understood so that problems can be solved easier (Patanakul & Milosevic, 2008, p. 124). Optimal benefit delivery can be assured where group success is maximised as opposed to the individual project success (Patanakul & Milosevic, 2009, p. 218). These seem to be related to the “exploitation of synergies” success dimension. Same holds for Thiry (2004, p. 249) and Larsen et al. (2006, p. 7) who argue that PPM must take into consideration the interfaces or interdependencies between projects, so when actions are taken they account for the synergies among projects. Hereby, Rungi (2010b, p. 150) indicates specific synergy gains: sales increase or cost decrease and resource savings (Schmidt, 1993, p. 404; Liesio et al., 2008, p. 680; Rungi & Hilmola, 2011, p. 153) and a subsequent profit boost. Canonico and Söderlund (2010, p. 803) measure the degree of

synergy exploitation of PIs based on the extent to which different project teams are required to cooperate to achieve the project goals. Crawfor and Haaland (1972, cited in Bendoly et al., 2010, p. 387) point on two more benefits of interdependencies: increased helping and information sharing. Danilovic and Sandkull (2005, pp. 193, 194) also discuss about information sharing and Formentini and Romano (2011, p. 545) specifically stress the significance of knowledge sharing.

Rungi (2010b, pp. 6, 8) in his empirical study provides more particular reasons of the usage of PIM in practice: to leverage benefits, to manage common resource pool effectively, to save resources and to deal with many overlapping activities. The author also states that PIM enables to overcome difficulties in making decisions, to find better solutions, to have easier control and to see the big picture which seems to be important for maintaining portfolio balance. Lycett et al. (2004, p. 290) and Larsen et al. (2006, p. 7) point towards similar reasons such as reduction in backlogs, reworks, delays and overlap and waste of resources. All of the abovementioned reasons indicate the practical benefits that companies usually reap from implementing PIM. These benefits of effective PIM are closely related to the indicated dimensions of portfolio success as stated in section 2.1.4.

The discussion presented in this section contributes to meeting the first research objective of the study and leads to formulation of the second proposition: *Effective PIM delivers a range of benefits contributing to the portfolio success.*

2.2.5 Negative effects from failed project interdependencies management

Aritua et al. (2009, p. 76) argue that some of the most difficult tasks in managing multiple projects are coordination of resources, schedule and costs and more importantly "maximising value from the combination while optimally managing the risks of the combination". Hereby, without attention to PIs "local suboptimum reigns" (Patanakul & Milosevic, 2009, p. 218). Many detrimental effects may occur due to the failure to consider PIs and subsequently distort portfolio success: schedule slippage, cannibalisation of resources and markets, resource misuse and shortage (Dooley et al., 2005, p. 471; Engwall & Jerbrant, 2003, pp. 406, 407; Formentini & Romano, 2011, p. 545; Hossain & Ruwanpura, 2008, p. 2421; Lycett at al., 2004, p. 294; Rungi & Hilmola, 2011, p. 156) These effects may distort budgets, expected durations and revenues of projects in a portfolio and therefore negatively affect "average project success" dimension of portfolio success. This may in turn cause intracompany or inter-project competition (Lycett et al, 2004, p. 294), reactive behaviour, short-term problem solving (Engwall & Jerbrant, 2003, p. 406), failure to exploit organisation learning (Lycett et al., 2006, p. 294) and other synergies (Lechler & Teichert, 2006, p. 2668) and evidently affect the "exploitation of synergies" success dimension. Furthermore, failure to consider PIs may lead to unforeseen risk transferences (Sanchez et al., 2009, p. 20) and a money drain for any company (Lee & Kim, 2001, p. 111), which can distort "portfolio balance" and "commercial success" respectively.

The discussion presented in this section contributes to meeting the first research objective of the study and leads to formulation of the third proposition: *Failed PIM causes a range of negative effect distorting the portfolio success.*

2.2.6 Challenges of project interdependencies management

All of the negative effects that the failed management of "combination" of projects (Aritua et al., 2009, p. 76) can cause, need to be considered. This is indeed the main task of PPM as argued before. However this task seems to be very difficult since the PI issues pose significant challenges to the portfolio managers. Hereby, Danilovic and Sandkull (2005, p 196) acknowledge that the task of identification of PIs and their management can be difficult. As Rungi (2009, p. 1509) argues, it may require more human resources and time since implementation of PIM procedures and evaluation of PIs regularly may be seen time-consuming by portfolio managers (Rungi, 2010b, p. 4). The lack of theoretical knowledge and knowledge on the practical supportive tools can be another challenge (ibid).

Despite these general types of challenges that portfolio managers may face, there are certain challenges that are closely related to particular types of PIs. For example, overcoming the opportunistic behaviour is closely related to managing resource interdependencies. Engwall and Jerbrant (2003, p. 407) state that there might be a case of artificial pushing a project into a crisis in order to get the priority and support for the company's resources; or simulating occupation of available resources to mitigate the risk of not getting back the resources once they are shared with other projects. This phenomenon of reluctance towards sharing and cooperation is also observed through the "social dilemma" concept discussed by Bergeron (2007, p. 1091). According to this author sharing scarce resources may create a social dilemma in which the project manager may get better pay-off if he/she does not share, but the organisation as a whole may suffer.

Zika-Viktorsson et al. (2006, p. 386) discuss human resources sharing in particular whereby it seems that the obstacles for leveraging knowledge are revealed. The authors argue that project co-workers involved in too many projects and lacking opportunities for recovering between their assignments show deterioration of their motivation and working performance, lack opportunities for individual professional development and go through high levels of psychological stress. This lead to a situation where sharing knowledge, especially tacit one (Tiwana, 1999, p. 51), would not be feasible and it would be challenging for managers to cope with. One of the challenges of management of market dependencies seems to be closely related to the knowledge management as it is difficult to collect, store and make people in the company share and use the knowledge (Tiwana, 1999, p. 76) on markets that their projects are operating in.

Managing outcome interdependencies can be challenging as well because of the need for closely coordinating results between projects (Teller et al., 2012, p. 600). It often happens that projects managers are focused on their projects exclusively (De Reyck et al, 2005, p. 524) and are not concerned with the significance of other projects in a portfolio and their results. An evident challenge that portfolio managers need to overcome is to make project managers have a holistic picture of the portfolio. Creating a group of projects that will exploit benefit interdependencies i.e. synergies as referred by Santhanam and Kyparisis (1996, p. 383) may pose challenges for portfolio managers due to the information overload and the lack of quality of information (Elonen & Arto, 2003, p. 398). Because of the information overload portfolio managers might not be able to identify the relevant

information or may consider inaccurate estimates that may lead to selection of projects that will not bring the expected benefits (ibid).

The discussion presented in this section contributes to meeting the first research objective of the study and leads to formulation of the fourth proposition: *PIM is a difficult task within PPM that presents a range of challenges to the managers.*

The negative effects of failed PIM per se along with its challenges imply a need for certain managerial practices that will enable managers to consider and manage interdependencies. These practices are discussed in the next section.

2.3 Project interdependencies management practices

In order to manage the issues arising from the PIs "the company should be able to choose the best set of available methods in order to address its singular needs in portfolio management" (Padovani et al., 2008, p. 20). Increasing degree of project complexity and PIs which are characteristic of project portfolios performed in modern multi-project organisations suggests that traditional PPM tools that consider projects isolated from each other are insufficient (Killen 2012, p. 805). This indicates the need for investigation of contemporary practices (tools, methods, and techniques) used to facilitate the management of PIs within a portfolio.

Many rational, "hard" tools have been indicated in the literature for PPM in general. They are considered to be efficient, expert-led and with stringent control against goals (Pollack, 2007, p. 267). However, it should be noted that, as Patanakul and Milosevic (2008, p. 124) discovered, "even though multiple-project managers must deal with PIs and interactions on a daily basis, still, not many tools and techniques are available for them" to manage this particular issue. Even tools that have been developed, as for example optimisation models, are not used often in practice because of the large amounts of input data required or because of their inability to model risk and complexity (Archer & Ghasemzadeh, 1999, p. 208). This is also reckognised by Chen and Cheng (2009, p. 390) and Cooper (1993, cited in Archer & Ghasemzadeh, 1999, p. 208) who argue that many of the project selection methods are considered to be complex and difficult to use because of the data requirements. Rungi (2010b, p. 4) identifies two more reasons for the avoidance of hard practices: lack of time to implement interdependency procedures and lack of theoretical knowledge and knowledge on the practical supportive tools. Rungi (2010b, p. 6), Rungi (2009, p. 96) and Rungi and Hilmola (2011, p. 150) confirm these with the finding that companies choose not use knowledge intensive and complex solutions, but more informal solutions such as gut feeling, sacred cow, meetings, group decision support systems or visual methods. The finding of Patanakul and Milosevic (2008, p. 124) that a multiple-project manager relies on "seeing the big picture and not getting lost in details" is also in line with the finding of the previously mentioned authors.

Even though Santhanam and Kyparisis (1996, p. 394) indicate that some hard practices such as mathematical programming methods are integrated in many commercial software, as Ms Excel and that there are many user-friendly tools, it seems that most of the researchers agree that these models are not used often in practice and that more informal

soft practices are implemented. These soft practices are emphasising learning, participation, facilitated exploration of projects, and interest in social processes (Pollack, 2007, p. 267). Nevertheless, in general, the hard tools are more tangible, with well-defined structure (Pollack, 2007, p. 267); they provide precision and an objective decision making (Bardahan et al., 2004). Therefore in our study we take into consideration both "hard" and "soft" practices.

The next two sections, 2.3.1 and 2.3.2 discuss hard (analytical, quantitative or any other objective formal methods) and soft (practices accounting for such intangible managerial aspects as organisational culture, political power distribution, leadership, etc.). Efforts were made to identify practices that deal with at least one type of the indeterdepenencies indicated in section 2.2.3.

2.3.1 Hard practices of project interdependencies management

Many theoretical and practical models have been developed to support the PPM process (Ghapanchi et al., 2012, p. 791; Eilat et al., 2006, p. 1020) using various metrics (Disckinson et al., 2006, p. 518). However, many of these models consider projects in isolation (Dickinson et al., 2006, p. 519; Killen, 2013, p. 805; Killen & Kjaer, 2012, p. 554; Lee & Kim, 2001, p. 111). Archer and Ghasemzadeh (1999, p. 209) provide a summary of the PPM techniques that facilitate the decision making but only some of them consider PIs: optimisation models and portfolio matrices (Ghapanchi et al., 2012, p. 793; Rungi, 2010b, p. 5). Optimisation methods select the combination of projects that deliver the maximum benefit. These models are primarily based on mathematical programming and therefore Cooper et al. (1998, cited in Dickinson, 2006, p. 519) refer to them as mathematical programming tools. These tools such as scheduling and resource allocation optimisation models (Blecic et al., 2008; Zuluaga, et al., 2007) are able to take into consideration PIs (Archer & Ghasemzadeh, 1999, p. 210).

Portfolio matrices are used for strategic decision making as well as for prioritisation and allocation of resources and based on the description provided by Archer and Ghasemzadeh (1999, p. 209) it can be implied that they may consider interdependencies between projects. Cooper et al. (1998, cited in Dickinson, 2006, p. 519) also add mapping portfolio tools that are used to visualise the portfolio balance through graphical and chartering techniques. Dickinson (2006, p. 520) acknowledge that these tools cannot be used for project prioritisation or selection, but for visualising PIs which is applicable for ongoing PPM.

Ghapanchi et al. (2012, p. 793) conduct a literature review and indicate some of the studies that discuss models considering PIs. Their study is used as a base for our further investigation of hard practices in literature. Since the optimisation models and visual tools have been indicated in literature as the only types of techniques that consider PIs, their principles of functioning as well as benefits and limitation are discussed in more details in two following sections 2.3.1.1 and 2.3.1.2.

Regarding the contextual application of the hard practices it can be noticed that many of them can only be applied in an organisational context where the required input data is readily available (Rungi, 2010b, p. 4). Furthermore, there should be knowledge existing in

an organisation about the hard practices in general (ibid) and expertise in utilisation of particular methods (Lee & Kim, 2001, p. 116). Rungi (2010b, p. 5) further found out that organisations need to devote time to implement and use hard tools. Stummer and Heidenberger (2003, p. 176) indicate another contextual condition by arguing that hard practices are applied in cases when the level of portfolio complexity is very high, with high resources at stake, requiring more sophisticated analytical processing in order to generate effective solution. This follows the implications of the contingency theory and particularly the intra-organisational contexts suggested by Donaldson (1987, p. 2).

2.3.1.1 Optimisation models

Optimisation or mathematical programming consists of different methods such as linear programming, goal programming, game theory (Khorramshahgol et al., 1988, p. 265), dynmic programming (Lee & Kim, 2001, p. 112), non-linear and quadratic programming (Chen & Cheng, 2009, p. 390). 17 optimisation models (see Appendix 1 for detailed description of each model) have been identified in the literature, which are argued to provide an optimal solution for various PPM tasks (e.g. Blecic et al., 2008; Colvin & Maravelias, 2011; Shackelford & Corne, 2001). Most of them are non-linear programming methods able to account for PIs (Santhanam and Kyparisis, 1996, p. 392). The aim of the non-linear programming is to minimise or maximise a mathematical function (e.g. portfolio value) which along with the functions that describe the constraints is non-linear (Thefreedictionary, 2013). Chen and Cheng (2009, p. 390) suggest that optimisation models can consider multiple objectives and constraints, such as resource and schedule constraints, deriving from PIs for instance.

Optimisation models differ in the particular ways they are developed (for example they are based on different algorithms) and used (project scheduling versus resource allocation for instance). Furthermore they differ in the types of PIs they consider or the number of projects which they can account for. For example, the Collaborative evolutionary multi-project scheduler developed by Shackelford and Corne (2001) considers only resource interdependences, whereas the Data Envelope Analysis developed by Eilat et al. (2006) considers resource, benefit and outcome interdependencies; Multi-objective evaluation model (Blecic et al., 2008) considers PIs between pairs of projects whereas the Mathematical model with non-linear 0-1 polynomial programming developed by Santhanam and Kyparisis (1996, p. 381) can consider PIs between more than two projects.

The main benefits of these models are their capability to enable more accurate evaluation and prioritisation of projects (e.g. Bardahan et al., 2004, p. 35), provide solution in complex situations (i.e. considering multiple PIs) (e.g. Eilat et al., 2006, p. 1022; Schmidt, 1993, p. 404; Lee & Kim, 2001, 112), interactively explore the whole domain of possible solutions (e.g. Blecic et al., 2008, p. 163), maximise certain project or portfolio objectives such as net present value (Zuluaga, et al., 2007, p. 3) while minimising costs for example (e.g. Aaker and Tyebjee, 1978, pp. 30-31). Some of them are also able to account for complexity by taking into consideration stochastic data, which contradicts the arguments of Archer and Ghasemzadeh (1999, p. 208) of inability of hard practicies to account for complexity. This contradiction seems to arise from the fact that these tools have been developed recently, and are therefore not accounted by Archer and Ghasemzadeh. Regarding drawbacks, many

optimisation models are restricted by availability and reliability of input data (e.g. Aaker & Tyebjee, 1978, p. 36; Liesiö et al., 2008), requirement of input data to be quantifiable (e.g. Dickinson et al., 2001) and by the fact that they can consider only limited number of projects (often only two), types of PIs (Rungi, 2010b, p. 5) or portfolio objectives. Moreover they require expertise in using quantitative models in order to receive reliable results and sometimes their operation can be very complicated and time consuming (Lee & Kim, 2001, p. 117, Rungi, 2010b, p. 5).

It should be noted that the 17 optimisation models do not comprise a complete list of the existing in literature optimisation models. They represent just a sample in order to get an understanding of the hard tools and their most frequent benefits and drawbacks in addition to the aforementioned ones in section 2.3.

2.3.1.2 Visual tools

Two types of visual tools have been identified in the literature: dependency matrices and network mapping. Danilovic and Sandkull (2005, p. 196) and Killen (2013) explain that dependency matrices represent matrix-based method used to visualise and manage PIs by plotting them in rows and columns. The specific benefits of this matrices are seen in providing transparency and synchronisation between projects. Danilovic and Sandkull (2005, p. 193) specifically discuss the applicability of this method within the context of complex products development that is seen comparable to the multi-project context. They focus on applying this method for managing knowledge PIs. According to them by applying dependancy matrixes managers get an improved understanding of the context and the need for information exchange. However Killen (2013, p. 807) argues that dependency matrixes can account only for PIs between pairs of projects. Although Danilovic and Sandkul (2005, p. 200) and Dickinson (2001, p. 523) indicate that they can be used for analysing more than two projects, they still cannot account for complex PIs (Killen & Kjaer, 2012, p. 558).

Killen and Kjaer (2012) and Killen (2013) propose network mapping. Network maps, or visual project mapping technique as referred by Killen and Kjaer (2012, p. 559) are excellent tools for visualising PIs. In this visual project maps, each project is presented as a node in a network and arrows are used to identify PIs (Killen, 2013, p. 807; Kilen & Kjaer, 2012, p. 559). The weight or the colour of the arrow identifies the strength or the type of the relationship that exists between projects (Killen & Kjaer, 2012, p. 559). They are also supported with software tools. The project maps, as opposed to dependency matrixes, are able to represent multiple PIs (Killen, 2013, p. 807) that are very important for fully understanding the PIs within a portfolio. The visual project maps were found in Killen's (2013, p. 811) experiment study to have better effect on decision making when compared to non-graphical lists. They helped managers to see a big picture of the portfolio. However, it requires time to develop visual tools and demands data and methods to account for the dynamic nature of the portfolio (Killen & Kjaer, 2012, p. 562).

The discussion presented in this section contributes to meeting the second research objective of the study and leads to formulation of the fifth proposition: *Organisations use*

optimisation models and visual tools as hard practices of PIM that have certain benefits, drawbacks and context in which they are applied.

2.3.2 Soft practices of project interdependency management

The PPM literature seems to be scarce in providing a sufficient representation of "soft" practices in the area of PIs management context. However several practices have been identified through the literature review and they are discussed in more details in this section.

Rungi (2010, p. 2) indicates informal methods of PIM such as "sacred cow" and "gut feeling". In "sacred cow" the author refers to Pennypacker and Dye (1999, p. 141), who state that sometimes projects are included into the portfolio just by the initiative of powerful official in the company. Therefore in case of the need to manage conflicts between interdependent projects, the "sacred cow" project is given a priority without questioning the decision of the senior. This is related to the observation of Elonen and Arto (2003, p. 397) who characterise PPM to be fraught by power and political processes. Power is found by Pfeffer (1992, cited in Elonen & Artto, 2003, p. 398) to be very important in decision making that involves PIs. However, there is a risk that the imposed decision will be perceived as authoritarian or political and cause PPM participants' dissatisfaction.

"Gut feeling" as informal method of managing PIs means that decision are made on the basis of intuition (Rungi, 2010, p. 2). Shackelford and Corne (2001, p. 1132) extend this idea by inclusion of experience or any kind of implicit information that the decision-maker may unreservedly possess, but has no means of indicating it explicitly in a formal way. Referring to the role of multi project master scheduler they state that the "gut feel" represents an experience-driven knowledge of how the portfolio plan should be mapped out. In particular the authors suggest that this knowledge may relate to information on suitability of using several different resources simultaneously, the seasonal factors, if applicable, or cultural information. This information and experience may induce master scheduler to make various changes in plans of interdependent projects. However both practices identified by Rungi (2010, p. 2), "sacred cows" and "gut feeling" – imply high level of subjectivity in decision-making and may involve significant risk of mistake.

Canonico and Söderlund (2010, p. 803) suggest another soft practice: periodical PM meetings where participants jointly develop solutions for arising strategic issues. This practice allow to manage PIs in interactive and colloborative way. Such interactions are not necessary to be formally organised and can be fostered in a regular working routine if there is a high level of trust between portfolio managers and project managers in organisation (Killen & Kjaer, 2012, p. 557) as well as culture nurturing information sharing among project teams (Aritua et al., 2009). However this practice is seen feasible mainly in organisations with a flat (Canonico & Söderlund, 2010, p. 804) or generally speaking post-beuracratic organisational structure (Vie, 2010, p. 182). Post-beuracratic organisational structure is charachterised by principles of flexibility and less hierarchical control, where managers empower employees, provide support and consultancy when needed, and practice dialogue-oriented communication approach (ibid). Alavi and Leidner (2010, p. 121) warn though that through these type of informal mechanisms it may happen that information and

knowledge are not transferred accurately from one member to another. Furthermore, Martinsuo (2012, p. 799) indicates another practice: bargaining and negotiation, which according to this author pervade actions and decision-making in PPM. However, the author indicates that it is usually not taken into consideration by rational PPM decision making frameworks as it requires investigating what is going on in the "pathways" and "boardrooms" of the organisations which might not be an easy task.

A range of authors in literature highlight the importance of creating cooperative organisational culture in order to promote cooperation through information and knowledge sharing and effective communication (Canonico & Söderlund, 2010, p. 803; Killen, 2012, p. 814; Killen & Hunt cited in Killen & Kjaer, 2012, p. 556). Kim and Wilemon (2007, p. 187) state that cultural norms often condition communication and pose difficulties in cooperation between project teams. Killen and Kjaer (2012, p. 563) in their study conclude that project culture and environment are important for an organisation's comprehension of PIs. The authors argue that cooperative culture establishing trust positively contribute to resolution of issues arising from PIs. This idea is supported by Canonico and Söderlund (2010, p. 803) who state that common culture and shared beliefs nurture leveraging synergies from PIs. Chinowsky et al. (2011, p. 170) states that with increasing degree of interdependencies more effective collaboration and information exchanges are required to ensure the meeting of expectations and fulfilment of task demands. The authors show that a lack of appropriate coordination and knowledge exchange can result in delays and potential misunderstandings. This is also in line with Lindner and Wald (2011, p. 886) that found out that cooperative culture with positive values regarding knowledge encourages knowledge sharing and trust. Strong knowledge-sharing culture should also prevent reluctance of project managers to share their resources; the phenomenon that can be defined as opportunistic behaviour (Engwall & Jerbrant, 2003, p. 407) or "social dilemma" (Bergeron, 2007, p. 1091).

This type of culture that fosters collaboration and sharing seems to be able to directly address the problem of neglecting PIs since the PIM in this way becomes embedded in the everyday life of the portfolio parties. In order to nurture this culture trainings and skills development as well as establishment of transparent rewards and recognition system can be suggested to induce beneficial exploitation of knowledge PIs (Kim & Wilemon, 2007, p. 176). Lessons learnt sessions may enable mutual interaction among projects in order to exchange and capture knowledge regarding mistakes and failure to avoid them in future (Formentini & Romano, 2011, p. 546; Killen & Kjaer, 2012, p. 557). This supports the importance of organisational learning in dealing with projects complexity (Kim & Wilemon, 2007, p. 176). However, the authors observe that sharing human resources can prevent learning transfers. If project participants are overwhelmed with pressure from multi-project assignments, transferring knowledge from one project to another may become a low priority for them. Thus potential of synergy from possessing common knowledge pool would not be realised. In this respect the importance of leadership is emphasised. It can contribute towards establishing adequate PPM system that can balance available human resources and business demands and avoid project overload of employees (Zika-Viktorsson et al., 2006, p. 392).

Canonico and Söderlund (2010, p. 797) discuss the importance of combaining diversity and standartisation of arrangements in organisations running multiple projects. The complexity of the modern project environment urges the requirements for adaptability to external changes while maintaining an optimal degree of control and accountability (Killen & Kjaer, 2012, p. 557). Therefore, Canonico and Söderlund (2010, p. 804) suggest that organisations characterised by high level of PIs should adopt interactive control systems. They allow achivement of flexibility required to deal with various types of PIs and avoid bureaucratisation while in the same time maintain high extent of control. In interactive systems "control is enabled by working proximity and proactive decision making" (ibid). It means that possibilities for open discussions between the participants of PPM process should be created in organisation. The adoption of interactive systems is most feasible in flat organisational structures with decentralised project control.

Jonas (2010, p. 820) argues that collaboration and cooperation incentives should be encouraged by the management, which emphasises the importance of organisational leadership. Jonas (2010, p. 820) refers to the role of portfolio manager as an interplay between various participants of PPM process who aims to resolve arising conflicts between project managers and encourages cooperation between different project teams for the mutual benefit. Beside acknowledging portfolio manager's role the author states that effective collaboration should arise from the general understanding that various parties involved in project portfolio realisation do not have differences in their basic interests. This requires certain knowledge and expertise about PPM from the side of company's top management. Formentini and Romano (2011, p. 545) also highlight the role of management leadership meaning that the value and benefits of knowledge exchange and collaboration should be clearly communicated to employees. However, in addition to promoting collaboration, project leaders should be able to accurately analyse situations and make effective decisions (Kirkpatrick and Locke (1991, p. 58).

Literature does not recognise any specific classification of soft PIM practices. However we believe that such practices as "sacred cow" and "gut feeling" can be seen as individual-centered, i.e. they are implemented on the level of individuals and therefore lack interactivity and do not account for various PPM participant perspectives. Opposed to that, the other five practices discussed above seem to be more group-centred, namely PIM is facilitated within a group of PPM participants, accounts for various PPM members' perspectives and facilitates more collaborative attitude to PIM.

As it can be implied form the previous discussion that soft practices, such as formal and informal meetings are more suitable for organisational contexts that are characterised with cooperative culture (Aritua et al., 2009, p. 78). Furthermore, post-bureaucratic or flat structure has been identified as another contextual condition by Canonico and Söderlund (2010, p. 804) that enables development of cooperative culture and implementation of colaborative formal and informal meetings. The soft practices are also found to be applied in cases when it is not possible to take into formal consideration the implicit factors influencing decision-making process such as distribution of political power and experts' intuition suggested by Rungi (2010, p. 2). Furthermore as Polack (2007, p. 276) argues soft practices can account for intangible factors such as social processes pervading personnel motivation and empowerment, organisational learning or knowledge sharing and can

therefore be applied in a situation when consideration of these factors is needed. Polack (2007, p. 271) further argues that soft practices should be considered for areas characterised with high degree of change such as information system development. Rungi (2010b, p. 5) also relates the more informal practices with organisations that are less experienced in PPM. Most of these contexts closely resemble to the intra-organisational contexts identified by Donaldson (1987, p. 2), demonstrating the contingent nature of the soft PIM practices implementation.

The discussion presented in this section contributes to meeting the second research objective of the study and leads to formulation of the sixth proposition: *Organisations use soft practices (individual- and group-centred) of PIM that have certain benefits, drawbacks and context in which they are applied*.

2.4 Theoretical framework diagram

The literature review section discusses the general notions of PPM, as well as the other five concepts that seem to be the key for answering the stated research questions: PIs, benefits of effective PIM, negative effects of failed PIM, challenges of PIM, hard and soft practices of PIM. The theoretical framework presented in Figure 1 and explained below summarises the theoretical findings discussed in the preceding sections.

As demonstrated in Figure 1, multiple types of PIs can be present in the project portfolios of the organisations within the ICT industry, such as resource, knowledge, output, market and benefit PIs. It is recognised that failed PIM leads to negative effects. Contrariwise it is discovered that effective PIM, is closely related to dimensions of portfolio success such as synergy exploitation, average project success, commercial success and portfolio balance. Therefore PIM is found to be an important area of PPM, although it can be found difficult due to the presence of various challenges. In order to manage PIs, i.e. leverage possible benefits and avoid potential negative effects, hard and soft practices of PIM are implemented. Two types of hard practices are indicated in this study: optimisation (mathematical) models and visual tools. Soft practices are divided in our study into individual-centred (“sacred cow”, “gut feeling”, leadership) and group-centred practices (cooperative working culture, periodical PM meetings, interactive control systems, provision of role clarity, lessons learnt sessions and trainings and skills development initiatives). These theoretical findings and related discussions presented in the literature review section are based on the PPM, contingency, complexity and resource-based theories that are recognised to be closely related to the area of PIM.

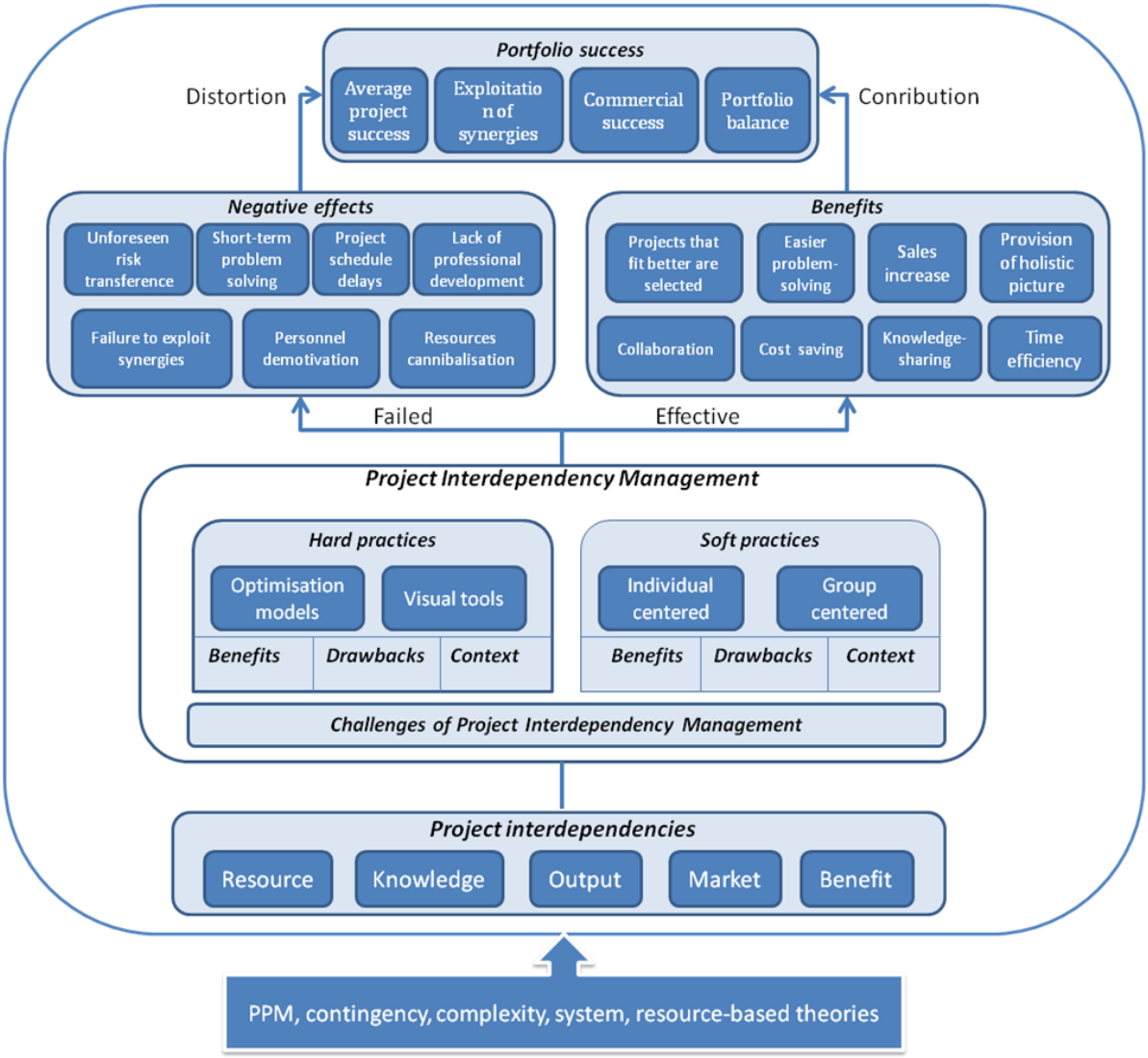

Figure 1: Theoretical framework

3 ICT Industry

The ICT sector is an exemplary area where project management is practiced extensively. The Organisation for Economic Cooperation and Development (OECD) defines ICT sector as "combination of manufacturing and services industries that capture, transmit and display data and information electronically" (OECD, 2002, p. 81). This definition of the ICT sector seems to be widely accepted since it allows for comparable statistics from country to country (April, 1999, p. 4) and therefore we adhere to it as well. ICT products and services are seen as the main drivers of productivity growth, economic performance (European Commision, 2013), research and innovation (OECD, 2010). According to the official website of the European Commission the ICT sector is responsible for substantial share of the European Union GDP and employment. The facts that the most valuable company, Apple, comes from the ICT industry (DeCarlo, 2013) or that more than 75% of the world's inhabitants now have access to mobile phones and that 50 billion mobile applications have been downloaded in 2012 (World Bank, 2013) support the statement of the important role that the ICT is playing in contemporary economy.

Except from being important from a general economic perspective, the ICT industry is significant for analysis from a management perspective since it is one of the industries that are closely associated with PM and PPM. Rungi (2009, p. 1509) and Soderlund and Maylor (2012, p. 689) argue that ICT is a modern and emerging PM-oriented industry along with the more traditional project sectors such as the construction industry. Jamaluddin et al. (2010, p. 1575) by studying 42 ICT companies found out that 98% of the interviewed employees were involved in PM. The study of Turner et al. (2010, p. 751) shows that all of the companies from the ICT industry they examined practiced PM, either for product development or client projects. The increased number of project managers and PM competences such as conflict management demanded by the ICT industry (Calisir & Gumussoy, 2005, p. 635) provides further indication of the extent to which PM in general has become a part of the management of the ICT based organisations. The PMI fact sheet from 2006 revealed that more than 35 000 of the 212 000 members of this organisation work in the ICT industry (Rivard & Dupre, 2009, p. 20). All of the aforementioned facts demonstrate the extent to which this industry has become project-based.

Kloppenborg and Opfer (2002, p. 12) found out that the ICT area is one of the dominant areas addressed in the PM literature. Fasanghari et al. (2007, p. 1488) provide similar arguments that most of the studies on project portfolio selection focus on the ICT sector, along with R&D and marketing. Their finding provides evidence that portfolio practices are present within this industry. Development of IT PM (Marchewka, 2000; Schwalbe, 2010) as a separate area within the general PM field confirms the popularity and the importance of the ICT industry and projects for the researchers. It is worth noting that when researchers refer to the ICT industry and PM and PPM, they usually discuss both ICT-using industries and ICT-producing ones (Jalava & Pohjola, 2002, p. 190). This study involves case studies from the ICT producing industry in particular.

The ICT industry faces many challenges, one of them being the increased complexity of the products as they now become combination of mechanics, electronics, software and services

(Kropsu-Vehkapera et al. 2011, p. 273). Its highly competitive and global nature (Hamidovic & Krajnovic, 2005, p. 677) represents another challenge that companies operating in this sector need to face. The proliferation of IT project failures, on the other hand, makes this industry even more interesting (Calisir & Gumussoy, 2005, p. 632). The Standish Group (2008) CHAOS research reports that only 32% of all IT projects succeeded in terms of being delivered on time, budget and with the required features and functions, 44% were challenged (late, over budget, or delivered with less than required features and functions), whereas 24% failed. The aforementioned challenges make the effective PM and PPM to be the main success factor for ICT companies (Standish Group, 2008). Thorp (1998, cited in De Reyck et al., 2005, p. 525) supports this statement by arguing that PPM plays an essential role in extracting value from IT projects. Hamidovic and Krajnovic (2005, p. 678) add to this by arguing that PPM within ICT industry provides basis for balancing resource capacities and achieving strategic alignment between the projects. Hereby, they stress the importance of considering PIs as they argue that "no project exists on its own". These arguments along with the evidence on the importance of the ICT industry for the economy and the PM field is an indication that this industry offers an excellent ground for studying PIs and challenges that portfolio or program managers are experiencing.

4 Methodology

This section discusses the philosophical and methodological stances that underlie this study. It starts with an overview on the ontology and epistemology that we ascribe to and continues with detailed description of the employed methodology, research strategy, research approach, and perspective taken. The description is accompanied with evidence that demonstrates the alignment between the aforementioned concepts. It also contains indication of the advantages of the employed methodology and research strategy as well as their limitations and the actions undertaken for overcoming them.

4.1. Philosophical stance

The philosophical stance represents the assumptions we hold about the way we see the world and it is usually explained through ontology and epistemology (Saunders et al, 2009, p. 108). The ontological stance conveys the "assumptions held about the nature of social reality" (Long et al., 2000, p. 190). The epistemological stance coveys the assumptions held "about the basis of knowledge and in what manner the knowledge can be transmitted to others" (Long et al., 2000, p. 190). Three major philosophical stances are distinguished by Saunders et al. (2009, p. 108) and Wainwright and Forbes (2000, p. 260): positivism, realism and interpretivism. The main characteristics of these philosophies are summarised by Delanty (1997, cited in Wainwright & Forbes, 2000, p. 261) as demonstrated in Table 3.

Positivism	Interpretivism	Realism
Scientism, unity of scientific method and matter (natural science taken as a model for social science)- **objectivist ontology**	Anti-scientism (separation of natural and social science in both method and matter)- **subjectivist ontology**	Believe in objective reality, whether of entities, theories or values- **objectivist ontology**
Empiricism, where experimentation leads from observation to verification- **empiricist epistemology**	Interpretation of meaning (hermeneutics)- **interpretative epistemology**	Emphasis on causal explanation rather than description, via qualitative research- **relativist epistemology**
Hypothesis testing, law like generalizations through	Linguistic constructivism (language defines the social world, tendency towards epistemological relativism)	Structure and agency are given the same weight

Table 3: Summary of major philosophical stances (adopted from Delanty, 1997, cited in 1997, cited in Wainwright & Forbes, 2000, p. 261)

Within realism, the philosophical stance of critical realism has developed. Ontologically it is considered to be least restrictive perspective able to accommodate insights from other philosophies, such as positivism and interpretivism (Bhaskar & Danermark, 2006, p. 295). Lyubimov (2011) argues that critical realism "requires a deep understanding of any social situation, going beyond the observable and investigating the mechanisms behind any event". This philosophical stance is also argued to be able to account for a complex nature of the social world (Wainwright & Forbes, 2000, 272) and this is particularly beneficial for our study where PIM is recognised to be a complex area of PPM (Teller et al., 2012, p. 600). Furthermore, the fact that our study suggests change in the current PPM practice that lacks considerations of PIs (Rungi, 2010b, p. 5), is in line with the critical realism main

characteristic of advocating change (Wainwright & Forbes, 2000, 272). Therefore this philosophical stance is adopted in our study.

According to Bhaskar (1998, pp. x-xi) and Platenkamp and Botterill (2012, p.112) critical realism combines ontological realism, epistemological relativism and judgmental rationality. Hereby, ontological realism conveys the belief in the existence of the world independently of our knowledge of it (Sayer, 1992, p. 5), i.e. the existence of an objective reality is acknowledged. Critical realists recognise the presence of various entities in objective reality, which have relationships among them and hence have power to influence each other as well as capability to generate events in a real world (Easton, 2010, p. 128). By objective reality in our research we refer, for example, to the presence of projects in an organisational portfolio that have interdependencies between each other and therefore can affect each other; and de facto the existence of various PIM methods and tools in a PPM practice. Critical realism also states that the world is stratified (Sayer, 1992, p. 5), which means there is a distinction between "the real world, the actual events that are created by the real world and the empirical events which we can actually capture and record" (Easton, 2010, p. 128). The realist/objectivist ontology of the critical realism is reconciled with epistemological relativism (Ryan et al., 2012, p. 304), which means that, first our knowledge about the world is constrained by the access to the empirical events only; and second, the knowledge is always mediated by pre-acquired "conceptual resources" we use to construe, understand and explain the reality (Fleetwood, 2004, cited in Fleetwood & Ackroyd, 2004, p. 30).

Thus the task of the researcher within the critical realism stance is to "uncover the structures of social relations in order to understand why we then have the policies and practices that we do" (May, 2011, p. 11) or to explore and understand the nature of the reality (Platenkamp, 2013, p. 119). This is in line with the "why" part of our research question which is aimed on investigating why organisations from the ICT industry implement PIM. This understanding is attempted to be reached through theoretical explanation built on several theories discussed in the section 2.2.2. This corresponds to the realistic philosophical stance that is argued to take into consideration several theoretical perspectives (Rungi, 2009, p. 1509). Furthermore, since realism in general recognises progress through theoretical and empirical accumulation of research (Pawson & Tilley, 1997, cited in Wainwright & Forbes, 2000, p. 271) we both review the literature and explore empirically the phenomenon of PIM. This allows us "not simply to collect observations on the social world, but to explain these within theoretical frameworks which examine the underlying mechanisms that inform people's actions and prevent their choices from reaching fruition" (May, 2011, p. 12). The empirical data in our study was collected from people, employees of two case study organisations. Therefore the findings to certain extent should be taken as interpretations of the social world as perceived by the participants of the study (Greener, 2008, p. 17). We, as researchers, are also actively involved in the interpretation, with our own understandings and preconceptions that might have been influenced by the theoretical findings. And here we may face the problem of the double hermeneutic (Myers, 2009, p. 39). Nevertheless adopting critical realism philosophical stance we accept that the reality is partly socially constructed (Easton, 2010, p. 120) and as Sayer (2000, p. 17) argues "there is always an interpretative or hermeneutic element in social science". Nevertheless, critical realism adopts the principle of judgemental

rationality, which means that the researchers should provide adequate and rational argumentation in their explanations (Easton, 2010, p. 124; Platenkamp & Botterill, 2012, p. 120). Therefore literature is reviewed and the theoretical model is established in this paper in order to provide better understating of the phenomenon of PI, to suggest study propositions that provide rational direction for the study and the places where to look for evidence and to explain empirical findings (Yin, 2003, p. 22).

4.2. Methodological stance

The choice of methodology naturally derives from the ontological and epistemological assumptions (Long et al., 2000, p. 191). Two main streams can be distinguished here: quantitative and qualitative. Quantitative research emphasises quantification in the data collection and analysis (Bryman & Bell, 2011, p. 26). It is an approach for capturing a view on the social world as a concrete structure (Morgan & Smircich, 1980, p. 498) and for testing objective theories through investigation of relationships among variables measured with particular instruments (Creswell, 2009, p. 4). It is specifically associated with deductive approach, with accent on theory testing, and positivistic philosophical stance (Bryman & Bell, 2011, p. 26; Saunders et al., 2009, p. 114). The particular strategies of inquiry related to this research include "hard" or natural science methods (Long et al., 2000, p. 191) such as experiments and surveys (Creswell, 2009, p. 12) followed by multivariate statistical analysis (Morgan & Smircich, 1980, p. 498).

Qualitative research involves studies that investigate phenomena in their natural settings by interpreting the meanings that people attach to them (Denzin & Lincoln, 2003, p. 5; Creswell, 2009, p. 175). The emphasis is therefore on the words rather than numbers (Bryman & Bell, 2011, p. 26). Yin (2009, p. 135) argues that qualitative research methodology gives an advantage by allowing understanding and representing the complex social world as perceived by the participants. This is achieved by immersion in the situation and consideration of the context of all the participants, including the researcher him/herself (Long et al., 2000, p. 191) that does not remain as an external observer (Morgan & Smircich, 1980, p. 498). The researcher usually employs wide variety of interpretative practices in order to better understand the matter of enquiry such as interviews, personal experiences or artefacts (Denzin & Lincoln, 2003, p. 5). Therefore many times the researcher is seen as a bricoleur that produces "a pieced-together set of representations that are fitted to the specifics of a complex situation" (Denzin & Lincoln, 2003, p. 5). On the other hand, the qualitative methodology is criticised by quantitative researchers to be overlay impressionistic and subjective because it is assumed that the qualitative findings rely heavily on the unsystematic views of the researcher on what is important, and on the close relationships that the researcher develops with the participants of the study (Bryman & Bell, 2011, p. 408). Furthermore, there is other critique such as difficulty of replicating a qualitative study because of its unstructured characteristics and reliance on researcher's ingenuity, difficulty of generalising findings, and lack of transparency (ibid).

However, in line with our ontological and epistemological stance (May, 2011, p. 12), we adopt the qualitative methodology and try to exploit its advantages as well as overcome its limitations. The qualitative methodology allows us to understand the phenomena of PIM as perceived by the portfolio and project managers that participate in this study. Furthermore,

the qualitative research enables understanding of the benefits, limitations and contextual conditions (Yin, 2009, p. 135) of certain PIM practices application which is one of our objectives that cannot be fulfilled with the rigorous, hard methods associated with quantitative methodology. The argument that PI is seen as a partial phenomenon that cannot be fully observed and therefore requires a qualitative approach (Rungi, 2009, p.1509) further justifies the methodology we employ. Efforts are also made to overcome the limitations by for example providing transparent description on the way the study was carried out and by trying to remain as objective as possible during the data collection process. Furthermore, we explicitly acknowledge that the findings are not meant to be statistically generalised.

4.2.1. Research strategy

Even though qualitative methodology does not privilege any specific strategy (Denzin & Lincoln, 2003, p. 8), authors such as Creswell (2013, p. 12) and Creswell (2009, p. 12) point toward five particular strategies: narrative research, phenomenology, grounded theory, ethnography and case study. Table 4 provides brief overview on these strategies.

Characteristic	Narrative research	Phenomenology	Grounded Theory	Ethnography	Case Study
Focus	Exploring the life of an individual	Understanding the essence of the experience	Developing a theory grounded in data from the field	Describing and interpreting a culture-sharing group	Developing an in-depth description and analysis of a case or multiple cases
Type of problem best suited for design	Needed to tell stories of individual experiences	Needing to describe the essence of a lived phenomenon	Grounding a theory in the views of participants	Describing and interpreting the shared patterns of culture of a group	Providing an in-depth understanding of a case or cases

Table 4: Contrasting characteristics of five qualitative approaches

Case study as a research strategy is adopted in this study. As defined by Creswell (2009, p. 13) it a "strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals". It is a strategy that some of the best-known business and management studies are based on (Bryman & Bell, 2011, p. 59). It is also argued to be perfectly suited to the critical realism stance (Easton, 2010, p. 119). Case study allows undertaking an empirical inquiry by investigating a contemporary phenomenon, such as PIs (Rungi & Hilmola, 2011, p. 150) in depth and within its real life context (Yin, 2009, p. 18; Easton, 2010, p. 119; Piperopoulos, 2010, p. 499; Cepeda & Martin, 2005, p. 852). It allows having a holistic picture of real-life events- such as organisational and managerial processes (Yin, 2009, p. 3) related to PIM. It is the preferred method when "how" and "why" questions are asked and when the researcher has limited control over events that are investigated (Yin, 2009, p. 2; Saunders et al., 2009, p. 146). It provides flexibility (Easton, 2010, p. 119) and accounts for complexity, context and ambiguity through rich and thick descriptions (Gummensson, 2007, p. 229; Piperopoulos, 2010, p. 498) that cannot be attained with quantitative methods such as surveys. Case study is also closely associated with qualitative research whereby the phenomenon is examined extensively and in-depth (Creswell, 2013, p. 97; Yin, 2009, p. 3). Even though Yin (2009,

p. 19) argues that case study is a method on its own and should not be associated with qualitative research only, this study adopts the view of Creswell (2013, p. 97) and Rungi (2009, p. 1509) that case study strategy suits well for the purposes of a qualitative research.

4.2.1.1. Case study research cycle

According to Cepeda and Martin (2005, p. 858) a sound case study research should consist of three elements or stages that are also implemented in this study:

- Conceptual framework that "explains graphically or in narrative form, the main issues to be studied – the key factors, constructs or variables – and the presumed relationships between them" Miles and Huberman (1994, p. 18, in Cepeda & Martin, 2005, p. 858). This framework is developed in section 2.4.
- Research cycle consisting of planning, data collection, analysis and reflection. The planning stage is inferred in sections 4.2.1 and 5.2.1 where decisions regarding selection of cases, research strategy or its design are discussed. Data collection and analyses are discussed in sections 5.2 and 5.3. Reflection involves review of all the previous stages and ends with modification of the conceptual framework that will account for the knowledge gained through this study. It is discussed in section 7.
- Theory building whereby theory is referred as "system of interconnected ideas that condense and organise knowledge" (Neuman, 1991, cited in Cepeda & Martin, 2005, p. 862). In our study we refer to the theoretical propositions which we develop based on our findings and that contribute to the existing conceptual framework. This conceptual framework might serve as a base for future studies.

The case study research cycle and its interplay with the conceptual framework are presented in Figure 2. Only one cycle is applied in this study.

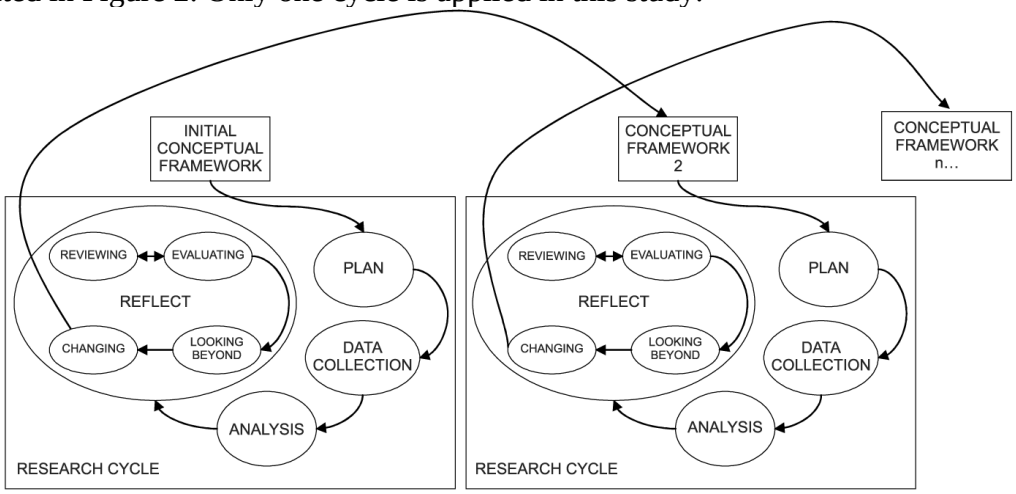

Figure 2: Conceptual frameworks and research cycle (as adopted from Cepeda and Martin, 2005, p. 858)

4.2.1.3 Case study types

This study involves two Italian organisations from the ICT industry and can therefore be considered as a multiple case study (Creswell, 2013, p. 97) as opposed to a single-case study. Multiple cases are included in order to examine the issue of PIM from different perspectives (Creswell, 2013, p. 99) and to generate findings that would be considered as

more powerful (Yin, 2003, p. 53). The rationale is also grounded in the need to examine whether the findings of the first organisation occur in the second organisation (Saunders et al., 2009, p. 146). Therefore replication is adopted whereby the individual case organisations are used for "independent corroboration of specific propositions" (Eisenhardt & Graebner, 1991, p. 620). "Literal replication" is adopted in this study whereby it is expected that the case studies will predict similar results, as opposed to "theoretical replication" that assumes contrasting results (Yin, 2003, p. 47). The limitation of the multiple case study approach is that it requires more resources and time (Yin, 2003, p. 47), but this limitation is overcome with the presence of two researchers. Furthermore, Yin (2003, p. 52) and Saunders et al. (2009, p. 147) distinguish between holistic and embedded case studies. The first one refers to the case when the organisation as a whole is examined, whereas the second, when there are multiple units of analysis related to logical sub-units within the case study organisation. The cases in this study can be considered as embedded, where the portfolio and project managers as individual employees (Yin, 2003, p. 45) are considered to be our sub-units of analysis. The limitation of embedded case studies is that it may happen that the researchers put an overly focus on the sub-units and fail to return to the larger unit of analysis. However, as we are aware of this drawback, during the data analysis we always try to refer back to the case study organisations as whole. The case study is also cross-sectional, as opposed to longitudinal, where we observe the phenomenon at a particular point in time.

Since the intent of this study is to understand how the PIs are managed, the cases are selected in order to better understand this phenomenon. Therefore, according to the typology of Creswell (2013, p. 98), they can be considered as instrumental, as opposed to intrinsic, whereby the main attention is put on the case itself. Furthermore, Yin (2009, p. 6) distinguishes between exploratory, explanatory and descriptive case studies. According to this author, case study strategy is usually associated with exploratory studies, as in our case, where the purpose is to discover how companies manage the PIs. Since we also try to explain why organisations need to manage PI, investigating benefits and negative effects deriving from them, the study is partially explanatory, but without any intents of hypothesising causal relationships.

4.2.1.4 Case study limitations and overcoming of them

Case study as a distinct form of empirical enquiry has been criticised for being conceptual, lacking in rigour, and providing evidence that is anecdotal and biased (Yin, 2009, p. 14; Lukka & Kasanen, 1995, p. 71; Gummeson, 2007, p. 228). According to Yin (2009, p. 14) researchers using case studies are criticised to fail to follow systematic procedures or allow biased views to influence the direction of their findings and conclusions. Further problem that is seen in case studies is the little basis for scientific generalisation they provide (Yin, 2009, p. 15; Easton, 2010, p. 119; Gummeson, 2007, p. 228) as they are usually based on a single instance. Another limitation mentioned by Yin (2003, p. 11) relates to the overlay effort that needs to be put in conducting a case study research because of the massive, unreadable documents that might be produced during the research. Meredith (1998, p. 444) hereby indicates that case study assumes costs, time and access hurdles, need for multiple methods or tools, lack of control and complications that may arise because of the context and the temporal dynamics.

However, Eisenhardt and Graebner (2007, p. 28) argue that bias can be limited by selecting knowledgeable informants that can discuss the phenomenon from various perspectives. This suggestion is implemented in our data collection method. Yin (2003, p. 10) counter the generalisability drawback by highlighting that the specificity of the case study is that its findings are generalisable, but to theoretical propositions and not to the entire population as in the case of statistical generalisation. This author refers to this as analytical generalisation whereas Bryman and Bell (2011, p. 61) refer to as "theoretical generalisation". This is the type of generalisation where "inquirer attempts to link findings from a particular case to a theory" (SAGE Dictionary, 2013). Therefore the goal of a case study, as indicated by Yin (2003, p. 32) is to expand and generalize theories and not to enumerate frequencies. The previously developed theoretical framework serves as a template with which the empirical results of the case study are compared with. This type of generalisability is employed in this study. Furthermore, as argued by Easton (2010, p. 119), critical realism justifies a study regardless of the number of units as long as it is conducted in a thoughtful, in-depth way whereby the objective is to discern why things are as they are. Yin (2003, p. 11) also highlights that case studies do not necessarily need to be related to massive ethnographic data, and that they easily can be conducted over the Internet, as in our case where we communicated with the respondents via Skype.

Despite the "unscientific feel" of the case study, Saunders et al. (2009, p. 147) encourage usage of case studies in cases that have explorative objectives. We follow this suggestion, as well as the suggestions of the authors that provide ideas for overcoming the case study drawbacks and adopt this strategy in this study. The suitability of a case study strategy for our research is discussed in more details in section 4.2.1.

4.2.2. Research approach and perspective

A hybrid approach, a combination of inductive and deductive approaches is used in this study. According to Saunders et al. (2009, p. 157), it is the recommended and more common approach in research in general, and a possible approach in a case study in particular (Gummensson, 2007, p. 229). Hereby, a theoretical framework, as a deductive element, is established to help us to structure the analysis and make sense of the findings (Saunders et al., 2009, p. 157). Reviewing existing theory and specifying theoretical propositions is seen as an essential step in the case study strategy that distinguishes it from the other qualitative strategies such as ethnography (Yin, 2003, p. 28; Cepeda & Martin, 2005, p. 858). It provides us with a perspective, an overall orienting lens to inform the study in terms of questions to be asked or data collection and analysis methods to be employed (Denzi & Lincoln, 2003, p. 5; Yin, 2003, p. 29). The stated propositions help us to move in the right direction and identify areas where to look for evidence (Yin, 2003, p. 22). The existing theory is also seen as the level to which the case study results will be generalised (Yin, 2003, p. 22). This type of generalisation is referred as "analytic generalisation" as discussed in section 4.2.1.4. The inferences from empirical evidence to theory along with the exploratory nature of the study demonstrate is inductive aspect. The particular perspective employed in this study is managerial one, whereby we primarily address the findings to managers in project-based organisations.

5 Research Design

This section starts with a brief description of the approach taken to select the reviewed literature and continues with a discussion on the methods used for data collection. Hereby, the units of analysis and criteria for their selection are presented, and the particular method of data collection is discussed along with its advantages and limitations. The description of the data analysis method is .also provided. Criteria of qualitative research are presented and the actions taken to ensure their fulfilment are discussed. The section concludes with an overview of ethical considerations.

5.1 Literature selection methodology

The search for the relevant literature is conducted by using the search engines accessible at the Umeå University's library resources, mainly the databases ScienceDirect, Emerald and IEEE Xplore digital library. In the literature search academic articles from peered reviewed journals are considered such as *International Journal of Project Management, Journal of Product Innovation Management, Project Management Journal, and Baltic Journal of Management.* Edited sections from relevant books (such as *The Wiley Guide to Project, Program & Portfolio management),* books and conference papers from the authors recognised in the PPM literature are also taken into account, as well as widely recognised in the project management area PMBOK standard. Google and Google Scholar are used as well for searching the web sources. In order to follow "the state of the art" in the PIM within PPM the time frame of the last 15 years is used for the majority of the papers selected, but attention is given to the seminal papers too.

The literature search is executed in two steps. First, through primary search using the following search phrases and Boolean logic: *project portfolio management, project interdependency, management of project interdependencies, interdependency management + project portfolio.* To evaluate the search results the articles abstracts are reviewed and it is judged whether a particular article is considered to be relevant for the investigated topic. And second, when going through literature review of the primarily selected papers additional articles related to the topic are identified as they are referenced in the papers under review.

5.2 Data collection

This section provides details on the way empirical evidence is collected. The units of analysis are presented and the method of data collection is discussed, along with its advantages and limitations.

5.2.1 Organisations selection

Purposeful selection is done where the cases selected are found to be relevant to the research question posed (Bryman & Bell, 2009, p. 442). The choice of the organisations is also motivated by convenience reasons (Bryman & Bell, 2009, p. 190) since the cases and the sub-units of analysis specifically are selected because the researchers had access to

them. Following our request, the MSPME programme coordinator at Politecnico di Milano provided us with contacts from two Italian organisations: Organisation X and Organisation Y. The organisations' selection is based on two criteria:

- the organisations are operating in the ICT industry since this industry is of our particular interest and it is recognised in the literature as closely associated with PM and PPM;
- the organisations are practicing PPM.

The background information about the case study organisations provided below is based on the organisation's profile description, published at their corporate websites, and on some of the respondents' answers.

Organisation X as stated on their website is an innovation-oriented organisation located in Milan, Italy, founded in 1988. It is owned by multiple shareholders: four recognised Italian universities, Public Authorities (Lombardy Region), and 15 leading multinational Companies in ICT and Media sectors. Its activities are organised around three main areas: innovation, research and education. Organisation X carries out research and development in many application fields by integrating hardware, software and the most recent multimedia communication technologies. They design a wide range of innovative products and services based on customer requirements and integrating the most recent scientific research results, the best technologies available on the market, the emerging standards and the reality of the industrial processes. Organisation X currently employs more than 140 professionals, 30 university faculty members, visiting researchers and post-graduates students. Organisation X has a hierarchical organisational structure, however is characterized by a low power-distance culture.

Organisation Y is a large commercial organisation, operating as a subsidiary of a multinational telecommunication service provider. Organisation Y with a market share of 32.8% is taking one of the leading positions in the mobile communications market in Italy. The key organisation's activities are internet service provision, mobile media and applications, telecom services, internet (general), telecom equipment and infrastructure. According to organisation's report from 31st of March, 2012, Organisation Y employs about 7600 people. In the last year Organisation Y has gone through the process of restructurisation, where the Project management department, which previously was a part of the technical department (IT department), was relocated within the business department (Product and Services department). According to Respondent 4 this was performed in order to furnish project management function in the organisation with a more business-oriented view and also to facilitate collaboration between the two departments.

Within each organisation we had a single contact person who provided support during the data collection. An introductory Skype meeting was conducted with them whereby we presented our research objectives, the data requirements, the criteria of interview respondents' selection, and we agreed on means of communication (Skype and email). During these Skype meetings we also asked the contact persons to provide us with the documents that they might consider relevant for PIM, however this request was rejected due to the confidentiality reasons.

5.2.2 Respondents selection

The contact person in each case organisation selected respondents for the interview based on the criteria set by us as the researchers:

- the respondents need to be experienced in working in a PM environment with interdependent projects (project and portfolio managers);
- the respondents need to be able to fluently communicate in English.

On the basis of these criteria, eight respondents are interviewed, three from Organisation X and five from Organisation Y. The contact persons themselves are also interviewed as they match the abovementioned criteria. The information on the positions of respondents and years of experience is displayed in Table 4.

5.2.3 Semi-structured interview procedure

As Easton (2010, p. 123) and Yin (2009, p. 11) argue, case study research is significantly eclectic in regard to the data that can be collected. However, as Yin (2009, p. 11) emphasises, it is usually associated with qualitative data collected via interviews. Hereby, two main types of interviews are distinguished: standardised (structured) and non-standardised (semi-structured and in-depth) (Saunders et al., 2009, p. 321). The first type is used to gather data that will be subjected to quantitative analysis. The second one is used for gathering qualitative data such as in case study research (ibid). Therefore, Bryman and Bell (2011, p. 465) refer to this type as a qualitative interview. This type of an interview is less structured when compared to the standardised, it is more concerned with the views of the respondents rather than the researchers' concerns, it allows "going off at tangents" or departing from the interview schedule, which is highly discouraged in standardised interviews. Case studies, and specifically multiple case studies (Bryman & Bell, 2011, p. 473), are usually associated with semi-structured interviews (Easton, 2010, p. 123). Rungi (2009, p. 1510), for instance, also implemented semi-structure interviews while studying PIs. Moreover Saunders et al. (2012, p. 377) suggest that semi-structured interviews suit well to exploratory and explanatory studies. Therefore this method is adopted in our study.

Semi-structured interviews as defined by Bryman and Bell (2011, pp. 205, 467) and Saunders et al. (2009, p. 320) refer to the case where the researcher utilises an interview guide with series of questions, expressed in general terms, which order can be varied based on the context of the interview. Therefore interview guides for the portfolio and project managers consisted of 11 general questions (see that Appendix 2) are developed. Only the first two introductory questions slightly differ from each other as to suit the role of the two groups of respondents. The questions were first sent to our contacts in the case organisations along with an outline of the purpose of the research and feedback was sought on their clarity and comprehensibility. The aim was to refine the questions and ensure that they could be understood clearly by all the respondents (Bryman & Bell, 2011, p. 475). Both contacts had not suggested any modification, so the initial question as presented in the interview guide, were used.

The first two questions are introducing ones (Bryman & Bell, 2011, p. 477) posed in order to familiarise ourselves with the respondents and their experience with interdependent projects. The rest of the questions are closely related to the established theoretical framework as demonstrated in Figure 3.

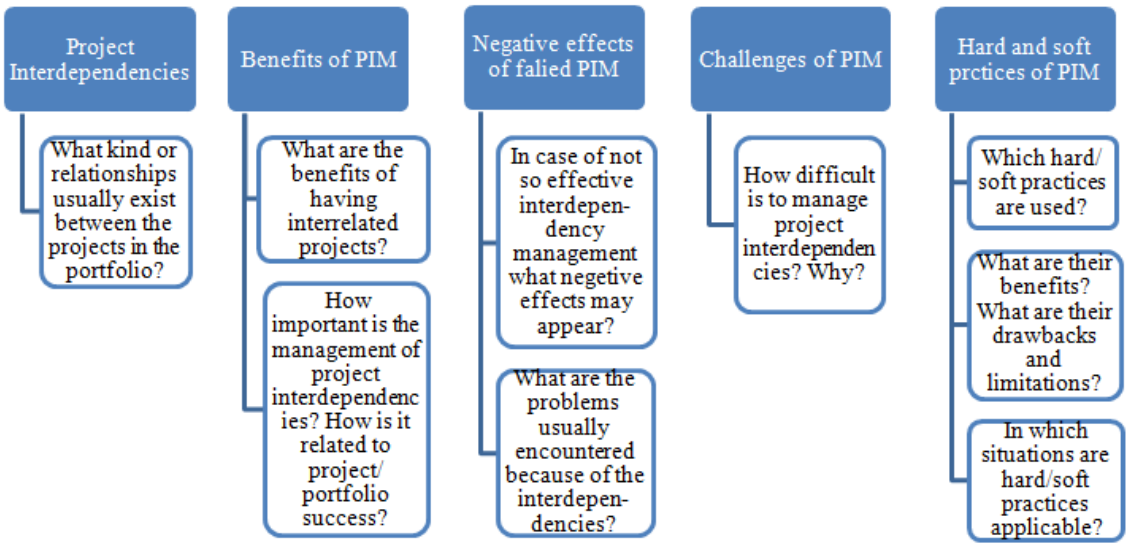

Figure 3: Theoretical framework- interview guide relationship

The interview process was flexible (Bryman & Bell, 2011, p. 467) allowing collection of rich empirical data (Eisenhardt & Graebner, 2007, p. 25). We were able to collect opinions of the human actors that attested PIM in order to record and analyse them (Easton, 2010, p. 123). Respondents were encouraged to speak freely and share their experience and knowledge as perceived by them. All the prepared questions were asked in a similar manner, but the flexibility to ask further questions in response to some important for our study replies was also retained (Bryman & Bell, 2011, pp. 205, 467; Saunders et al., 2009, p. 320). This type of an interview design is of particular importance for our multiple case study design as it allows us to introduce some structure needed for cross-case comparability (Bryman & Bell, 2011, p. 467) while retaining the flexibility to ask follow-up and probing questions. This would not have been possible if we employed in-depth interviews that are more non-directive and informal neither structured interviews that are too rigid (Saunders et al. 2009, p. 321). We as researchers tried to remain balanced, not talking too much or too less, and avoid using leading questions (Bryman & Bell, 2011, p. 475).

5.2.4 Interview proceeding

In our study we employ internet-mediated interviews (Saunders et al., 2009, p. 321) conducted in a virtual environment via Skype, because of the physical location discrepancy between the Italian respondents and the researchers located in Sweden. Therefore they can be considered as synchronous or real-time (Bryman & Bell, 2011, p. 659; Saunders et al., 2009, p. 349). The interviews took from 21 to 45 minutes. Only four interviewees were able to use web camera while we used web camera during all the interviews. Both researchers participated in all of the interviews, whereby each was asking question in a pre-agreed sequence. The follow-up and probing questions were asked interchangeably. The interviews

were recorded using Skype recording appliances and were later transcribed. The information on interview duration and transcripts length is presented in Table 5. It should be noted that the contact person from case Organisation Y was present during all the interviews carried out in this organisation. In the first interview he/she was an active respondent (Respondent 4), whereas in the rest of the interviews he/she expressed interest to attend passively in order to mitigate potential language barriers. Respondent 4 arranged his interview in combination with Respondent 5* as he/she assumed they both had similar opinions on the questions asked. Therefore, Respondent 5* did not actively participate, but only contributed with several comments that he/she considered to be omitted by Respondent 4.

Organisation	Respondent	Position	Years of experience	Interview duration, min	Transcript, number of pages
X	Respondent 1	Project manager	8	00:36:38	8
	Respondent 2	Portfolio manager	13	00:34:26	7
	Respondent 3	Portfolio manager	15	00:21:35	8
Y	Respondent 4	Portfolio manager	7	00:44:22	8
	Respondent 4*	Portfolio manager	n/a		
	Respondent 6	Project manager	12	00:24:08	6
	Respondent 7	Project manager	13	00:36:01	8
	Respondent 8	Project manager	5	00:26:56	6

Table 5: Respondent presentation

5.2.5 Limitation of qualitative interviews and their overcoming

A number of issues are related to qualitative interviews. Saunders et al. (2009, p. 326) summarises them as: reliability, generalisability and forms of bias. Because of the unstandardised nature of the interviews, the issue of reliability arises; whereby it is questioned whether different interviewers would come up with same results. Regarding generalisability, interview data is found to be difficult to be statistically generalised to the entire population (Saunders et al. 2009, p. 327). Regarding bias, Saunders et al. (2009, p. 326) distinguish two types of bias: interviewer and respondent bias. The interviewer bias occurs in case where the comments, tone or the non-verbal behaviour of the interviewers influences the responses of the respondents. Furthermore, the preconceptions or the theoretical evidence that the researchers have examined might also influence the interpretation of the responses. The means we employ in order to overcome the three above mentioned interview drawbacks closely resemble the actions we take in order to adhere to the criteria for quality research. Therefore this is explained in details in section 5.4.

Regarding respondent bias, it may be caused by the perceptions that respondents have about the interviewers. Moreover, because of the sensitivity of a topic, respondents may not be willing to reveal certain aspects, giving a partial picture of the phenomenon as a consequence. Eisenhardt and Graebner (2007, p. 28) argue further that interviews are often associated with data bias caused by the conscious attention of the respondents on the impressions they convey or the retrospective sense making. Yin (2009, 132) adds self-reporting of the respondents which may not reflect the true reality, as another drawback. In order to overcome the respondent bias Eisenhardt and Graebner (2007, p. 28) suggest

selecting informants that are knowledgeable about the phenomenon and that can view it from various perspectives, such as organisational actors from different hierarchical levels. Therefore in our study we both include project and portfolio managers. However, we acknowledge that the presence of the contact person in organisation Y may have affected the reliability of the data. Regarding retrospective sense making it is not noticed that respondents had any difficulties to recall their experience in PIM.

The particular limitation of the interviews we conducted by using Skype as a mediating technology, is that we were not always able to observe the body language and see how the respondents react in a physical sense to the questions. For example, we were not always able to see discomfort, puzzlement or confusion. However we paid attention to the verbal responses that would not have been possible if we conducted the interviews in an asynchronous environment via email for example. Another limitation of the Skype interviews can be related to the technical issues such as the cases when the line was poor and the respondents were not able to hear us well or vice versa. In this case we repeated the question or asked the respondents to repeat their answer. However, we did not experience any major problems with the connection and we were able to record all the interviews in a comprehensive manner. Another limitation of our study particularly is related to the potential presence of language barrier. All the interviews were conducted in English which is not a native language neither for the researchers nor for the respondents. The mechanisms employed to overcome this limitation are explained in section 5.4.

The drawback of our data collection method in general is that it relies only on the respondents' opinions as a source of evidence, whereas it is acknowledged that the main trait of a case study is multiple types of data sources (Yin, 2009, p. 11) used to triangulate the findings. Although we interviewed both project and portfolio managers in order to provide multiple perspectives on the investigated phenomenon and attain data triangulation as defined by Guion et al. (2011, p. 2), still this type of triangulation could be found limited. We made efforts to get one more source of evidence via organisational documents, but access was rejected due to confidentiality policies of the organisations. However, we tried to complement this with investigator triangulation (ibid) by having two researchers.

5.3 Data analysis

According to Bryman and Bell (2011, p. 571), one of the main challenges of qualitative research is to analyse a vast and difficult to handle narrative data base such as interview transcripts. As Yin (2004, p. 110) argues, in order to deal with a large amount of data a case study investigator must rely on a rigorous thinking together with the sufficient representation of empirical findings and a careful account of their meanings. To pursue this the author suggests three general strategies: "developing a case description", "thinking about rival explanations" and "relying on theoretical propositions". In this study we will pursue the strategy of "relying on theoretical propositions", which implies that the initial research objectives and case study design are lean to the theory-based research question, the literature review and developed theoretical framework to guide the research direction (Yin, 2004, p. 112). The other two strategies according to Yin (2004, p. 114) are more appropriate for descriptive or purely explanatory studies.

Cross-case analysis is an analytical approach applied in this study as it is evidently relevant for multiple case-studies (Yin 2003, p. 133), it increases internal validity and reliability of the research (Voss et al., 2002, p. 215) and it is aimed to deepen understanding of the investigated phenomena (Miles and Huberman, 1994, p. 172), which is in line with the exploratory nature of this study. Out of the two types of cross-case analysis outlined by Miles and Huberman (1994, p. 172), variable-oriented and case-oriented, the latter one is applied in this study as it seems to be more appropriate for qualitative research. The authors explain that within case-oriented cross-case analysis principal similarities and constant associations, as well as deviations in findings are indicated and thereafter aggregated to provide a more general rationalisation of the investigated matters. Yin (2003, p. 133) names this type of analysis as a cross-case synthesis and notes that examination of results here relies heavily on fair and plausible argumentative interpretation. In order to corroborate robustness of the analysis Template analysis is employed in this study as an analytical procedure to be followed when analysing collected empirical data.

Template is a hierarchical list of categories or codes that represent the themes revealed from the theoretical background of the research and collected qualitative data (Saunders et al., 2012, p. 572). Codes can be defined as "tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study" (Miles & Huberman, 1994, p. 56). A hierarchy of predefined codes subsequently attached to data units is intended to help guiding the analysis of qualitative data (Saunders et al, 2012, p. 572). As suggested by Saunders et al (2012, p. 558) and Miles and Huberman (1994, p. 58) development of the predefined template in this study is guided by the theoretical background provided in the literature review section, i.e. based on the concept-driven data categorising (Saunders et. al., 2012, p. 558). The initial concept-driven (ibid) codes are "descriptive" codes, which means they involve minimum of interpretation and they are based on the notions determined in the literature (Miles & Huberman, 1994, p. 56).

The initial template guides the process of data analysis. While proceeding with the analysis of the collected data, the template is revised and amended according to the findings. Units of data providing new relevant evidence to the research question that cannot be ascribed to the predetermined list of codes are assigned with new codes. Thus in this case data-driven categorisation is employed (Saunders et. al., 2012, p. 573). In order to create the data-driven codes we use the "grounded" approach (Miles & Humerban, 1994, p. 58). Within this approach two-phase coding method suggested by Charmaz (2006, cited in Saunders et al., 2012, p. 568) is employed in particular. First, open coding is used to disaggregate unlabeled data into conceptual units and provide them with a code. These codes according to Miles and Humerban (1994, p. 57) are "interpretative" as they derive from the researchers exegesis of respondents' answers. And second, focused coding is applied to reassess the coded data and analyse whether the initially developed codes can be ascribed to larger units of these data (ibid, p. 569). Analysing interview transcripts within template analysis procedure involves also elimination of redundant codes in cases where relevant chunks of data are not recognised. The hierarchical order of the initial template is not changed during the template revision.

Saunders et al. (2012, p. 572) state that this approach combines both deductive and inductive aspects since predetermined categories from initial template (deductive aspect)

can be amended according to data analysis implications and new findings (inductive aspect). Thus King (1998, cited in Saunders et al., 2003, p. 397) suggests that template analysis may be helpful in identifying new research directions and emergent issues of the topic that the researchers did not have intention to concentrate on in the beginning of their research project. This indeed occurs in this study as explained in section 7, Discussion. This analytical technique is clearly in line with a hybrid research approach, pursued in this study. According to Cassel and Symon (2004, p. 257) Template analysis works especially well when is employed with the purpose of getting insight from various perspectives on a particular topic or content, which is in line with our decision to interview both portfolio and project managers.

5.4 Criteria for qualitative research

Since it is not enough to just claim that well-carried out research will lead to good conclusions, criteria for judging the quality of the study and the findings should be introduced (Miles & Huberman, 1993, p. 277). However, these criteria have been a subject to an extensive debate (ibid) and it seems that there is not a definite list to adhere to. Saunders et al. (2003, p. 100) for example, propose reliability and validity as the most prominent criteria in business and management research in general. Bryman and Bell (2011, p. 394) argue that these two criteria are also relevant for qualitative research in particular, but that their application requires some adjustment in qualitative terms. Guba and Lincoln (1994, p. 112) provide this adjustment by proposing trustworthiness and authenticity as criteria. In our study we adhere to five main practical criteria suggested by Miles and Huberman (1993, p. 277) that are deemed by these authors to be applicable to a qualitative reserch and critical realist tradition. These authors, while naming the criteria, they pair the more traditinal terms with the "more viable alteratives for assesing the "trustworthiness" and "authenticity" of social science research. In this way they seem to provide a viable overview of the criteria suggested by other authors in the literature.

1. **Objectivity/Confirmability**. This criteria aims to ensure neutrality of researchers and that the study is free of unacknowledged bias. We try to fulfil this criteria in the way Saunders et al. (2009, p. 328) suggest: by acquainting ourselves with the topic through literature review, remaining neutral during the interview process, demonstrating attentive listening, and by being sensitive to the cultural differences that might exist between our own cultures (Macedonian and Russian) and the Italian culture of the respondents. The experience with the Italian culture and language (both of us lived in Italy for 6 months, February-July 2013) helps us to understand some culturally specific meanings, which is specified in section 7, Discussion. However, the language discrepancies between the respondents and the researchers, facilitated through the use of the English language, might have contributed to the misinterpretation of the questions and the answers and might have led to biased findings. We try to overcome this limitation by setting an English fluency criterion for the selection of respondents. Furthermore, we test our understanding and provide summaries of the explanations given by the respondents (Saunders et al., 2009, p. 328). The employed semi-structured interview form that allows us to probe some meanings that are considered to be culturally specific or misunderstood. Having two researchers present throughout the research process also contributes to the objectivity of the findings. Anyhow, in line

with Sayer's (2000, p. 17) argument regarding the interpretative element in social science research, we explicitly acknowledge that the findings might be subject to double hermeneutics, whereby the language barriers and our preconceptions shaped by the reviewed literature might have contributed to this. All the interviews are transcribed and opportunity to read the transcripts in order to verify the information is provided to respondents. We also provide explicit and detail description of our method and procedures in section 4. All the interview transcripts are available in a database by request for possible reanalysis (Miles & Huberman, 1993, p. 278).

2. **Reliability/Dependability/Auditability**. This criteria aims to ensure that the study is consistent and stable over time and across methods enabling different researchers to come up with similar results. Hereby we acknowledge that the results of our study are not meant to be repeated since we believe they reflect the reality at the moment they were collected (Saunders et al., 2009, p. 327). In any case, we provide detailed notes of our research approach and the reasons underpinning it within sections 4 and 5 on the Methodology and Research Design that can be referred to by other researches (Saunders et al., 2009, p. 328). The interviews were carried out according to semi-structured interview guide and interview procedure explained in section 5.2.4. The interview questions were reviewed by our thesis supervisor as well as by the contact persons in the case organisations. In order to avoid respondents' bias, knowledgeable respondents were selected as explained in section 5.2.5. We, both researchers, were involved in the research process and we were usually coming up with similar interpretation of the data confirming its reliability. Providing the respondents with the interview questions in advance to allow them to prepare also contributes to the reliability of the study (Saunders et al., 2009, p. 328). Furthermore, all the respondents were recorded using multiple appliances: Skype recording application and smart phone dictaphone in order to avoid risk of information loss. The recorded interviews and relevant interview transcripts were organised and stored as an electronic database.

3. **Internal validity/Credibility/Authenticity**. This criterion questions whether the study findings make sense, whether they are credible and authentic? We believe that the provided thick description of the background of our research as well as the converging conclusions derived based on the data interpretation by the two researchers, satisfy this criterion. During data analysis and discussion, the empirical data is linked to the categories of prior theory (Miles & Huberman, 1994, p. 279), further contributing to this criterion. Furthermore, the final conclusions of the research are shared for verification with the contact persons as original informants from the case organisations.

4. **External validity/transferability/Fittingness**. This criterion seeks to uncover the extent to which research findings can be generalised (Saunders et al., 2003, p.102). As stated in section 4.2.1.4, the generalisability of these study findings are subject to analytical generalisation whereby the research findings are linked to the theory.

5. **Utilisation/Application/Action orientation.** In line with the critical realism stance, this criterion questions the "actionability" of the research i.e. the study's theoretical and practical contribution. We believe that with this study we increase the level of understanding of PIM for each party and raise awareness about its importance. We also

provide managerial implications where we discuss the importance of our findings for the managerial as well as the academic audience. The findings are also accessible to the potential users via the University website.

5.5 Ethical considerations

Potential ethical issues are considered in this study as an important aspect of any business research (Bryman & Bell, 2011, p. 122). Two sets of ethical contemplations are addressed: (1) ethical principles of interaction with participants of the research and treatment of data received; and (2) use of literature and other secondary materials such as web-pages.

When interacting with the respondents of this study we adhere to four ethical principles suggested by Diener and Crandell (1978, cited in Bryman & Bell, 2011, p. 128) related to avoidance of harm to participants, lack of informed consent, invasion of privacy and deception. According to Bryman and Bell (2011, p. 128) the researchers should assess carefully their influence on the participants of the study and any risk of harm should be minimised, including any means of inconvenience, potential of stress and threat to career prospects or future employment. Following this principle all the respondents were assured, in the sent in advance interview guide and in the beginning of each Skype interview, that their responses will be treated confidentially and for the research purposes exclusively. Following the principle of confidentiality all the respondents' identities are anonymised in this study. The contact persons from both case study organisations were informed that this study, after the final thesis seminar and approval, will become a public document and that it will be publicly available on the internet. Therefore it was agreed to anonymise the organisations' names. All the interviews were conducted only at time convenient for the respondents and with the respect to the chosen by them conditions. For example, the contact person from Organisation Y insisted on his presence at all the conducted Skype meetings with Organisation Y respondents, which was respectfully fulfilled. Following the principles of avoiding lack of informed consent and deception, the interview guides with stated research purpose and outlined question guidelines were sent to the contact persons from the case study organisations and, to our knowledge, they were further forwarded to each of the respondents prior to the conducted interviews. All the Skype interviews were recorded only with univocal respondents' permission, asked and received in the beginning of each interview. Although we did not explicitly inform the respondents that they were free not to answer the questions if they did not wish so, to our belief we attempted to avoid any means of privacy invasion by treating each respondent sensitively and withdrawing questions when the respondent found them difficult to answer.

In this study all the used literature sources and other secondary materials were aimed to be acknowledged by provision of proper citation and referencing and in order to avoid any concerns related to plagiarism. To our knowledge, no ethical issues were raised during the research process.

6 Data Analysis and Display

This chapter displays the data analysis results. Section 6.1 outlines the template analysis outcomes and demonstrates the final template. Section 6.2 displays the results in clustered meta-matrices (Miles & Huberman, 1994, p. 178), which allow producing a summary material for the reporting of findings. Each matrix is followed by a brief description whereby evidence, in a form of quotations is used to support the findings. While conducting data analysis we use cross-case analysis where we outline similarities and differences between the case organisations.

6.1 Template analysis

The initial template includes five main themes representing key concepts identified during theoretical investigation and presented in the developed theoretical framework: PIs, benefits of effective PIM, negative effects of failed PIM, challenges of PIM, hard and soft practices of PIM. Within these five themes seven main categories of data are elaborated following interview questions asked to the respondents: PIs types, benefits of having interdependent projects, importance and benefits of PIM, negative effects of interdependent projects, challenges of PIM, hard practices, and soft practices. Each of two categories "hard practices" and "soft practices" includes three sub-categories: "benefits of practices", "drawbacks and limitations of practices" and "contextual conditions". Specific descriptive codes are created within each category and sub-category indicated as an abbreviation and attached to the chunks of data when analysing interview transcripts (Sauders et al., 2012, p. 572). A fragment of initial template is demonstrated in Table 6. The complete initial template is shown in the Appendix 3.

6	HARD PRACTICES	
6.0.1	Optimisation models	OPTMOD
6.0.2	Visual tools	VIST
6.1	Benefits of hard practices	
6.1.1	Objective	OBJ
6.1.2	Precise	PRC
6.1.3	Provide optimal solution	OPTSOL
6.1.4	Systematic identification of interdependencies	SYSID
6.1.5	Enable seeing the big picture	BIG PIC
6.1.6	Tangible	TANG
6.2	Drawbacks of hard practices	
6.2.1	Require large input data	REQD
6.2.2	Ignores intangible aspects	NINT
6.2.3	Time and expertise consuming	TECNS

Table 6: A fragment of the initial template

The initial template is revised where new codes are created and redundant ones are eliminated. Table 7 demonstrates a fragment of the revised template, whereby new codes are highlighted in bold and redundant codes are crossed out. The complete final template is shown in Table 8.

6	HARD PRACTICES	
	~~Optimisation models~~	~~OPTMOD~~
	~~Visual tools~~	~~VIST~~
6.0.1	Collaborative tools	COLL TOOL
6.0.2	Tracking tools	TRACK TOOL
6.1	Benefits of hard practices	
	~~Objective~~	~~OBJ~~
	~~Precise~~	~~PRC~~
	~~Provide optimal solution~~	~~OPTSOL~~
	~~Systematic identification of interdependencies~~	~~SYSID~~
6.1.1	Enable seeing the big picture	BIG PIC
6.1.2	Tangible	TANG
6.1.3	Issue anticipation	ISS ANT
6.1.4	Easy to use	EASY
6.1.5	Fast	FAST
6.1.6	Enable informational alignment	INF ALIG
6.1.7	Information repository	INF REP
6.2	Drawbacks of hard practices	
6.2.1	Require large input data	REQD
6.2.2	Ignores intangible aspects	NINT
6.2.3	Time and expertise consuming	TECNS
6.2.4	No single "best" solution	NSBS
6.2.5	Not agile	NAGL

Table 7: A fragment of the revised template

1	**INTERDEPENDENCY TYPOLOGIES**		5.1.4	Fast	FAST
1.1	Resource	RES	5.2	**Drawbacks of hard practices**	**DRBH**
1.2	Market	MAR	5.2.1	Time and expertise consuming	TECNS
1.3	Knowledge	KNOW	5.2.2	Require large input data	REQD
1.4	Benefit	BEN	5.2.3	Ignores intangible aspects	NINT
1.5	Outcome	OUT	5.2.4	No single "best" solution	NSBS
2	BENEFITS OF SUCCESSFUL PIM		5.2.5	Not agile	NAGL
2.1	Important	IMP	5.3	**Contextual conditions of hard practices**	CONTH
2.2	Success	INC SUCC	5.3.1	Available knowledge	KNOW
2.3	Efficient resource management	EFF RES MGT	5.3.2	High complexity	HCOMP
2.4	Knowledge/information sharing	KNOW/INFSHR	5.3.3	Always	ALW
2.5	Time efficiency	TIME EFF	6	SOFT PRACTICES	
2.6	Problem solving improved	PROB SOL	6.0.1	**Individual-centered**	IND-C
2.7	Ability to see a big picture	BIG PIC	6.0.1.1	Sacred cow	SCOW
3	NEGATIVE EFFECTS OF UNSUCCESSFUL PIM		6.0.2	**Group-centered**	GR-C
3.1	Schedule slippage	SCH SLIP	6.0.2.1	Periodic PM meetings	PMM
3.2	Inefficient resource utilisation	RES INEFF	6.0.2.3	Informal conversations	INCON
3.3	Market cannibalisation	MAR CAN	6.0.2.4	Knowledge-sharing facilitatiom	CULT
3.4	Intra-company conflicts	CONF	6.0.2.5	Leadership	LEAD
3.5	Risk transference	RISK TRAN	6.0.2.6	Negotiation and convincing	NECO
3.6	Employees demotivation	EMP DEM	6.1	**Benefits of soft practices**	BENS
4	CHALLENGES OF PIM		6.1.1	Cooperation enabling	COOP
4.1	Difficult/Challenging	DIFF/CHA	6.1.2	Learning/knowledge sharing	LKN
4.2	Complexity	COMPL	6.1.4	Conflict resolution	CONF
4.3	Prioritisation	PRIOR	6.1.5	Fast	FST
4.4	Time-consuming	TIME CON	6.1.6	Issues anticipation	ISS ANT
4.5	Lack of a holistic picture	KNOW LACK	6.2	**Drawbacks of soft practices**	DRBS
4.6	Political reasons	POL REAS	6.2.1	Time-consuming	TCNS
4.7	Legal reasons	LEG REAS	6.2.2	Risk of mistake	RMST
5	HARD PRACTICES		6.3	**Contextual conditions of soft practices**	CONTS
5.0.1	Collaborative toos	COLL TOOL	6.3.1	Need to consider implicit aspects	IMP
5.0.2	Tracking tools	TRACK TOOL	6.3.2	Collaborative culture	CCULT
5.1	**Benefits of hard practices**	BENH	6.3.3	Organisational structure	ORGST
5.1.1	Enable informational alignment	INF ALIG	6.3.4	Innovation-intensive business	INNB
5.1.2	Enable seeing the big picture	BIG PIC	6.3.5	Urgency	URG
5.1.3	Easy to use	EASY	6.3.6	Intra-organisational usage	INU

Table 8: Final template

6.2 Interviews results analysis and display

The meta-matrices are used to display the interview results and to facilitate the data analysis as suggested by Miles and Huberman (1994, p.178) and Saunders et al. (2012, p. 564). Hereby, the respondents are listed in a row and data codes are in a column. The appropriate cells are marked to indicate which of the respondents supports the coded issues indicated in the matrix. As for Respondent 5* only the comments he/she made explicitly are considered in the data analysis (the specificity of interview with him is explained in section 5.2.4).

Respondent / Codes	*1*	*2*	***3***	***4***	*5*[1]*	*6*	*7*	*8*
RES	√	√	√	√	√	√	√	√
MAR	√	√	√	√				
KNOW	√	√		√			√	
OUT			√	√		√	√	√

Table 9: Types of project interdependencies

It is found out, as demonstrated in Table 9, that the two case organisations have normally projects in a portfolio that are interdependent, or as Respondent 4 contends: "*we have some constraints, so one project affects another within the project portfolio…*"; or as Respondent 2 states "*since the project is not a single unit but is operating within a world in which you have shared resources, shared know-how you cannot expect to keep all the projects as it is"*. As Table 8 demonstrates the most common PI that portfolio/project managers are encountering in both organisations is related to resources. All of the respondents mentioned that they need to share resources among projects where the most frequent are human resources, technologies and a common budget. Respondent 4 from Organisation Y for example mentions that "*resources from one project move to another*" which is in line with Respondent's 1 from Organisation X case where "*the same developers are working on two parts, on two projects*". Regarding shared technologies, Respondent 1 from Organisation X contends that "*each project is different from the others but the technology sometime is similar*". Respondent 5* explains that some projects are interrelated with each other because of budget constraints where "*if you push one project there is another one* […] *to keep down*". Respondent 2 states that this occurs because *"they* [the projects] *have the same sponsor* […] *so the same resources and the same sponsor".* Regarding market PIs, they are found to be present by all of the respondents in Organisation X and by one respondent in Organisation Y. All of them discuss these PIs in terms of having projects that are targeted to the same customers. Respondent 2 from Organisation X confirms this by arguing that "*there are projects that may belong to the same customer"*. Knowledge PIs are found to be frequent as well where four respondents, two from each organisation are pointing to them. Respondent 2 from Organisation X explains that "*there are projects, from different customers, that may use the same know-how, same experience* […] *a know-how that is created in one project can be reused in another project*". Respondent 7 from Organisation Y contends similarly that they use to speak with other project managers in order to learn about their knowledge and experience regarding certain project aspects. Hereby, the respondents also mention the competences and the skills of developers that need to be

[1] * refers to the respondent who did not actively participate in the interview

shared. Outcome PIs have been identified by five respondents. They are well described by Respondent 3 from Organisation X: "*Maybe we start with idea generation and we do a prototype and we do a product design. So this is three different projects of the same stream where the final objective is the same*". Similarly Respondent 6 explains that it happens that "*sometime a project can be released only if another project is completed*" providing evidence of the existence of outcome PIs in Organisation Y.

Respondent / Codes	1	2	3	4	5*	6	7	8
IMP	√	√	√	√		√	√	√
INC SUCC		√	√	√				
EFF RES MGT		√	√	√		√	√	
KNOW/INF SHR	√	√	√	√		√	√	√
TIME EFF	√	√		√		√	√	
PROB SOL	√			√				√
BIG PIC		√						

Table 10: Benefits from an effective project interdependency management

As Table 10 demonstrates, most of the respondents find managing of PIs to be very important as it bring a range of benefits. This is clearly demonstrated by Respondent 1 that states that the importance of managing interdependencies "*it's high, is very high*" and Respondent 7 also confirms this for organisation Y stating that PIM is "*very important*". One of the reasons for being important is because, as two respondents from Organisation X and one form Organisation Y explicitly indicate, it contributes to project/portfolio success. Respondent 3 from Organisation X acknowledges that "*it's fundamental for the success of the projects and the success of the company as well*" and Respondent 4 from Organisation Y argues further that through management of interdependencies he/she verifies the strategy accomplishment. Hereby Respondent 2 from Organisation X explains into more details why it is contributing to success by arguing that "*portfolio success is a sum of a success of every single project".* When probed to clarify what is meant by success Respondent 2 and 3 state that a project is considered to be successful if completed within budget, time and quality requirements. Further benefit of managing interdependencies is found to be the efficient management of resources or as respondent 7 from Organisation Y explains, especially "*it's very important in this period when the resources are very limited*". This benefit is identified by two respondents from organisation X and three from organisation Y. Respondent 3 from Organisation X for example, states that by having interdependent projects they are able to utilise human resources that possess unique competences in a most efficient way, and in this way to keep running ongoing projects normally while having the best resources on them. Respondent 7 from Organisation Y and Respondent 2 from Organisation X have identical opinions when they explain that interdependent projects enable resources not to remain underutilised but to be instead assigned to other interdependent projects. Respondent 6 from Organisation Y explain this benefit in terms of costs saving during project implementation.

The ability to reuse the knowledge and experience created in other projects is another benefit of PIM that is identified by most of the respondents. Respondent 6 from Organisation Y explains this into more details: "*So if a person is involved* […] *in different projects of the same activity he can also try to explain to other colleagues what he learnt*

before, so we have also a sharing of experience […], [it is] *the best thing we can have in this case*". According to this respondent this also leads to an increase in the competence of the people that work on the projects. Respondent 1 from Organisation X adds that knowledge and experience from other projects may contribute toward better planning of projects by providing them with baselines to compare with. Effective PIM is also found to bring time-efficiency gains whereby respondents (2, 4 and 7) from both organisations argue that it may contribute to more efficient, faster processes and cross-fertilisation of ideas. Hereby Respondent 1 from Organisation X observes that "*when you are missing something that can be useful* [and it is available in other projects], *it can save time*". Respondent 7 from Organisation Y clearly explains the cause of the time-efficiency by stating that *"you don't tend to invent by scratch anything but you can leverage from experience of other projects*". Respondents 6 and 7 observe the time-efficiency benefit in terms of delivery times whereby they state that "*we can address quicker and better some solution in order to deliver in less time*" (Respondent 6) and "*to have delivery time in the complex environment as our company is not only the matter of ordinary activities, but you need to organise the activities in order to have them not interface with other project*" (Respondent 7).

Improved problem solving and understanding is found as another benefit of PIM whereby Respondent 6 from Organisation Y for example indicates that "*you can't manage the issue and you can't find the solution before the problem appears*" without PIM and that to fulfil this purpose people are encouraged to interact as stated by Respondent 4 from Organisation X. Respondent 8 observes this benefit from a different angle by arguing that through interdependent projects it is easier to get support from the common sponsor since "*you have to speak with the same people and you have to take the decisions with the same people, so if you have done good work with the 1st project probably you can share this good job in the 2nd project*". Furthermore, only one respondent from Organisation X identifies additional benefit by noting that through PIM he/she is able to see the big picture of the portfolio or as he/she states "*because if you don't have it* [PIM]*, it means that the project is operating like a sort of a single unit*".

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
SCH SLIP	√	√	√			√	√	√
RISK TRAN					√	√		√
RES DIFF	√	√	√			√	√	√
CONF		√	√	√				
MAR CAN				√				
EMP DEM		√						

Table 11: Negative effects from failed project interdependency management

Along with the benefits from managing PIs, the respondents also identify negative effects in case management fails to pursue this process effectively (See Table 11). Firstly, schedule slippage i.e. delays in projects is indicated by three respondents from each organisation as a negative effect occurring because of failed PIM. Respondent 3 from Organisation X notes that "*dealing with delays is an issue and again we try to manage it by sharing resources* […] *as much as possible*" whereas Respondent 2 emphasises that in this case "*your delays are more visible than when you do in a single project*". Respondent 7 from Organisation Y observes that because of outcome PIs, if the first project is delayed, the second one will be

postponed as well or as Respondent 8 argues "*probably it* [the project] *would be stopped until the second is released*". Respondent 6 from Organisation Y describes a situation of failed PIM where it happened that "*delivery date was unreached, so we did not catch the delivery date that we set at the beginning of the project*". He/she, as Respondent 7 relates the possible delays to the problems that one project may transfer to the others. This issue is closely related to risk transferences that are indicated only by three respondents in Organisation Y as other possible negative effects of failed PIM. Hereby Respondent 5* warns that "*you have to link the risk of one project to another one*", whereas Respondent 8 explains that "*the risk is that the project that is an enabler can create some technical problem or anything else and the 2nd one that is dependent can't go without the first one released*".

Another negative effect that may occur due to failed PIM, identified by three respondents from each organisation, is related to resource difficulties. Hereby respondents identify two main problems: resource shortages or over budget situations. Regarding the first one, resources that are needed might be occupied by others and hereby Respondent 1 from Organisation X describes a real-life situation: "*you have to share between two project managers, and* [one of them might say] *no I want this today, and today I need now, I have these milestones, and I need for 100%*". Respondent 3 also shares his/her experience: "*so sometimes I don't have the best person for that project, I need to convince the project manager* [from another project] *to allocate*". However, this respondent argues that they do not experience in Organisation X any other resource shortages. Regarding the second resources problem, respondents claim that if PIM fails "*the risk is not to be able to deliver the project* […] *on budget*" (Respondent 3), the costs will explode and "*you can invest a lot of money without the right* […] *outcomes*" (Respondent 8).

Two respondents from Organisation X and one from Organisation Y point out to possible conflicting situations arising from PIs mainly related to the need of prioritisation of different project aspects. Respondent 3 from Organisation X, for example, describes a possible conflicting situation and the way he/she handles it: "*Since competences are so important, everybody wants the best person with full skills. Sometimes I have to arrange the best option which is the compromise between the competences needed in the resources*". Similarly, Respondent 2 tries to manage prioritisation conflicts and notes that in this situation "*You have to find the way to convince them, that they are all from their perspective are the same priority, but you manage as you can to make sure you also realise your portfolio objectives*". Respondent 4 from Organisation Y also mentions that there might be some issues when resources are allocated from one project to another.

Only Respondent 4 unambiguously states that because of market PIs cannibalisation, as another negative effect might occur where "*Bundle offer could introduce a kind of cannibalisation impact on services in the market that are already in place*". Respondent 2 from Organisation X is the only one to indicate that if the PIM fails "*you may have team that is overstressed or* […] *people that are not happy to work*".

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
DIFF/CHA	√	√	√	√		√	√	√
COMPL	√	√	√	√	√		√	
PRIOR	√	√	√	√	√		√	
TIME CON	√							√
KNOW LACK						√		√
POL REAS				√				
LEG REAS	√							

Table 12: Challenges of project interdependency management

The respondents from both organisations indicate that they find PIM to be very challenging and difficult task (see Table 12). Respondent 8 from Organisation Y explains that: "*It's very difficult because you have to have at the same table at the same time the right person, the right people in order to understand every aspect, every point of the project, every requirement, every impact area and so… it can be very difficult, very difficult*". Several particular challenges are identified as presented in Table 11. Firstly, most of the respondents note that they are facing very complex situations where "*you need to consider the project environment, a lot of projects, a lot of protocols, a lot of different let's say objectives…*[which] *"involves a lot of analysis, a lot of feedbacks*" as explained by Respondent 7 from Organisation Y. His/her colleague, Respondent 4 argues similarly that PIM is complex because more issues need to be managed. Hereby Respondent 5* adds that complexity comes from the fact that "*if you change one project you will change a lot of projects in a special area*". Respondent 3 from Organisation X describes the complexity he/she specifically encounters while managing resources: "*because the major issue is* […] *to allocate the proper people to the right projects with the right competence*".

Another challenge that most of the respondents indicate relates to difficulties of prioritisation, which is complicated by presence of various interests of multiple partes in a portfolio. Respondent 2 from Organisation X for instance explicitly identifies that "*every one of us has interest, different interest, different view*" and he/she suggests that "*you have to get them buyed-in* [the project managers] *because you're giving priority to another thing because everyone when you're dealing with different people is thinking that my project is top-priority*". Likewise, Respondent 3 from Organisation X describes a conflicting situation requiring prioritisation decision where he/she explicates that "*our projects need very specific competence. Sometime we find only one person or maybe two* [who have this competence], *so I have lots of project that need this single person. It's not so easy to solve the conflict*." Respondent 7 from Organisation Y describes a similar case where he/she needs to deal with prioritisation difficulty because of scarcity of resources: "*The main problem is that all the projects* [need] *release in the same time, immediately and obviously it's not possible to do so in the environment of the company as we are, because we need to organise activities step by step* […] *so we need to prioritise*".

PIM is found by two respondents, one from each organisation, to be also time consuming, whereby Respondent 1 explains the challenge "*it's just the time that you need to analyse the relationship and understand how you can treat, and if there are benefits, or disadvantages*". Respondent 4 from Organisation Y is the only one to identify political issues with which he/she needs to cope with during PIM by stating that this task is "*Not*

easy because of political reasons where it may happen that certain projects are in portfolio without business case". Respondent 6 and 7 from Organisation Y, on the other hand are the only to identify the lack of knowledge and experience in PIM as a challenge of PIM. Respondent 6 for example explains that "*when you find interdependency with another project and the person on the other project is younger in terms of experience, you find it more difficult* […] *to address the solution*". Legal reasons as one of the challenges of PIM are also identified by one respondent. Hereby Respondent 1 argues that PIM and sharing of resources, for example, can be limited because of the intellectual property rights or copyrights that certain projects possess.

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
APP PLAT	√	√	√	√	√	√	√	
TRACK TOOL	√	√						√

Table 13: Hard practices

Hard practices for PIM as discussed in the literature are not identified in the case organisations (see Table 13). Respondent 4 from Organisation Y even explicitly acknowledges that they do not use any sophisticated mathematical models. However, it is discovered that organisations use web application platforms as hard tools that allow them to identify PIs. The web application platforms are used as a central repository for storage of information, sharing and collaboration. They are indicated by almost all of the respondents. Hereby SharePoint as a specific web application platform is indicated explicitly by two respondents, one from each organisation. Respondent 4 argues that "*with this portfolio tool we contain information like budget, forecast, the project, the sort of different information related to the project: the scope of the project, the status of the project"* and also share this information with all the involved parties. Respondent 5* qualifies this tool as a "*financial model"* whereas Respondent 6 calls it a "Master plan" (Note: being concerned to mention the actual name) and explains that they use it to "*collect also the information related to the cost, and* […] *also to find the relations in term of person involved in the project and relations between other project so the interdependency relations are traced in this tool*". Respondent 1 from Organisation X clarifies that he/she uses SharePoint with his/her client only, and that currently this tool is not used in Organisation X, even though it was tried to be implemented in the past. On the other hand Respondent 3 indicates that in Organisation X they use software application developed by their own organisation that helps them "*to predict the resource allocation in the projects*". He/she also states that resource and outcome PIs can be identified and displayed by this tool. For instance it can generate report as a list of resource- or output-interdependent projects, exhibiting assignment of various resources and their occupation.

Another group of hard tools that is mentioned by respondents refers to tracking tools used simply for tracking information or creating to-do-lists. For example Respondent 8 from Organisation Y mentions that the tools they use are "*not sophisticated. We use the simple excel chart*" for tracking actual project data with the forecasted one. Respondent 1 from Organisation X on the other hand describes: "*I use Evernote that is just a sketch note, let's say, just to keep the meetings' minutes, and all the things to do in the week*", but he/she admits that these are his/her personal notes. Herby it can be noticed that these tools do not

enable consideration of PIs during decision making, but are used only to trace already taken decisions.

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
INF ALIG	√	√	√	√		√		
BIG PIC		√	√	√		√		
EASY	√		√				√	
ISS ANT	√		√					

Table 14: Benefits of hard practices

It is found out that the abovementioned hard tools bring certain benefits to the users. They are displayed in Table 14. The most frequently mentioned one is related to informational alignment that is indicated to be enabled in both organisations. Respondent 1 from Organisation X explains that: "*using SharePoint we can interface each other* [refers to the customer]*, since we are in different location and keep track of the status of the work*"; or as respondent 2, by referring to the plans he/she makes emphasises: "*you have to talk looking at the same thing"*. Respondent 3 also find it beneficial as the tool enables them to keep information in one place and format. Respondents from Organisation Y have similar observations. Respondent 6 for example states that the tool allows them "*to show a summary of the projects that we are working in a specific moment and almost all know which are the next project, the next release project, so it is also useful to align our management*" or respondent 4 comments that the tool enables them to share information with different users, implying that everyone has the same information. The hard tools are also indicated by two respondents per organisation to enable them to see the big i.e. holistic picture. Respondent 3 from Organisation X explains clearly that "*the benefit is having a single place where I can see the allocation of all my 30 people, considering we are 30 people so 30 projects as well running together, so a single copy, everything at a glance*".

Another benefit that is indicated by two respondents from Organisation X and one from Organisation Y is that the hard tools are easy to be used. Respondent 3 from Organisation X notes that "*it's simple, consider a form that you fill in very quickly*". Respondent 7 from Organisation Y notes that all the information are automatically available and ready to be easily shared; or accessed, as noted by respondent 1. Two respondents from Organisation X only, identify that hard tools enable them to foresee problems, or as respondent 1 argues "*to foresee problems* […] *I can see what happens in the next month, two months, also in one week*".

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
TECNS	√					√		
REQD	√		√					
NINT		√		√				
NSBS	√							
NAGL				√				

Table 15: Drawbacks of hard practices

Table 15 displays several drawbacks of hard practices identified by the respondents; three of them are supported by more than a single opinion. Respondents from both organisations

note that hard tools existing in their organisations seem to be time and/or effort consuming. Respondent 6 from Organisation Y states that to maintain the information in the corporate system is *"a little bit time consuming, because we need to update this tool every time there is a change".* This idea is supported by the Respondent 1 from Organisation X who expresses that the system that has been implemented previously, referring to SharePoint, requires significant effort to be maintained, but that also the current ones he/she is using are perceived as "*too much work to synchronise things and to keep updated and so on*". However, this opinion is opposed by the Respondent 3 from the Organisation X who states that from his/her point of view updating information in the system(referring to the web application platform), does not require much time. However he/she points out another drawback of it. As a limitation of the utilised system Respondent 3 names its ultimate dependence on permanent and comprehensive update of data: *"If some project manager does not update the information, then the information is useless"*. This is only supported by the Respondent 1 from the same Organisation X who also regards a need for a large amount of input data as a limitation of the hard tools. Another limitation of hard tools is indicated by Respondent 2 from Organisation X and Respondent 4 from Organisation Y. That is the inability of hard tools to account for more intangible organisational aspects, "*something that is going behind*" as comments Respondent 2, such as experience and personal characteristics of human resources or various political matters important for decision making.

Another limitation of hard practices application is identified only by the Respondent 1 from Organisation X who states: *"I think it's just the problem* […] *to find the solution that can be used for all, that maybe is impossible"*. It relates to the difficulty to find a single universal solution which will encounter specificity of all the projects, satisfy all the PM styles and comply with the variety of system requirements (like different operational systems) existing in the organisation. Apart from this, Respondent 4 from Organisation Y while explaining about mathematical models in general criticises them for not being flexible and agile enough to be exploited within the ICT industry which is characterised by highly dynamic environment. He/she explains his/her position as following: *"For us I think it would be very difficult to introduce something that is like a mathematical model. Because in telecommunication things change very-very quickly, so the risk is [that] we introduce something like mathematical model is not able to be on the same path of what is going really in the market*." However as Table 14 reflects Respondent 4 is the only one who comments on this limitation of hard tools.

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
KNOW		√						
HCOMP	√							
ALW			√			√		

Table 16: Contextual conditions of hard practices

It is difficult to discern in the collected empirical data the contextual factors that condition the application of the hard tools (see Table 16). None of the respondents is clearly aware of a particular context in which they apply the tools they use. However from four respondents, some contextual conditions can be implied. For example, from Respondent 2 from Organisation X it can be implied that the existence of knowledge and awareness about

possible solutions conditions the usage of hard tools: "*Actually if honestly I also do not know which are* [referring to possible solutions]. *I've never investigated the existing* [hard tools for PIM] *if they also can be helpful. But honestly I didn't have a chance to get in touch with such programme."* When Respondent 1 from Organisation X speaks about applicability of hard tools in general he/she mentions the presence of complexity in organisational portfolio as a contextual condition. Respondent 3 from Organisation X and Respondent 6 from Organisation Y both do not identify any particular circumstances that condition application of hard tools to manage PIs, namely application platforms used in their organisations. They state that those platforms are to be used "*always*", i.e. as a part of organisational routine.

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
PMM		√	√	√		√	√	√
INCON	√					√	√	√
CULT	√			√			√	
NECO		√	√					
LEAD		√						
SCOW				√				

Table 17: Soft practices

Table 17 shows that the most common soft practices of PIM in the case organisations are periodic PM meetings, informal conversations, facilitation of knowledge-sharing culture and, practice of negotiation and convincing people. According to Respondents 2 and 3 Organisation X prefers to rely on *"formal meetings, typically with* […] *one or two people*", as Respondent 3, for instance, says. In contrast, within Organisation Y there is a practice of periodic group meetings, involving project managers and specialists from different departments. Respondent 4 describes: "*We have once a month* [Name] *meeting. This is to verify the PIs with a Head of II department, then* [Head of Product and Service, portfolio managers]. […] *We're trying to facilitate the solution and indicate which are the problems we have in a portfolio. And we have some meeting that we call "PMO review", it's more informal. The attendees of this meeting are the portfolio manager, the project manager, in which we try to consolidate all the information that we have in a portfolio tool."* The PM meetings as a soft practice for PIM are acknowledged by all the respondents from Organisation Y and two respondents from Organisation X.

Informal conversations and meetings as a practice of PIM are identified by four respondents, one from Organisation X and the rest from Organisation Y. For instance, Respondent 6 from Organisation Y states: "*you know some people and you maintain these relationships in order to have them when you need the information*". This refers to the reliance of project managers on informal conversations with their colleagues when trying to get information required for decision-making conditioned by PIs. Respondent 1 from Organisation X refers to the practice of informal conversations while having brief coffee-meetings, distinctive for Italian working culture: "*Just speak with the others, have a coffee. We are Italians, so we like to meet each other to have coffee together and just think"*. It is worth mentioning that the practice of informal conversations is mentioned only by respondents in a PM position, all the portfolio managers have neglected this practice.

The practice of facilitation of a cooperative culture is named by two respondents from Organisation Y and one from Organisation X. Respondent 4 states that there is a practice of encouragement of inter-project communication and an intention "*to make them* [project managers] *to see interconnection between projects in a portfolio, to have a broader view*". The practice of facilitation of cooperative culture is supported by Respondent 1 from Organisation X who states: *"I think we are encouraged to go to talk with our colleagues for any* [issue] [...] *my head of division, always encourages to share the knowledge"*. Respondent 1 also recognises the practice of lessons learnt sessions as an exercise to enhance knowledge exchange and consider PIs: *"We are trying to organise some meetings in our organisation, between project managers and specialists just to share the knowledge of maybe lessons learned".* The interview with the Respondent 7 reveals that encouragement of interaction and collaborative attitude between employees in Organisation Y is facilitated through corporate building design and space organisation. According to Respondent 7 Organisation's Y management has consciously chosen an open office design and provision of several meeting rooms, recreation areas and coffee corners in order to facilitate the culture of open communication and cooperation: "*you can move from office to another and we have recreation areas to facilitate this kind of environment* [of open communication and cooperation]*. This is designed from top-management in order to realise this kind of approach."*

The forth most common soft practice of dealing with PIs is identified by two respondents from Organisation X as negotiation and convincing. Both respondents are portfolio managers and suggest that in order to resolve some issues related to PIs they employ negotiation and convincing in order to buy-in people. Respondent 2, for instance, explains that in order to manage resource-interdependent projects "*you start negotiate with the clients in order to see if you can rearrange the schedule and give some opportunity to move forward with another project or another client";* and continues further: "*It is important, let's say, to convince".* Respondent 2 from Organisation X also identifies leadership as another soft practice used for PIM: *"And of course there are situation where you cannot just convince everyone. So in certain situations you just take your leadership and decide."* However this finding is not supported by other respondents. Such soft practice as sacred cow is identified only in Organisation Y by Respondent 4. He/she says that "*there are sometimes political reasons why there is a specific project within a portfolio, so it can be in a portfolio that there is not business case so…anyway… so we have to keep things into consideration",* which refers to the practice of sacred cow, indicated in literature.

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
COOP	√	√		√		√		√
LKN	√			√			√	√
CONF		√	√	√				
FST	√					√		
ISS ANT						√	√	√

Table 18: Benefits of soft practices

As demonstrated in the Table 18 respondents from both case study organisations see benefits of soft practices such as cooperation enabling, learning and knowledge exchange, conflict resolution, time-saving and ability to anticipate issues. Cooperation is indicated as

a benefit of soft practices by five respondents. For instance, Respondent 6 from Organisation Y states: "*we can share immediately the problem and find together a solution*". This is in line with the Respondents' 1 and 2 opinions from Organisation X. Respondent 8 from Organisation Y supports the suggestion of cooperation facilitation as a practice of PIM by saying that informal practices such as meetings and conversations encourage common discussions and brainstorming to find the best answer as well as to share knowledge and information. As stated by Respondents 4 and 8 from Organisation Y PM meetings are the best way to align everybody within the same picture and to verify information and knowledge sharing. Respondent 1 from Organisation X also highlights inter-projects learning and improved understanding as the benefit of soft practices: *"I'm always, I think it's useful so when I'm invited to this meeting I'm positive, I can learn*".

According to Respondent 3 from Organisation X, application of softer practices allows to find "*the right compromise between all the interests"* and discover a win-win solution. Hereby resolution of conflict of interests between multiple portfolio stakeholders is demonstrated as another benefit of softer practices and it is supported by two more respondents, one from each organisation. Respondent 4 from Organisation Y, for instance, comments on the benefit of PM meetings: "W*e know that there are some dependency between project E and project B and we find with them if it is incorrect and stimulate them in order to have as more agreement as possible."*

Respondent 1 from Organisation X and Respondent 6 from Organisation Y also name soft practices to be fast. As Respondent 1 says informal conversations for instance *"don't require preparation".* And Respondent 6 confirms: "*We can say that the informal method is faster than the formal and official method"* because he/she explains that it is more time-consuming to make an update in a hard tool then to *"to make a meeting and share with all the colleagues the news."* Furthermore, three respondents from Organisation Y identify possibility to foresee potential issues and identify risks related to PIs as another benefit of such soft practices as facilitation of cooperative culture, conversations and meetings. As Respondent 6 states "*you can anticipate problem instead of waiting that the problem appears in your project. So the informal meetings have to resolve problems but also to anticipate some that can happen next in the future".* Respondent 7 confirms this referring to the application of informal conversations and relationships with colleagues in order to get their support in prediction of potential risks and encourage proactive working approach: "*You have more proactive approach then. Usually you don't need to ask for something, but* […] *they* [colleagues] *send you the information or inform you proactively if any problem is coming*".

Respondent / Codes	1	2	**3**	**4**	5*	6	7	8
TCNS	√	√						√
RMST	√						√	

Table 19: Drawbacks of soft practices

Several drawbacks of soft practices are also indicated by the respondents as shown in Table 19. Respondent 2 from Organisation X and Respondent 8 from Organisation Y point out that soft practices require time to be effectively executed. As Respondent 8 comments "*I'm sure that these* [soft practices] *are really important practices* […] *and you need to use it.*

[But] *at the same time you have to stop your operative work.* […] *You need* […] *to find time to dedicate to these informal activities".* Although in Respondent's 1 opinion soft practices are time-saving, in another instance he/she reveals that other project managers in Organisation X may perceive some soft practices (as lessons learnt sessions, for example) as inefficient and time-consuming. Apart from this drawback, risk of mistake related to application of soft practices and its limitation for external usage are indicated by Respondent 1 and Respondent 7 as other shortages of soft PIM practices. Respondent 1, for instance, states that the results of meetings and informal conversations are usually not tracked and not formalised, which therefore may lead to the loss of information and risk of mistake.

Several / Codes	1	2	**3**	**4**	5*	6	7	8
IMP		√	√					
CCULT	√					√	√	
ORGST	√						√	
INNB	√		√					
URG		√						
INU	√							

Table 20: Contextual conditions of soft practices

Table 20 displays the identified conditions for application of soft practices, but as it can be noticed only two conditions are recognised by more than a single respondent: presence of cooperative culture in the organisation and the need to consider implicit factors. Respondents 2 and 3 from Organisation X refer to the situation when taking into consideration of implicit factors is needed such as individual characteristics of human resources, their experience and competences or variety of stakeholders' interests. These implicit aspects, according to the respondents can only be accounted by soft practices but not by hard ones. Presence of cooperative organisational culture as a contextual condition for soft practices application is identified by Respondent 1 from Organisation X and Respondent 7 from Organisation Y. Both acknowledge the positive influence of existing cooperative culture in their organisations as a facilitator of soft practices application. Although Respondent 6 does not explicitly identify presence of cooperative culture as a contextual condition for soft practices implementation, the respondent acknowledges positive influence of information- and knowledge-sharing culture on identification of interdependencies and states: *"One of the best attitudes that we have in our company is that we are open to share all the information we have. […]* Our *approach is* [to] *share everything in order to reach the best result*".

Organisational structure is identified as another contextual condition for soft practices application. Respondent 1 refers to low power distance organisational structure present in Organisation X: "*There is a hierarchy, yes, but you are encouraged to talk with all the levels of the organisation, it's very flexible".* And Respondent 7 from Organisation Y referring to the use of meetings and communications within resource-interdependent projects mentions, indicates that the effectiveness of these practices depends on the organisational structure:*"*[…] [flat] *organisational structure that is needed because we have to run a lot of projects and we have limited resources and we are dependent doing operation activities on the third parties".*

Respondents 1 and 3 from Organisation X identify the innovation-intensive nature of the business as another contextual condition for soft practices application. As Respondent 1 says: "*We are trying to import all* […] *the knowledge from the universities, the latest things to the corporate world. Ok, and* […] *we are always trying to innovate the process, sometimes we have to brainstorm or just to talk because we think is very important, because we need the ideas and so…".* And this is in line with the suggestion of Respondent 3 who explains that Organisation X is dealing with innovations and states therefore: "*our projects need very specific competence".*

Other contextual conditions identified are urgency, intra-organisational usage and are each of them is supported only by a single respondent. Hereby Respondent 2 describes situations prescribing application of soft practices as circumstances "*in which there is no time to do, so there is an urgency behind".* Respondent 1 from Organisation X states such practice as informal meetings is conditioned by intra-organisational application: "*the informal meetings are very good inside the organisation, but are not so good with the customer".*

Overall the empirical findings demonstrate that the respondents from both case study organisations see PIM to be an important, although challenging part of PPM, but also confirm that there is a room for improvement. Respondent 7 from organisation Y explains that "*at the moment we do not consider all the implications of interdependencies, only on the surface*". Respondent 3 from organisation Y also states "*we may have some improvement*". It is clear that hard tools in the case study organisations are used only for identification of interdependencies and not for decision-making and management per se. As Respondent 4 from Organisation Y states: "*I think it's normal that the decisions make human being not to a tool.* […] *In my point of view it's normal that we cannot rely on tool. We see it as a supporting decision, but not the one that is making decision."* And although in overall respondents do see the benefits and importance of hard tools, the managerial preference in terms of dealing with the issues arising from PIs is evidently given to soft practices. As confirmed by Respondent 2: *"At the moment I still rely on soft practices".*

7 Discussion

This section discusses the key findings discovered in the preceding section in terms of similarities, differences and remarks outlined within the process of cross-case analysis. The cross-case analysis demonstrates that the two case organisations are very similar in the way they manage PIs whereby most of the findings of the first organisation occur in the second organisation as well (Saunders et al., 2009, p. 146). The instances that are case-specific are emphasised and explained.

In order to confirm or disprove the theoretical propositions, get deeper insight on the investigated topic and provide answers to the established research question, the indicated findings are related to the previous studies, discussed in the Literature Review. For the contradicting findings possible reasons of their appearance are outlined. The discussion is centred on five key concepts reflected in the theoretical framework, presented in section 2.4: PIs, benefits of effective PIM, negative effects of failed PIM, challenges of PIM, hard and soft practices. This section ends with a revision of the previously developed theoretical framework diagram whereby the empirical research findings are incorporated.

7.1 Project interdependencies

The presence of PIs is recognised in both case study organisations as a common feature of project portfolios, which confirms that projects are not implemented in isolation, but rather contain various interrelations with each other as indicated in the literature (Killen & Kjaer, 2012; Rungi & Hilmola, 2011, p. 147; Engwall & Jerbrant, 2003, p. 406; Hamidovic & Krajnovic, 2005, p. 679). Resources, market, knowledge and outcome types of PIs are identified in the case study organisations. This differs from the theoretical PI typology outlined in section 2.2.3 only in terms of benefit PIs which are not recognised in any of the case study organisations. According to Santhanam and Kyparisis (1996, p. 383) and Zuluaga et al. (2007, p. 2) benefit PIs are related to the non-linear increase of benefits delivered by implementing interdependent projects, which might not be realised if PPM does not consider PIs comprehensively. This seems to be the case for both case study organisations that state that PIM is not practiced thoroughly and that there is a room for improvement. This is in line with the findings of Elonen and Artto (2003, p. 398) and Teller et al. (2012, p. 597) that PIM is often an area of weakness for contemporary PPM. These findings provide support for the *first proposition of this study that there are various types of PIs present in a project portfolio in an ICT organisation*, demonstrating that organisations while evaluating PIs should be aware that there might be multiple types of PIs. These findings contribute to meeting the first study objective.

7.2 Benefits of effective project interdependency management

It is identified that case study organisations do consider PIs and consider PIM to be important because of the benefits they realise from effective PIM. The findings indicate that efficient resource management, information and knowledge sharing, increased time efficiency and improved problem solving are seen as key benefits in the case study organisations. This supports the arguments of authors in literature that PIM brings resource

savings, reductions in backlogs, reworks, delays and overlaps, overcoming difficulties in making decisions, increase in cooperation and information sharing, and in overall intensifies knowledge leveraging and amplifies organisational learning (Crawfor & Haaland, 1972, cited in Bendoly et al., 2010, p. 387; Formentini & Romano, 2011, p. 545; Larsen et al., 2006, p. 7; Rungi & Hilmola, 2011, p.153; Rungi, 2010b, pp. 6, 8; Verma & Sinha, 2002, p. 460).

The indicated benefits of effective PIM could be ultimately related to the portfolio success dimensions outlined in the section 2.1.4. Hereby time efficiency can be seen as a facilitator of delivering projects within the predetermined schedule, that represents one of the project success "Iron triangle" criteria (Atkinson, 1999, p. 338) and therefore related to the "average project success" dimension of portfolio success. Information and knowledge sharing can help to advance staff competencies and leverage organisational learning (Danilovic & Sandkull, 2005, pp. 193, 194; Formentini & Romano, 2011, p. 545) and can therefore be related to the "exploitation of synergies" dimension. Improved problem solving can positively contribute to the mitigation of identified threats and issues in order to maintain adequacy of various risks, projects durations and resource requirements towards expected benefit realisation. This is clearly related to "portfolio balance" success dimension (Archer & Ghasemzadeh, 2007, p. 95; Cooper et al., 1999, p. 335; Teller & Kock, 2012, p. 819; Voss & Kock, 2012, p. 517). The increased efficiency of resources utilisation could be seen as a contribution to "average project success" dimension, (Atkinson, 1999, p. 338), and "commercial success" dimension, as resource-saving helps to keep overall portfolio costs within predetermined budget and therefore to maintain the profitability of a portfolio. Furthermore, efficient human resources utilisation derived from PIM is seen beneficial not only in terms of cost-optimisation. As suggested by Respondent 3 from Organisation X, PIM also enables sharing unique staff competences. According to Respondent 3 this is crucial for Organisation's X business as it mainly deals with innovation, where professionals' expertise and competences are considered to be rare and valuable resources. These findings are clearly related to the implications of resource-based theory, that organisation's competitive advantage derives from the application of valuable and rare resources (Barney, 1991, pp. 105, 106) marshalled by an organisation. In addition to the discussed above, several respondents explicitly acknowledge that PIM contributes to the project/portfolio success and eventually to the success of the company. These findings correspond to Rungi's (2010, p.103) empirical study conclusion that efficient PIM results in a higher success rate and highlight the importance of PI consideration within PPM.

These findings provide support for the *second proposition that effective PIM delivers a range of benefits contributing to the portfolio success*, and contribute to meeting the first study objective.. Therefore, organisations that have interdependent projects should consider PIM since it may have a positive effect on their portfolio success.

7.3 Negative effects of failed project interdependency management

Apart from the benefits deriving from effective PIM this study reveals a range of negative effects identified as a consequence of a failed PIM. Both practice and theory (Dooley et al., 2005, p. 471; Engwall & Jerbrant, 2003, pp. 406, 407; Formentini & Romano, 2011, p. 545; Rungi & Hilmola, 2011, p. 156; Hossain & Ruwanpura, 2008, p. 2421; Lycett at al., 2004,

p. 294; Sanchez et al., 2009, p. 20) name project delays, resource misuse and deficiency and unforeseen risk transferences as major negative outcomes of failed PIM. These negative effects can distort the "average project success" and "portfolio balance" portfolio success dimensions. It is also found that conflicts of interests are seen in the case study organisations as a negative effect arising from PIs. Respondents mainly relate these conflicts to the need of prioritisation of different project aspects, such as resources (Teller et al, 2012, p. 598) resulting into the necessity to find a compromise between parties and deal with potential dissatisfaction. The authors in literature discuss that arising conflicts of interests may lead to intracompany or inter-project competition (Lycett et al, 2004, p. 294) or to an opportunistic behaviour (Engwall & Jerbrant, 2003, p. 407), which could prevent "exploitation of synergies". Employees overstress and demotivation are identified only by the Respondent 2 from Organisation X as a consequence of failed resource PIM. This seems to be closely related to negative occurrences such as presence of strong psychological stress, staff demotivation, decline in working performance and lack of opportunities for professional development discussed by Zika-Viktorsson et al. (2006, p. 391). The latter one in particular may significantly limit knowledge sharing which is indicated above as an important benefit of PIM. The reason that stress and demotivation are indicated as negative effects of failed PIM by a single respondent only might be that other respondents consider them as personal aspects not appropriate for sharing. This might be the case especially for Organisation Y where the portfolio manager was present during all the interviews. Another negative effect of failed PIM identified in this study is market cannibalisation (Rungi & Hilmola, 2011, p. 156); however it is also mentioned only by a single respondent. This effect may have detrimental influence on the "commercial success" dimension.

These findings provide a support for the *third proposition that failed PIM causes a range of negative effects distorting the portfolio success,* and contribute to meeting the first study objective. Therefore, organisations that have interdependent projects should consider that by neglecting PIM they may experience detrimental portfolio success effects.

7.4 Challenges of project interdependencies management

The importance of PIM in terms of delivering related benefits and avoiding potential negative effects is confirmed by all the respondents from the case study organisations. However, PIM is unanimously seen in the studied organisations to be a demanding and difficult task as there are significant challenges to be overcome. Our findings demonstrate that complexity is perceived as the main challenge of PIM. The complexity is identified as the necessity to deal with big amount of information, cope with multiple requirements and constraints and decide on priorities when trying to achieve portfolio goals. This challenge resembles the messy and unpredictable nature of situations that portfolio managers may face, complicated by the presence of the inaccurately defined and ambiguous goals as described by Aritua et al. (2009, p. 78), Santhanam and Kyparisis (1996, p. 381) and Studenmayer (1997, p. 50). The PIM is also seen to be complex due to the need for PPM to deal with the dynamic changes within the structure of PIs. Hereby it can be noticed that the complexity and systems theory are applicable to the phenomenon of the PI (Aritua et al., 2009, p. 78; Teller et al., 2012, p. 599) as discussed within the theoretical framework in section 2.2.2.

Another challenge of PIM identified in the Organisation Y, by a single respondent though, is the presence of political aspects that according to Elonen and Artto (2003, p. 398) are to be accounted for. This challenge might also intricate prioritisation of the interdependent projects. Other challenges identified in the literature (Rungi, 2009, p. 1509; Rungi, 2010b, p. 4) and confirmed empirically in our study are extra resources and time requirements to implement PIM procedures and evaluate PIs regularly, as well as lack of theoretical and practical knowledge to comprehensively and effectively manage PIs. Lastly, legal issues (for example, intellectual property rights or copyrights) relevant for certain projects carried out in the Organisation X are as well identified as one of the challenges of PIM. This is most probably because the solutions developed by Organisation X presume radical innovations or they are owned by different clients. Organisation Y does not identify this issue as it seems the ICT services they provide are not a subject to legal protection.

These findings provide support for the *fourth proposition that PIM is a challenging task within PPM*. Therefore, organisations that practice or consider implementing PIM should consider that it is a rather difficult task that poses multiple challenges. These findings contribute to meeting the first study objective.

7.5 Hard practices of project interdependency management

In order to manage PIs, it is found that the case study organisations use various hard and soft practices as indicated in the literature. However, the study reveals that the they do not use such hard tools as optimisation models based on mathematical programming or logical algorithms and visual tools such as dependence matrices or network maps discussed in the literature review section. The studied organisations rather prefer to rely on web application platforms, such as SharePoint and tracking tools as hard practices of PIM which are not identified during the literature review phase of this study. The web application platforms are used as a central repository for the storage of information, sharing and collaboration based on multipurpose set of Web technologies (Microsoft.com, 2013). They allow identifying PIs as explicitly confirmed by Respondent 3 from Organisation X. However, web application platforms do not provide any ready solutions or guidance on PIM. This is opposed to the optimisation models which as literature suggests are capable to provide an optimal solution during portfolio selection, scheduling, resource allocation or portfolio review (Blecic et al., 2008; Colvin & Maravelias, 2011; Shackelford & Corne, 2001) as discussed in the section 2.3.1.1. The second type of hard practices identified in both organisations is tracking tools. The purpose of their application is only for organisation of individual work in terms of tracing relevant information or already taken decisions on the matters related to PIs. The tracking tools functionality evidently includes neither identification of PIs nor support in their analysis. Nevertheless, the identified hard practices seem to comply with the characteristics of the hard practices determined by Pollak (2007, p. 267) such as interest in underlying structure (web application platforms allow to exhibit assignment of various resources and their occupation, as well as output interrelations between projects) and control against predetermined goals (tracking tools and tracing of status in the web application platforms).

The avoidance of more sophisticated hard practices indicated in the literature and application of relatively simple ones in the case study organisations, we believe, can be

explained by three major reasons: lack of experience in PPM within the organisations, lack of knowledge about available hard tools for PIM and the range of the benefits delivered by application platforms and tracking tools identified in this study. The most commonly mentioned benefit of the web application platform is the provision of informational alignment among multiple parties involved in PPM and portfolio implementation. As stated by the respondents, the web application platform allows keeping information in one place and format, working from different locations and presenting the same picture to all the users. These advantages are appraised in both case study organisations as a positive contribution towards identification of PIs and related risks. This seems to be closely related to other benefits of application platforms named by the respondents: provision of a holistic picture and enabling anticipation of potential issues, which are also indicated by a number of authors in literature as general benefits of PIM (Rungi, 2010b, pp. 6, 8; Lycett et al., 2004, p. 290; Larsen et al., 2006, p. 7).

The provision of the holistic picture should prevent overconcentration of project managers on their projects exclusively, but account for portfolio environment and facilitate close coordination of the results between projects, which are mentioned by Teller et al. (2012, p. 600) and De Reyck et al (2005, p. 524) to be challenging aspects of PPM. This can be seen as a matter of particular importance especially for the management of outcome PIs. Thereby informational alignment and possession of the holistic picture looks to be crucial for effective strategic decision making as well as for prioritisation and allocation of resources and prediction of possibile problems. This though corresponds with the benefits of portfolio matrices, described by Archer and Ghasemzadeh (1999, p. 209) and gives an impression that portfolio matrices are not used in the case organisations only because there is a lack of knowledge about them. However, our findings demonstrate one more benefit of the hard practices, which could be assigned specifically to the tools identified in the case study organisations and give additional explanation why the tools discussed in literature are not implemented. The web application platforms and tracking tools seem to be particularly beneficial for practitioners because they are easy to use. This is clearly an advantage over the optimisation models which require expertise (Lee & Kim, 2001, p. 117) as well as over visual tools which need to be modified every time when the structure of PIs changes (Killen & Kjaer, 2012, p. 562). Based on the description and the benefits of these hard practices, it can be noticed that they can be used for identification of any of the previously mentioned PI types. The advantages of the hard practices applied in the case study organisations seem to comply with the implications of information-processing theory (Studenmayer, 1997, p. 31) that prescribes organisations to process information in order to accomplish tasks, coordinate activities and deal with the outer environment, i.e. to operate as open systems.

It seems that the drawbacks of the hard tools identified in the case organisations are fairly similar to the theoretical ones. For example, the finding that the hard tools, such as SharePoint, are time consuming and require effort to maintain data, is in line with the argument of Rungi (2010b, p. 5) and Lee and Kim (2001, p. 117) regarding drawbacks of optimisation models. However there is an evident contradiction in opinions between two respondents in Organisation X, where one considers utilisation of web application platform (SharePoint) to be time consuming and the other to be time-saving. This contradiction might be explained by the differences in the positions that these respondents are holding. Respondent 1, being a project manager responsible to update the information in the

application platform, finds this tool to be time-consuming. Respondent 3, on the other hand, is a portfolio manager responsible to analyse and use the data that is already entered by the project managers, and therefore finds this tool as easy to use and not time-consuming. It is worth noting that the benefit of interviewing respondents able to observe the phenomenon form different perspectives are exercised here (Eisenhardt & Graebner, 2007, p. 28).

It seems that despite the inherent differences in the nature, both theoretically and empirically identified tools have another similar drawback: they rely on significant amount of data to become useful (Alavi & Leidner, 2001, p. 124; Archer & Ghasemzadeh, 1999, p. 208; Chen & Cheng, 2009, p. 390; Aaker & Tyebjee, 1978). Furthermore, they both have well-defined structure (Pollack, 2007, p. 267) which does not allow them to account for the intangible aspects such as experience and personal characteristics of people using them, as indicated by our the respondents.

Another finding mentioned by Respondent 4 while he/she comments on possibility of using mathematical methods in general, indicates that they are not agile and cannot account for the dynamics of the ICT industry (Hamidovic & Krajnovic, 2005, p. 677). However, it is most probable that Respondent 4 is not aware about the recent developments in the optimisation models that as the literature indicates can account for complexity (Bardahan et al., 2004; Eilat et al., 2006). The lack of awareness or knowledge might be also causing the difficulty of finding a single solution that will satisfy all users which is mentioned by Respondent 1 from Organisation X as another drawback of the hard practices. It is worth mentioning that while in Organisation X all of the respondents identify certain drawbacks of the tools they use, two respondents from Organisation Y do not indicate any. We suspect that they might not want to bring negative aspects on surface in the presence of their portfolio manager that, as it was indicated, was present during all the interviews.

It seems that because of the specificity of the hard tools used in the case organisations, it is difficult to determine the contextual conditions that govern their application. It looks that they are regarded to be a part of the organisational routine and that their applicability is not dependent on any contextual conditions. Therefore, they are used “always” as explicitly indicated by two respondents. On the other hand, Respondent 2 from Organisation X confirms that existence of knowledge on possible solutions conditions implementation of hard practices and he/she makes this comment while referring to hard tools in general. This seems to be in line with the finding of Rungi (2010b, p. 4) that lack of knowledge and time limits application of PIM practices. It also justifies the avoidance of optimisation models and visual tools as mentioned before. Similarly, the finding that existence of complex portfolio is a context in which hard tools in general are useful corresponds to the argument of Stummer and Heidenberger (2003, p. 176) that more sophisticated hard tools are needed in cases where portfolio complexity is very high. Nevertheless, these findings are not identified in Organisation Y where it seems that the respondents do not see the application of hard tools to be conditioned by any factors.

Based on these findings it is difficult to draw a clear conclusion on the applicability of the contingency theory principles for the hard practices identified in the study organisations. However, there are some findings that refer to the general application of hard practices. Based on these findings it can be concluded that certain contexts (availability of knowledge

and presence of complexity) determine their applicability as argued by proponents of the contingency theory in PPM (Donaldson, 1987, p. 2; Martinsuo, 2012, p. 798; Rungi & Hilmola, 2011, p. 158).

These findings disconfirm the *fifth proposition that organisations use optimisation models and visual tools as hard practices of PIM that have certain benefits, drawbacks and context in which they are applied*. However our study demonstrates that the case organisations use web application platforms and tracking tools as hard practices that have certain benefits and drawbacks. These are to our knowledge new findings within the PIM area that require further analysis. These findings contribute to meeting the second study objective.

7.6 Soft practices of project interdependency management

The findings of this study demonstrate that there is a significant number of soft practices used to tackle PIs in the case organisations. In contrary to the previously discussed hard practices, they are not only used to identify PIs, but also to manage the corresponding benefits and issues. They also provide the case organisations with benefits over the hard practices that respondents see particularly important. Therefore, both case study organisations rely mainly on the soft practices of PIM. The identified practices seem to possess the characteristics indicated by Pollack (2007, p. 267) such as learning, participation, facilitated exploration of projects and interest in social interactions. Both group-centred (formal and informal PM meetings and creation of cooperative culture) and individual-centred (leadership, negotiation and convincing and sacred cow) are identified in the case organisations.

The practice of formal and informal meetings is well acknowledged in cases where participants need to jointly develop solutions for arising issues such as the ones caused by PIs (Canonico & Söderlund, 2010, p. 803). It seems that any type of PIs may be tackled with these practices. It is found that Organisation X prefers individual meetings, whereas Organisation Y practices group meetings. This can be explained by the comparatively smaller number of employees that Organisation X has and therefore project and portfolio managers are able to devote time to many individual meetings. Killen and Kjaer (2012, p. 557) indicate that meetings do not need to be formally organised and this is indeed supported by respondents in PM positions from both case study organisations. They indicate that it is a normal practice within Italian business culture to have informal coffee meetings to discuss the projects they are working on and in that way to tackle also the PIs they are concerned with. This cultural aspect of the Italian business environment was observed by us while studying in Italy during February-July 2013. Although the literature states that PM meetings do not have to be formally organised, this particular practice to our knowledge is not examined in the PPM literature. One reason here might be that such informal practices are not usually accounted by rationally built PPM frameworks (Martinsuo, 2012, p. 799). Or it might be only Italy-specific and therefore not found in the mainstream research. The fact that it is not recognised by the portfolio managers in both case organisations might indicate that it is an informal practice occurring at lower management levels. Therefore the presence of this practice creates a prefect rationale for further research.

The empirical evidence reveals another soft PIM practice which is a fostering of a cooperative culture. This practice is emphasised in the literature by several authors such as Canonico and Söderlund (2010, p. 803), Killen and Kjaer (2012, p. 556) and Kim and Wilemon (2007, p. 187). The authors suggest that this practice is about promotion of information sharing, effective communication or lesson-learned sharing (Formentini & Romano, 2011, p. 546) that contribute to realisation of the PPM goals. It seems that through this practice knowledge PIs are managed in particular. The importance given to the creation of cooperative culture by both theory and practice seems to arise from the fact that it provides the collaborative context for performing other soft practices (e.g. PM meetings). It also enables the opportunity for leveraging knowledge PIs (Teller et al, 2012, p. 600). Negotiation and convincing is found to be important when people need to be bought-in in particular decisions, as in the case of Organisation X. This closely resembles the practice of bargaining and negotiation indicated by Martinsuo (2012, p. 799) used in real-life managerial activity and decision making. This seems to be especially important for resource type of PIs, when resources need to be negotiated between different projects. The importance of leadership and decision making in situations where compromise cannot be attained, is another finding that is supported by Formentini and Romano (2011, p. 545) and Kirkpatrick and Locke (1991, p. 58). The sacred cow practise identified empirically is in line with the finding of Rungi (2010, p. 2) that indicated it as one of the informal practices that organisations rely on. This finding also confirms the existence of power and political processes, discussed by Elonen and Arto (2003, p. 397), in Organisation Y. It seems that these practices are particularly important for managing resource PIs as well. Although these three practices are acknowledged in the literature, they are recognised only by few respondents from the case organisations. This might be because other respondents refrained to reveal these more subtle and implicit practices that as noted by Martinsuo (2012, p. 799) might take place in the boardrooms.

This study demonstrates that the soft practices bring various benefits to PIM in the case organisations as suggested in the literature. The most common benefit that relates to the increased cooperation and knowledge-sharing in the organisations, where solutions regarding PIs are sought jointly, is in line with the argument of Kim and Wilemon (2007, p. 187) and Canonico and Söderlund (2010, p. 803) or Lindner and Wald (2011, p. 886). The finding indicating that through meetings the project/portfolio managers try to ensure presence of the holistic picture in the organisation can be related to Jonas (2010, p. 820) argument that effective cooperation should come from the general understanding that various parties involved in project portfolio realisation do not have differences in their basic interests. Information sharing as a benefit of soft practices corresponds to the identified benefits of web application platforms: informational alignment and provision of a holistic picture. It seems that the combination of these soft and hard practices can be beneficial for organisations since it may leverage the abovementioned positive effects. Indeed, the findings from Organisation Y demonstrate that exploitation of application platforms and conduction of formal meetings carried out in combination are seen as complementary to each other. Combining hard and soft practices is not identified in the literature and therefore can be investigated in further studies.

It seems that soft practices are used by case organisations to manage some of the negative effects arising from PIs such as delays and conflicts, which are also mentioned by some

authors in literature such as Chinowsky et al., (2011, p. 170) and Killen and Kjaer (2012, p. 563). Soft practices are also found to be faster when compared to the hard tools. Although this benefit is not acknowledged by previous studies, the literature states that hard tools are time consuming, which indirectly supports this finding. Further, soft practices enable not only resolution of conflicts, but also anticipation of issues as identified by Organisation X which is equal to one of the benefits of the hard tools, indicate by Organisation Y.

The empirical findings demonstrate that soft practices have also certain drawbacks. The most frequently mentioned drawback is that they are time-consuming. Hereby, it can be noticed that opinions of the respondents in both organisations are divided in regard to this issue. Some of them as mentioned before find soft practices to be fast and time-saving whereas others discuss the need of devoting time in order to implement them. This is most probably because the first group of respondents compares hard and soft practices and finds the soft ones as relatively time-saving. On the other hand, the second group does not make this comparison but evaluates them in isolation as time-consuming. The fact that one respondent (Respondent 2) finds soft practices to be time-consuming, but choose them as the preferred method in urgent situation, supports the aforementioned assumption. The risk of mistake inherent in soft practices is found as another drawback mainly because of the fact that their content cannot be tracked and can therefore be lost easily. Therefore some important decisions can be overlooked or information might be passed inaccurately (Alavi & Leidner, 2010, p. 121).

The findings of our study demonstrate that that there are certain contexts when the soft practices for PIM are implemented. Firstly, this corresponds to Polack's (2007, p. 276) argument that soft practices are used when there is an interest in social processes, often underpinned by such implicit aspects as political processes (Elonen & Artto, 2003, p. 397) or presence of beliefs and values, embedded in organisational culture and influencing organisational performance (Johnson et al., 2009, p.128). Secondly, the notion of cooperative culture seems to be double-faceted. On one side, it refers to a soft practice of PIM, whereas on the other it is seen as a context (Aritua et al., 2009; Canonico & Söderlund, 2010, p. 803) that enables implementation of other soft practices, as outlined before. Similarly, organisational structure is found to be another contextual condition that influences the applicability of soft practices. Hereby, we discovered that an organisation structure is a particular context that enables soft practices. This is most probably because soft practices are characterised with high level of interaction (Polack, 2007, p. 276) which is enabled by post-bureaucratic organisational structure (Vie, 2012, p.182). This contextual condition is also acknowledged in the literature by Canonico and Söderlund (2010, p. 804) whereby these authors indicate the flat structure (a form of post-bureaucratic organisational structure) is an enabler of project meetings in particular. The finding that soft practices are more applicable in a context that is characterised by innovation is in line with Polack (2007, p. 271) argument that soft practices are needed for non-traditional areas characterised with high degree of change such as information system development. Hereby, it should be noted that this context is explicitly recognised only by Organisation X. However, it can be also the case for Organisation Y since it also operates in the ICT industry. The finding that soft practices are implemented in a context of urgency is in line with the previous finding where soft practices are indicated to be fast to deal with PI issues, despite the time that needs to be devoted to them. The last condition suggests that soft practices are more useful for

intracompany context, mainly because of their drawbacks that their content cannot be tracked. These contextual findings demonstrate the application of contingency theory principles more clearly than in the case of the identified hard practices.

These findings provide support to the *sixth proposition that organisations rely on soft practices (individual- and group-centred) of PIM that have certain benefits, drawbacks and context in which they are applied*. Therefore, organisations that need to manage PIs may rely on softer practices since they are found to be given preference in the case study organisations. These findings contribute to meeting the second study objective.

7.7 Revised theoretical framework diagram

The initially developed theoretical framework underpinned by the findings derived from the literature is revised and elaborated according to the empirical results. The revised theoretical framework diagram presented in Figure 4 summarises the theoretical and empirical findings discussed in the preceding sections.

As discussed in section 7.1 the benefit type of PIs is not recognised by the respondents in the case study organisations and therefore four main types of PIs are presented in the revised framework: resource, knowledge, output and market. It is empirically confirmed that failed PIM leads to a range of negative effects such as unforeseen risk transference, conflicts of interests, schedule slippages and delays, market cannibalisation, resource diffusion and personnel demotivation, which negatively affect portfolio success. It is also confirmed that effective PIM delivers significant benefits (i.e. efficient resource management, knowledge and information sharing, time efficiency, improved problem solving and provision of a holistic picture), which positively contribute to the portfolio success. In order to manage PIs, i.e. leverage possible benefits and avoid potential negative effects, hard and soft practices of PIM are implemented. Two types of hard methods are identified in the case study organisations: web application platforms and tracking tools, while utilisation of optimisation (mathematical) models and visual tools was disconfirmed. Both individual-centred (sacred cow, negotiation and convincing, leadership) and group-centred practices (formal and informal meetings and creation of cooperative culture) are recognised in the case organisations. Moreover it is discovered that hard and soft practices can be beneficially exploited not only separately but also in combination. Outlined in the literature review section PPM, contingency, complexity and resource-based theories are acknowledged to be closely related to the area of PIM, although application of contingency theory for the implementation of hard practices cannot be clearly justified based on the findings.

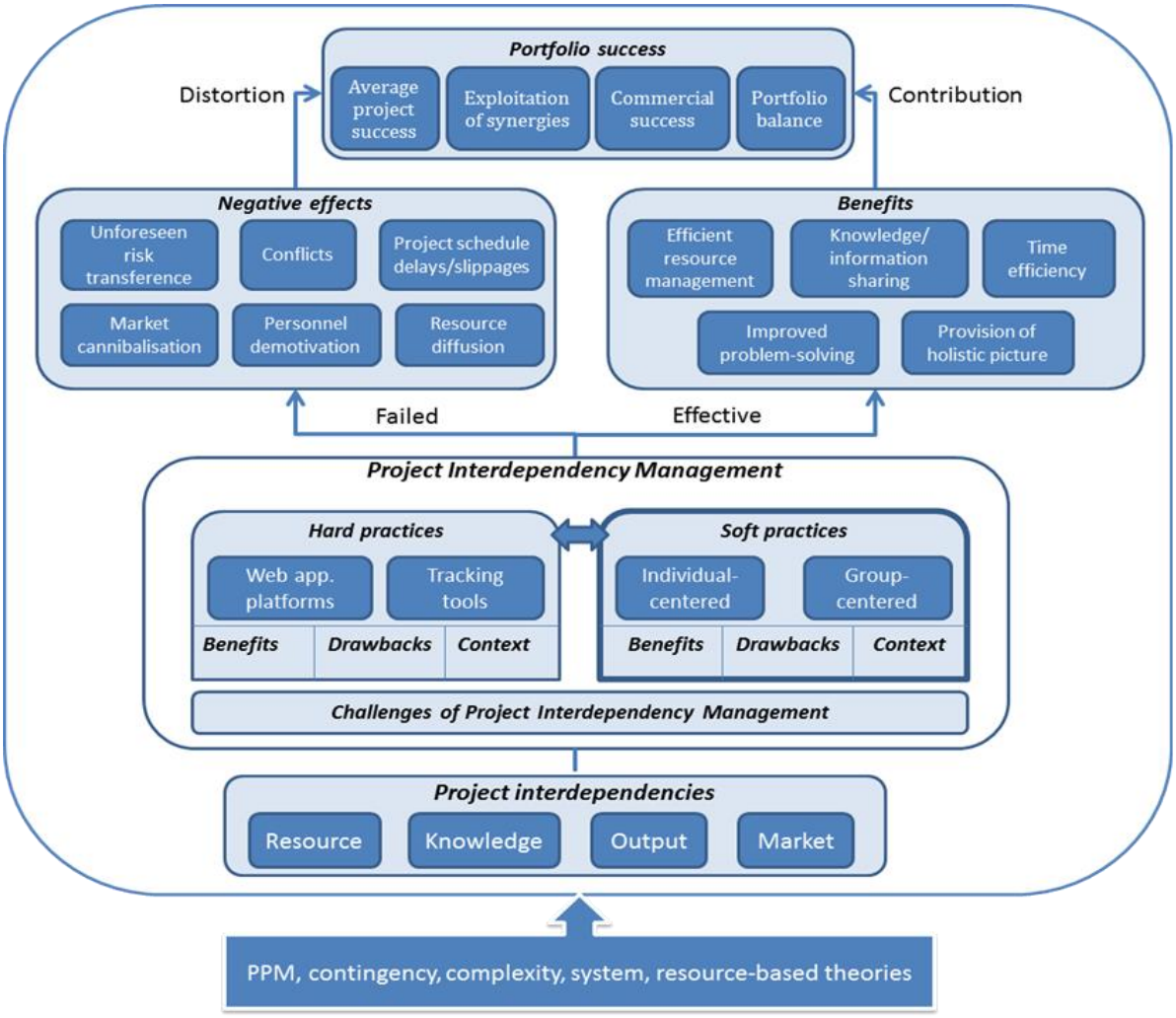

Figure 4: Revised theoretical framework

8 Conclusions

This section starts with an overview on the key findings derived from the study whereby the answers to the research question and objectives are highlighted. It continues with an outline of the managerial and theoretical implications, and concludes with explanation of the study limitations and suggestions for future research.

8.1 Conclusion

The literature recognises that PIM is an important area of PPM that lacks real-life empirical examination (Rungi & Hilmola, 2011, p. 158; Reyck et al., 2005). Therefore, this study investigates why and how organisations from the ICT industry manage PIs in a project portfolio. It specifically examines the benefits of PIM, the negative effects of failed PIM and the challenges that PIM is facing. Furthermore, it focuses on the hard and soft practices employed for PIM. The examination is based on a cross-case analysis of two Italian organisations operating within the ICT industry. The ICT is chosen as an excellent ground for studying PIM since it is of significant importance for the contemporary world's economy where PM and PPM are practiced intensively. The study relies on qualitative research methods since it is discovered in the literature that the PPM theory lacks qualitative and case study approaches to better understand the complexity of the under investigated phenomena of PIM (Kilen et al., 2008, p. 34; Rungi & Hilmola, 2011, p. 150). Semi-structured interviews are conducted via Skype to collect the empirical data and template analysis is used to analyse the findings. The theoretical background on PIM is provided through literature survey on which bases six theoretical propositions are established and theoretical framework diagram is developed.

The findings of the study confirm the first proposition that there are various types of PIs existing in the project portfolios of the case organisations, such as resource, output, knowledge and market PIs. The findings also confirm the second proposition that comprehensive consideration of PIs within PPM delivers benefits contributing to the portfolio success such as efficient resource management, information and knowledge sharing, increased time efficiency, improved problem solving and ability to see a big picture (Archer & Ghasemzadeh, 1999, p. 210; Rungi, 2010a, p. 117; Rungi 2010b, p. 2; Teller et al, 2012, p. 597; Thiry, 2004, p. 250). This study also corroborates the third proposition that effective PIM helps to avoid possible negative effects which in turn distort the portfolio success: project delays, resource misuse and deficiency, unforeseen risk transferences, market cannibalisation, conflicts of interests and personnel demotivation (Dooley et al., 2005, p. 471; Engwall & Jerbrant, 2003, pp. 406, 407; Formentini & Romano, 2011, p. 545; Rungi & Hilmola, 2011, p. 156; Hossain & Ruwanpura, 2008, p. 2421; Lycett at al., 2004, p. 294; Sanchez et al., 2009, p. 20). These findings emphasise the importance of effective PIM and provide the answer to the first part of the research question, i.e. why organisations manage PIs.

However, as acknowledged by authors in the literature (Elonen & Artto, 2003, p. 398; Rungi, 2009, p. 1509; Rungi, 2010b, p. 4; De Reyck et al, 2005, p. 524) and confirmed by the empirical findings PIM can be complicated by the following challenges: the presence of complexity, the need for extra resources and time for PIM implementation, the difficulty of

managing conflicts of interests and prioritisation of interrelated projects and presence of legal issues. This corroborated the fourth proposition that PIM a challenging task.

In order to manage issues arising from PIs and leverage related benefits organisations implement certain hard and soft practices as suggested in the literature. Although the findings disconfirm the fifth proposition that organisations use optimisation models and visual tools as hard practices of PIM, it is revealed that the case study organisations use other hard tools to manage PIs, namely web application platforms and tracking tools. It is also found that the organisations realise that the employed hard tools deliver a range of benefits, and that their application is limited by some drawbacks. Particular context in which they are implemented is not found though.

The empirical findings support the sixth proposition that organisations use soft practices of PIM that have certain benefits, drawbacks and context conditioning their exploitation. Both group-centred (formal and informal PM meetings and creation of cooperative culture) and individual-centred practices (leadership, negotiation and convincing and sacred cow) are identified in the case study organisations. Moreover the findings demonstrate that hard and soft practices can bring benefits when applied not only separately, but also in combination. Hereby exploitation of web-application platform as a hard tool and meetings as a soft practice are found to be complementary to each other. Overall both hard and soft practices of PIM are seen to be important within PPM theory and practice, however it is identified that soft practices are exploited more intensively. The abovementioned findings provide the answer to the second part of the research question, i.e. how organisations manage PIs. The theoretical framework initially developed on the basis of the theoretical background on the matter of PIM is elaborated and revised according to the empirical findings. The key findings of this study apply to both case organisations demonstrating the similar reasons they see for managing PIs and the similar way of PIM implementation.

8.2 Managerial implications

This study takes the managerial perspective into consideration and it is believed that the findings may provide useful insights to the PM and PPM practitioners. However, it should be noted that because of the nature of the case study as an employed research strategy, accompanied with analytical generalisation, caution should be exercised when these findings are to be transferred in another context. Since statistical generalisation is not applicable in this study, making any claims that would infer adequacy of the findings to all the project-based ICT companies cannot be made. Therefore, the following recommendations should be taken only as possible insights that PPM practitioners may consider.

Firstly, PPM practitioners should be aware that there might be several types of PIs within a portfolio that are to be managed. This study reveals four: resource, knowledge, outcome and market PIs. Secondly, they should understand the importance of PIM. This study demonstrates that implementing effective PIM leads to various benefits that can contribute to portfolio success. Otherwise, failed PIM may lead to a range of negative effects that in turn may distort the portfolio success that PPM practitioners would certainly be aiming to avoid. However, PPM practitioners should also be aware that PIM is not an easy task. It

may pose challenges that have to be overcome such as presence of complexity, complicated prioritisation, increased time and resource requirements, presence of political aspects, lack of knowledge and expertise regarding PIM and presence of specific legal issues in particular cases. Thirdly, PPM practitioners can consider employing various PIM practices, hard and/or soft, in order to tackle PIs. Regarding hard practices, if there is no expertise in utilising optimisation models or visual tools suggested by theory, practitioners should try to employ the tools that are a part of their daily routine. In this study these are web application platforms and tracking tools, which however allow only identification of PIs. Therefore attention should be devoted to soft practices as they are found to be a prevailing mechanism for managing PIs. PM and PPM practitioners may find useful implementing group-centered practices such as formal and informal meetings and promotion of cooperative culture. Furthermore, practitioners may develop individual competences such as leadership or negotiation. They should also remain attentive to the benefits as well as the limitations of these soft practices in order to exercise PIM most effectively. Moreover practitioners should realise that there are particular contexts in which soft practices are applicable, such as presence of cooperative culture, flat organisational structure, urgency and an innovative nature of the business.

8.3 Theoretical implications

This study contributes to the PIM area of PPM that is considered to be under-investigated by current researchers (Eilat et al., 2006, p. 1020; Rungi & Hilmola, 2011, p. 150). This is carried out through exploration of real-life practice of PIM that is identified to be lacking in the current literature (Reyck et al., 2005; Rungi & Hilmola, 2011, p. 158). The contribution is made through analytical generalisation and aimed at expanding the current state of the PPM body of knowledge whereby the theoretical framework incorporating the empirical findings of this study is developed. The findings are mostly in line with the current state of literature, but they as well oppose some aspects and bring new insights. The empirical evidence supports the theoretical propositions related to PI types, benefits of PIM and negative effects of failed PIM, challenges of PIM and more intensive utilisation of soft practices than hard ones. However, the study shows that the hard tools identified in the literature are not in use in the studied organisations, but web application platforms and tracking tools are implemented instead. This finding provides a new perspective to look at hard tools for PIM and demonstrates that practice is not keeping up with the theory, mainly because of lack of awareness and knowledge about suggested in the literature solutions. Furthermore, this study provides new insights, that the current literature does not consider in the context of PIM such as perception of soft practices as faster ones that could be applied in urgent contexts, the use of negotiation and convincing as a soft practice, the legal issues as a challenge of PIM within the ICT industry or the implementation of hard and soft practices in combination.

8.4 Limitations and future studies

There are several limitations of this study that are to be highlighted. The employed qualitative methods and case study research strategy may have led to double hermeneutics and consequent bias in findings, despite the employed mechanisms that aimed to avoid them. Therefore future studies may investigate the PIM phenomenon through quantitative

research that is perceived to be more objective. This type of studies would also enable to quantitatively measure (e.g. through correlation analysis) the explanatory aspects of the current study such as the effect of PIM on portfolio success, which in this case was approached in a qualitative manner. They may also test the implementation of suggested in theory soft and hard practices. An interesting research might also examine the effects of particular PIM practices on the portfolio success. Future studies may employ a survey as a method closely associated with quantitative research in a large random sample that would enable statistically generalisable results. Random sampling and statistical generalisation are not feasible for this study because of the employed research strategy of multiple case studies.

Limitations to the employed research strategy can also be identified. Although data and researchers triangulation are used, this study can be criticised for relying on limited types of evidence which is the project and portfolio managers' responses since the inquired access to the organisations' documentation was rejected. Therefore future studies that will decide to use the same strategy may overcome this by conducting research that will involve multiple sources of evidence. Future studies may also involve cases from different countries or industries that would examine the PIM phenomenon in a different areas then the ICT industry in Italy examined in this study. The fact that this study employs semi-structure interviews may invoke reliability concerns, which also can be overcome with a quantitative study that would use standardised interviews. The conduction of the research in English, which is a native language neither for the researchers nor for the respondents, might have also led to misunderstandings and biased findings. The use of Skype as a mediating technology, that sometimes posed technical issues might have led to similar outcomes. Therefore, these limitations are suggested to be overcome through studies that would involve face-to-face interviews in native language for both researchers and respondents.

More research is encouraged to theorise and verify the usage of web application platforms and tracking tools as hard practices used for identification of PIs since they are to our knowledge not investigated within the area of PIM. Their benefits and limitations may be more thoroughly explored and the context in which they are applied may be investigated in detail as this study could not draw any clear conclusions on this issue. The soft practices that are discovered through this particular study can be investigated in a similar manner. Future studies may also investigate more thoroughly the application of hard and soft practices implemented in combination whereby the benefits, drawbacks and the context can be specifically examined.

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Appendices

Appendix 1: Optimisation models

Tools	Description	Benefits	Drawbacks
Multi-objective evaluation model (Blecic et al., 2008)	It takes into consideration three criteria: actors' interest, relevance of sequence i.e. interdependency and resources and generates all Pareto-optimal sets of sequences (Blecic et al., 2008, p. 155-156). The model takes a stepwise treatment of interdependencies recognising that the different order of the same projects might have a different effect on the strategic objectives. For each pair of projects the interdependency and synergetic effect is estimated and then this information is used to calculate the overall interdependency effect for longer sequences (Blecic et al., 2008, p.161). The computation is performed with software called ASA using an evolutionary-based algorithm (Blecic et al., 2008, p. 162). Even though these authors acknowledge that the model is designed for urban planning projects, its applicability seems more general.	- allows considering multiple projects - interactively explores the whole domain of possible solutions - defines different alternative strategies of implementation of projects	-interdependencies can be taken only between pairs of project
Multi-stage stochastic programming framework (Colvin and Maravelias, 2011)	The objective of the model is to maximize expected net-present value (ENPV) as well as to consider risk. The method discussed in this paper can be employed to address general stochastic optimisation problems under endogenous uncertainty observation (These are problems where the decision maker can affect the underlying stochastic process (Colvin & Maravelias, 2011, p. 618).	- considers risks and several risk management approaches	-restricted by availability and reliability of stochastic data
Collaborative evolutionary multi-project scheduler (Shackelford and Corne, 2001)	A model that is able to deal with multi-project resource-constrained scheduling problems by combining standard automated scheduling with master scheduler guidance. Hereby based on the description of the master scheduler it can be implied that these authors refer to the person responsible for scheduling a portfolio of projects. "It uses an evolutionary algorithm to evolve schedules according partly to standard criteria of due date slippage and makespan, but also includes the master scheduler's input as part of a schedule's selective fitness" (Shackelford & Corne, 2001, p. 1131).	- accounts for the gut feeling of the master scheduler	-takes into consideration only resource interdependencies
Nested real option model (Bardahan et al. ,2004)	The model differs from other real options studies that use this method to make go or no-go decision for a single project. It is a real options portfolio Optimisations algorithm applied to real options results in a prioritisation framework, where project funding decisions are made in each period and their impact on the overall portfolio value is updated dynamically (Bardahan et al., 2004, p.35). They suggest this model since according to them the uncertainties in the IT investments and the inability to incorporate the impact of flexibility (interdependencies such as positive impact on future projects) force managers to rely on gut feeling.	-enables more accurate valuation and prioritisation of projects -accounts for the interdependencies and sequencing constrains typically associated with IT projects in particular	-the overall portfolio volatility can not be estimated accurately Ghapanchi et al. (2012, p. 793)

Data Envelope Analysis (Ghapanchi et al., 2012)	A mathematical programming approach model in which the authors introduce fuzzy variables that do not have exact value in order to account for the uncertainty and therefore name this model as Fuzzy DEA (FDEA) (Ghapanchi et al., p. 794). The FDEA model is argued to generate more feasible portfolios and therefore offers an opportunity for examination of more portfolios and it takes uncertainty into consideration. It further proposes the optimal or most efficient portfolio i.e. the one that maximizes output while minimizing resources.	- allows selection the best portfolio of IT projects by taking both project interactions and project uncertainties into consideration	-this is a theoretical method, practical applicability and convenience of use is not tested
DEA–BSC model (Eilat et al., 2006)	The methodology combines the Data Envelope Analysis (DEA) with Balanced Scorecard (BSC) and takes account for uncertain and subjective data. The methodology takes into consideration project level characteristics and portfolio level ones (e.g. balance of risk and reward within the portfolio), as well as input and output balance. After using a portfolio generation algorithm and an accumulation function that takes into account possible complex interactions among projects, the methodology employs the DEA–BSC model to evaluate the alternative portfolios and select the best one(s). Hereby the general structure of inputs and output is represented as hierarchy. The interactions between projects in terms of resources, value and outcomes are represented in corresponding matrices (Eilat et al., 2006, p. 1030). The DMU in this method refers to both projects and portfolios.	- responds to the three goals of effectiveness, efficiency, and balance - Considers several interdependencies: resource, benefit and outcome	-it takes account for static portfolio selection problems only without considering already ongoing projects
Branch and bound algorithm model (Schmidt, 1993)	The model solves a nonlinear integer program with multiple quadratic constraints (Schmidt, 1993, p. 407, 409). The model uses the value, cost and outcome matrices as inputs in order to determine the value of the portfolio.	- accounts for three types of interdependencies (benefit, resource and outcome)	-it requires expertise in using this type of quantitative models
Quantitative method, combining Dependency Matrix and spreadsheet-based Optimisation Model (Dickinson et al., 2001)	A non-linear integer optimisation model method which quantifies the interdependencies between projects The model estimates if and when to start a project and it takes into consideration whether the projects that it depends upon are also funded. "The Optimisation model identifies the funding strategy that maximizes the potential return, subject to budgetary and portfolio balance constraints" (Dickinson et al., 2001, p. 520). Once the optimum strategy is found, the model can be used evaluate, in real-time, the impact of minor changes to the portfolio. Hereby Dependency matrix is used for documenting and quantifying dependencies. After the matrix is generated, it is calculated "what percentage of a project's revenue is attributable to itself and how much is attributable to its interdependencies" (Dickinson et al., 2001, p. 523). The spreadsheet-based Optimisation Model (a nonlinear, integer program) is used to incorporate data from the dependency matrix and additional variables (timing, portfolio cost, revenue) and to estimate the financial performance to	- allows to evaluate, in real-time, the impact of minor changes to the portfolio - gives graphical representations of results - overcomes the problem of static project selection as it allows usage when project are initiated a different funding cycles	- it requires all input data to be quantifiable - considers only benefit interdependencies and doesn't take into consideration the resource or technical interdependencies

	directly calculate the total performance of any portfolio (Dickinson et al., 2001, p. 523). The main goal of the model is to maximize the estimated financial return taking into consideration the portfolio balance and budget constraints.		
Robust portfolio modeling framework (Liesiö, Mild and Salo, 2008)	A framework which accounts for wide range of project interdependencies. It is specifically possible through this framework to estimate the project synergies via an interval, and situations where uncertain synergies may arise can be modeled. When all efficient portfolios are computed, it is possible to identify which projects are robust at any budget level by taking into consideration the budget-dependent core-index. Hereby the authors consider a portfolio to be efficient "if no other feasible portfolio gives a higher overall value at a lower cost" (Liesiö et al., 2008, p.684). Core index analysis on the other hand aim to identify core and exterior projects, whereby core projects are the ones that are recommended for selection and exterior, those that can be rejected (Liesiö et al., 2008, p. 683).	- takes into consideration budget constraints and incomplete information (e.g. cost or budget) - not long solution time - can be performed from personal computer	- requires significant amount of input data
Integrated model for ICT project selection (Lee and Kim, 2001)	The model takes into consideration interdependencies and multiple criteria by combining three methods: goal programming, Delphy and analytic network process (ANP). Goal programming, as argued by these authors, is used for problems characterized with conflicting objectives. Delphy method is used to evoke expert group opinion on the degree of interdependent project relationship, to determine the organisational objectives of the project selection and to specify the criteria for selection (Lee & Kim, 2001, p. 115). ANP is used to set priorities for objectives and determine trade-offs among them. The Delpy method and ANP are used to generate data used as input for the goal programming that is ultimately used to evaluate the considered alternatives and to find an optimal solution.	- may take any resource, technical and benefit interdependencies - takes account for conflicting objectives - considers expert opinions	-seems complex, and time consuming because of the group opinion that needs to be collected via Delphy method -not tested on real problems
Mathematical model with non-linear 0-1 polynomial programming (Santhanam and Kyparisis, 1996)	The non-linear model is used in order to "model project interdependencies as they exist in the problem situation" because otherwise the cost and benefits sharing would not be captured (Santhanam & Kyparisis, 1996, p. 381). It can consider all the different types of interdependencies and may consider more than two projects (Santhanam & Kyparisis, 1996,, p. 381). The model is tested on a real world ICT project selection. The aim of the model is to select the set of projects that have passed the go/no go decision and that will maximize the total benefit considering constraints or interdependencies such as resource and logical. When the model was applied on a real project the company found it useful because of it ability to enable sensitivity or what-if analysis.	- considers all the different types of interdependencies - polynomial model is used to capture interdependencies between more than two projects.	-does not take into consideration multiple criteria for selection (Lee and Kim, 2001, p. 112)

0-1 integer non-linear programming model with a nonlinear objective function and constraints (Aaker and Tyebjee,1978)	one of the earliest that was identified in the literature review that considers project interdependencies during project selection and budget allocation. It is a 0-1 integer non-linear programming model with a nonlinear objective function and constraints (Aaker & Tyebjee, 1978, p. 34). The model aims to determine the expected value of the best subset of projects considering the budget constraints (Aaker & Tyebjee, 1978, p. 31). 0-Matrix is utilized to demonstrate the possible resource overlaps.	- considers three types of interdependencies: resource, effect and technical and also the probability of success of every project - considers budget constrains - matrix visually demonstrates resources overlaps - possible to account for more than two projects	- requires data that need to be supplied from various groups within the organisation
Three phase approach to portfolio analysis (Stummer and Heidenberger, 2003)	In the first phase all projects are screened, through scoring and Delphy method and the worthy ones are consider for further analysis; in the second phase multiobjective integer linear programming model is used to identify all efficient Pareto-optimal portfolios as defined by Liesio et al. (2008), in at least on objective (Stummer & Heidenberger, 2003, p. 176); and the third phase, through an interactive system, determines the portfolio that fulfills the decision makers' requirements (Stummer & Heidenberger, 2003, ibid, p. 175). Therefore, the model does not generate one single optimal portfolio but allows the decision maker to apply his/her judgment to explore the space of the generated portfolios and then to select the one that meets his/her preferences (Stummer & Heidenberger, 2003, p. 176).	-allows the decision maker to apply his/her judgment to explore the space of the generated portfolios and then to select the one that meets his/her preferences - takes into consideration complex project interdependencies and time profiles of the objectives - considers interdependencies between more than two projects	- linear nature of the model does not take account for more complex dependencies (Santhanam and Kyparisis, 1996) - requires to declare all the subsets of interdependent projects in advance which doesn't allow to perform dynamic management of interdependencies (Blecic et al., 2008, p. 160) - the model does not schedule the projects but only presents a time profile
Planning and execution simulation model (Hossain & Ruwanpura, 2008)	It is "a special-purpose simulation (SPS) tool that is used to optimize a multi-project environment focusing on company resources, program schedules, uncertainties and business strategies" (Hossain & Ruwanpura, 2008, p. 2425).	-integrated with popular managerial software: Microsoft Access and Primavera - can be used for any number of projects regardless business strategies and constraints	- takes account for resource interdependencies only - data intensive

		-reduces waste of idle time of resources or minimizing the uncertainty -enables to add a new project to ongoing projects and to analyse and predict future problems	
Mixed-integer programming model (Zuluaga, et al.,2007)	A mathematical model that accounts for both project interdependencies and project scheduling in the same time. Regarding project interdependencies it takes into consideration resource, benefit and technical ones (Zuluaga, et al., 2007,). The objective of the model is to maximize the net present value of the selected projects and satisfies time windows within early and tardy dates (Zuluaga, et al., 2007, p. 2). With the experiment they take it is shown that interdependencies affect the optimal scheduling of projects but also the number and combination of projects in an optimal portfolio (Zuluaga, et al., 2007, p. 6).	-takes into account benefit, resource and technical interdependency - Maximases net present value and satisfies time windows within early and tardy dates - takes into consideration budget limits as well as cash flow generation	- considers interdependencies between two projects only
Dependence structure matrix and domain mapping matrix approaches (Danilovic and Sandkull, 2005)		- enables systematic identification of interdependencies and relations in multi-project environment with the main aim of reducing uncertainty - provide transparency and synchronization between projects	- provides only static snap-shots of interdependencies, doesn't allow to take account for dynamic nature of the portfolio

Appendix 2: Interview guides for portfolio and project managers

Management of project interdependencies in a project portfolio

(Interview guide for portfolio managers)

We are two Masters students pursuing international Masters in Strategic Project Management at Politecnico di Milano and Umea University, Sweden. In our Master thesis research we are investigating how companies from the ICT sector manage project interdependencies in a portfolio. For this purpose we would like to carry out this interview in order to find out how this issue is tackled in your company.

By interdependencies we refer to effects that projects might have on each other and to their mutual contribution to the benefits required by the company. Please take the following questions as a general guideline for the upcoming interview.

Please note that all the data collected will be treated with confidentiality and will be used solely for this research purposes.

Interview questions:

1. Would you mind if our interview will be recorded? We may assure you that all the data will be treated confidentially and only for the research purpose.
2. Could you please tell us briefly about your job role, department, and years of experience?
3. Do you have projects in your portfolio that are dependent on each other by any means?
4. What kind or relationships usually exist between the projects in the portfolio?
5. What are the benefits of having interrelated projects?
6. What are the problems that you usually encounter because of the interdependencies?
7. Do you use any tools or techniques to deal with the problems arising from interdependencies between projects?
    a. In which situations are these tools and techniques applicable? Please, specify particular circumstances when you use these techniques?
    b. What are the benefits of applying these techniques?
    c. What are the drawbacks or limitations of applying these techniques?
8. Do you use any softer, more informal practices, to deal with the problems arising from interdependencies between projects?
    a. In which situations are these softer, informal practices applicable? Please, specify particular circumstances when you use these practices?
    b. What are the benefits of applying these practices?
    c. What are the drawbacks or limitations of applying these practices?
9. How important according to you is the management of project interdependencies in a project portfolio? Why (what are the benefits)? How is it related to portfolio success?
10. How difficult do you find managing project interdependencies? Why?
11. In case of not so effective interdependency management what negative effects in your opinion may appear?

Management of project interdependencies in a project portfolio

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Please note that all the data collected will be treated with confidentiality and will be used solely for this research purposes.

Interview questions:

1. Would you mind if our interview will be recorded? We may assure you that all the data will be treated confidentially and only for the research purpose.
2. Could you please tell us briefly about your job role, department, and years of experience?
3. Have you ever experienced to have a project that was dependant by any means on other projects in the company's portfolio?
4. What kind or relationships existed between your project and the other projects in the portfolio? What are the benefits of having interdependent projects?
5. What are the problems that you usually encounter because of the interdependencies?
6. Do you use any tools or techniques to deal with the problems arising from interdependencies between projects?
    a. In which situations are these tools and techniques applicable? Please, specify particular circumstances when you use these techniques?
    b. What are the benefits of applying these techniques?
    c. What are the drawbacks or limitations of applying these techniques?
7. Do you use any softer, more informal practices, to deal with the problems arising from interdependencies between projects?
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Appendix 3: Initial template

1	INTERDEPENDENCY TYPOLOGIES		5.1.6	Enable seeing the big picture	BIG PIC
1.1	Resource	RES	5.2	**Drawbacks of hard practices**	**DRBH**
1.2	Market	MAR	5.2.1	Require large input data	REQD
1.3	Knowledge	KNOW	5.2.2	Ignores intangible aspects	NINT
1.4	Benefit	BEN	5.2.3	Time and expertise consuming	TECNS
1.5	Outcome	OUT	5.3	**Contextual conditions of hard practices**	**CONTH**
2	BENEFITS OF SUCCESSFUL PIM		5.3.1	Available data	KNOW
2.1	Important	IMP	5.3.2	Available time	HCOMP
2.2	Increases Success	INC SUCC	5.3.3	Available knowledge	ALW
2.3	Leverage synergies	SYN	5.3.4	High complexity	HCOMP
2.4	To see the big picture	BIG PIC	6	SOFT PRACTICES	
2.5	Problem solving improved	PROB SOL	**6.0.1**	**Individual-centered**	**IND-C**
2.6	Efficient resource management	EFF RES MGT	6.0.1.1	Sacred cow	SCOW
2.7	Efficient scheduling	TIME	6.0.1.2	Gut feeling	GUT FEEL
3	NEGATIVE EFFECTS OF UNSUCCESSFUL PIM		**6.0.2**	**Group-centered**	**GR-C**
3.1	Schedule slippage	SCH SLIP	6.0.2.1	Role clarity	ROLCL
3.2	Inefficient resource utilisation	RES INEFF	6.0.2.2	Interactive control system	PMM
3.3	Market cannibalisation	MAR CAN	6.0.2.3	Periodic PM meetings	CULT
3.4	Intra-company conflicts	CONF	6.0.2.4	Working culture facilitation	LEAD
3.5	Short-term problem solving	ST PROB	6.0.2.5	Leadership	LLS
3.6	Failure to exploit synergies	FAIL SYN	6.0.2.6	Trainings	INCON
3.7	Risk transference	RISK TRAN	6.0.2.7	Lessons learn session	NECO
3.8	Employees demotivation	EMP DEM	6.0.2.8	**Benefits of soft practices**	**BENS**
4	CHALLENGES OF PIM		6.0.2.9	Cooperation	COOP
4.1	Difficult/Challenging	DIFF/CHA	6.1.1	Learning/knowledge sharing	LKN
4.2	Complexity	COMPL	6.1.2	Flexibility	FLEX
4.3	Resource- and time-consuming	RESTIME CON	6.1.4	Conflict resolution	CONF
4.4	Lack of knowledge	KNOW LACK	6.1.5	Fast	FST
4.5	Opportunistic behaviour	OPP BEH	6.1.6	Account for personal characteristics	PERSCH
4.6	Lack of a holistic picture	PIC LACK	6.2	**Drawbacks of soft practices**	**DRBS**
5	HARD PRACTICES		6.2.1	Subjective	SBJ
5.0.1	Optimisation models	OPTM	6.2.2	Risk of mistake	RMST
5.0.2	Visual tools	VIST	6.2.3	Dissatisfaction	DISSFN
5.1	**Benefits of hard practices**	**BENH**	6.3	**Contextual conditions of soft practices**	**CONS**
5.1.2	Objective	OBJ	6.3.2	Implicit	IMPL
5.1.3	Precise	PRS	6.3.3	Urgency	URG
5.1.4	Provide optimal solution	OPTSOL	6.3.4	Organisational structure	ORGST
5.1.5	Systematic identification of interdependencies	SYSID	6.3.5	Communication competences	COM