Systematic concept identification and evaluation for IT/business alignment

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Abstract

In project management, initial requirements definition takes place in the front-end phase, where the uncertainties are highest and decisions have the biggest influence; this constitutes a considerable process risk, risk that can, however, be mitigated by ensuring that requirements are validated and understood by stakeholders before starting with the development of the solution.

This research investigates approaches to the front-end phase of IT/business alignment projects which incorporate this type of risk mitigation. We use an initial exploratory case study to apply one such approach, Problem Oriented Engineering (POE). The case study is retrospective, applied to the front-end phase of an IT/business alignment project.

The case study shows that POE can be applied to model all process steps in the real-life project, identifying the related relevant stakeholders and their involvement in the process. Specific validation points and their outcomes could also be modelled. Additionally, the case study demonstrated that problem diagrams can provide suitable models of concepts in their organisational context, with associated requirements to be satisfied.

Although retrospective, the outcome of the pilot research is encouraging: POE gave an indication of when development risk was accumulated and the extent of related sunk costs when concepts were rejected by stakeholders.

Future research should assess the extent POE models can be used in practice to allow stakeholders to understand better identified concepts, the rationale for their choice and their impact on the organisation. Our conclusion is that this type of analysis has the potential to become a powerful project management tool that can be applied to the front-end phase of project, with the purpose of systematising concept identification and evaluation, and in this way reducing development risk.

1 Introduction

1.1 The research problem and its context

The alignment of business and IT can be defined as the fit and integration between business strategy and IT strategy that manifests itself through the actual value that IT creates for the organisation (van Grembergen & de Haes 2009). Over the past 30 years, the value of this alignment has been widely acknowledged (Davenport et al. 1990, Lederer & Mendelow 1986, Chan & Reich 2007, Huang, C. Derrick & Qing Hu 2007, Khaiata & Zualkernan 2009) and many CEOs and CIOs have cited this as their priority (Reich & Benbasat 2000). Companies around the world are forced to be flexible and adaptive to the business environment in response to market forces of
increased competition and globalisation, hence they are placing increasing emphasis on strategy development and implementation (Hawking 2009). As business strategy changes, so must IT strategy remain aligned. As such, information systems (IS) must be capable of adapting in order to facilitate continuous business process improvement (Hunter 2009), and to create value for the organisation either by improving individual business processes, or providing inter-process linkages, or both (Tallon & Kraemer 1999).

There are many examples of how IT must remain aligned to the changes in strategy. The automotive industry, for instance, has been affected by globalisation for decades. Car manufacturers have changed the location of their production facilities to make use of the best possible manufacturing conditions. Their vendors have been forced to move their own production facilities accordingly, in order to comply to their customers’ requirements. Additionally they have been required to keep the same service standards independently from the location. The new required production facilities and the standardisation of service have forced the vendors to centralise their information systems and set up homogeneous processes in order to be able to serve their global customers.

The Project Management Institute (PMI), which is an international body aimed at bringing professionalism to the area of project management (Carton et al. 2008), defines projects as the instruments used by organisations to implement change with the purpose to “help meet their strategic goals like meeting changes in market demands, customer requests, or organisational requirements and in this way adapt to the changing business environments”. This is the case for IT/business alignment projects which, according to Tiernan & Peppard (2004), are business change projects or information systems (IS) projects. They utilise IT and include the design and implementation of new business processes while, at the same time, they establish new ways of working and create new intra-organisational and inter-organisational relationships. Such projects are as much about changing the way a business operates as they are about technology and are usually the preconditions for major changes in business (Davenport 2000). This combination of technology and change management makes projects more complex and more susceptible to be influenced by changes outside of the project boundary which lead to uncertainty thus increasing risks.

In spite of a plethora of project management methods and tools, project deviation and failure are common. A study that was conducted by Böhle et al. (2015) in 2013, which examined 5400 IS projects, for instance, came to the conclusion that 50% of those projects exceeded their planned budget before completion or, equivalently, produced a reduced scope than planned, while 20% even put the existence of the company at risk. Poor project requirements definition has been identified as one of the major causes of
project failure due to the fact that it leads to a poor design basis (Yang et al. 2012).

The initial requirements definition takes place during the initial phase of a project life cycle. This phase is also known as project ‘front-end phase’ or ‘pre-project planning’ and, according to the PMI, it is the basis “to align the stakeholders’ expectations with the project’s purpose” and “help set the vision to the project” (Project Management Institute 2013).

In this phase, when the uncertainties are at the highest, any decision taken may have a critical influence. In consequence, understanding of risks related to these uncertainties is crucial to be able to manage projects (Williams & Samset 2010). In this context, risk is defined as an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives (Project Management Institute 2013). Many studies confirm that success during the following phases of a project is highly dependent on the quality of the front-end phase (Yang et al. 2015). Accordingly, this phase is said to have the largest impact on long-term success or failure (Williams & Samset 2010).

In spite of the importance of the front-end phase, the standard set within the Project Management Body of Knowledge, a best practice vehicle to understand project management in information systems (IS) projects (Carton et al. 2008), does not provide a tool set or best practices for the execution of this phase and there is more expertise in delivering “well-defined, pre-specified project within a clearly defined constant environment” (Williams & Samset 2010). Similarly, the success factors or best practices during the front-end phase are rarely in the scope of scientific literature (Kock et al. 2016). Furthermore, little is discussed about the contribution of project management practices to strategic alignment (Morris 2009), either in terms how to address the necessary information for decision making at the front-end phase (de Oliveira et al. 2015) or how to do a structured analysis and selection of alternative solutions (Williams & Samset 2010).

In project management the alternative solutions are usually called project ‘concepts’. Williams & Samset (2010) defines ‘concept’ in the context of projects as “a mental construction meant to help solve a problem or satisfy a need”. We will use the terms ‘concept’ and ‘solution’ interchangeably throughout this report. The front-end phase activities related to the analysis of alternative solutions are concept identification and evaluation. Although they are considered by project managers, the most important activities within this phase (Nobelius & Trygg 2002);(Williams & Samset 2010), a systematic approach to these activities could not be identified in the literature.

In summary, despite the fact that the front-end phase of a project, and
its concept identification and evaluation activities, are acknowledged as critical to project success in the context of IT/business alignment, very little has been devoted to them in both academic and practitioner literature. In particular, specific approaches and practices able to mitigate related development risks don’t appear to have received much attention, while the high incidence of project failure continues to be of concern. This apparent gap motivates this research.

1.2 Aim of the research

The aim of this research is to investigate approaches to the front-end phase of IT/business alignment projects, and specifically its concept identification and evaluation activities, which allow appropriate mitigation of risk, hence contribute to project success.

From our initial literature review in section 2, it transpires that knowledge of approaches and practices around the front-end phase of such projects is patchy, both in the practitioner and academic literature, with no single approach able to address all most critical activities of the phase and mitigate their related risk in an adequate manner.

Some of the approaches come from the Requirements Engineering (RE) literature, particularly early RE, which is not unsurprisingly given that many IT/business alignment projects involve the development of information systems, hence there is an overlap between project and system development life-cycle. Yet, as we will see in section 2, approaches currently proposed or adopted don’t go far enough in providing coverage of activities and mitigation of risk.

However, this begs the question of whether other approaches from software and system engineering may be a suitable starting point instead. Therefore this research will attempt to meet the research aim by applying and adapting one such approach, the Problem Oriented Engineering framework (Hall & Rapanotti 2009, Hall et al. 2008, Hall & Rapanotti 2015, 2016), for use in the front-end phase of IT/business alignment projects.

Specifically, the research aim will be tackled by answering the following research questions:

Q1: Which activities are included in the front-end phase of IT/business alignment projects and what are their related risks?

Q2: To which extent do approaches currently proposed or adopted in project management provide coverage for those activities and are able to mitigate those risks?
Q3: To which extent can the Problem Oriented Engineering framework be applied and adapted for use in the front-end phase of such projects?

Q4: To which extent is such an application and adaptation fit to the needs of real-world IT/business alignment projects?

1.3 Contribution to knowledge and practice

This research will contribute to knowledge by increasing understanding of the front-end phase of IT/business alignment projects, and proposing and evaluating an approach able to cover its most critical activities of concept identification and evaluation, and mitigate their related risk.

This research may, subsequently, have an impact on practice, and specifically on project management, by providing guidance and techniques which may be applicable in the front-end phase of such projects to identify and mitigate risk and reduce uncertainty of outcomes.

1.4 Report outline

The reminder of this paper is structured as follows: in section 2 we describe the project front-end phase and the different approaches found in the literature and in current practice to address the activities related to this phase. We also discuss the research gap and motivate our proposed research. In section 3 we describe our research methodology. section 4 and 5 describe in detail the pilot research and its implications on subsequent research. The report concludes with an outline on the research work plan.

2 Literature review

2.1 The project front-end phase

A project is a delimited set of activities carried out in order to change or create something (Tiernan & Peppard 2004). The Project Management Institute (PMI) describes a generic project lifecycle as structured into four temporally contiguous phases: starting the project, organising and preparing, carrying out project work and closing the project (see Figure 2.1).

In this research, we are primarily concerned with the starting phase of the project lifecycle, variously known in the literature as: ‘front-end phase’ (Williams & Samset 2010), ‘ideation phase’ (Kock et al. 2016), ‘pre-project’
Various similar definitions of the phase exist: Kock et al. (2016) defines it as the somewhat unstructured period between the proverbial “blank sheet of paper and the project proposal”; Williams & Samset (2010), as the group of “activities from the time the idea is conceived, until the final decision to finance the project is made”; Project Management Institute (2013), as the set of activities necessary to grant the authorisation by the organisation to start a project and commit resources accordingly.

The output of the phase are the project charter and the stakeholder register. These documents will contain the information required to decide to proceed or not with the project, based on a ‘concept’ i.e. a “mental construction meant to help solve a problem or satisfy a need” (Williams et al. 2009). Both activities and output will be described in detail in the next subsections.

The success or failure of a project is defined in terms of the value, time, budget, duration and risk: value is the sum of products, services and results to be provided as a project; time and budget are the estimated effort; and project duration and risk represent the effects of uncertainty on the project as a whole (Project Management Institute 2013).

Project success is influenced by many factors, primarily the choice of project concept, which needs to be aligned with the organisational strategy
(Morris 2009). As stated by Williams & Samset (2010), the need to ‘do the right project’ is on a par with ‘doing the project right’.

Choosing the right concept is challenging. This choice within the front-end phase is when the knowledge is at its lowest and the uncertainties are at the highest. Furthermore, there is not a strong tradition of identifying alternative concepts as the basis for designing projects and it can be difficult to understand, at this early phase, the direct and indirect effects that the chosen concept will have. This issue sometimes gets lost through the pressure to achieve project goals and may lead to a wrong evaluation of alternatives. For instance, should the so called ‘zero’ alternative of not doing the project not be considered, it is possible that a concept will be implemented that worsens the present situation. Hence, “it is the anticipated effect of a solution to be implemented that should guide the choice of concept, rather than the present undesired situation” (Williams & Samset 2010).

A project concept should meet the requirements of different stakeholders and who will end up, ultimately, deciding which concept to implement with different stakeholders having possibly conflicting requirements. And, as in all human interactions, personal agendas, judgements and interests, will all have an impact. On the other hand personal judgement can be beneficial, with, for example, stakeholders acting as project champions and shaping projects in response to changes in the environment (Miller & Hobbs 2009).

Therefore, even if the alignment between organisational strategy and project concept is achieved, there are many additional factors that will affect the success of the front-end phase. The front-end is thus considered by some authors (Artto et al. 2011) to be the most troublesome and chaotic phase, but at the same time the one that provides the greatest opportunities to improve the overall innovative capability of a company.

2.2 Risks and risk assessment in projects

Risk can be defined as “the likelihood that a hazard will result in harm” (Fafinski 2008). The assessment of risk has evolved with time. In the middle ages, risk was related to the possibility of an objective danger or Act of God that could not be imputed to wrongful conduct. It was characterised by a lack of human control and hence blame could not be attributed (Fafinski 2008).

With time, there was a trend to include human responsibility and blame attribution. Unanticipated outcomes could be the consequence of careless human behaviour rather than fate. Risk started to be assessed in terms of the scale of its consequences and the likelihood that it will occur, hence was defined as the product of the probability and consequences (magnitude and
severity) of an adverse event (that is, a hazard) (Bradbury 1989). This type of approach is called ‘realistic perspective’ and is used by several disciplines, such as project management, to quantify risk (Fafinski 2008).

As discussed previously, risk is one of the criteria for project success and is defined by PMI as “an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more projects objectives” (Project Management Institute 2013). Hence various projects risk management strategies exist.

**Risk management strategies** Project risks has its origins in the uncertainty present in all projects. Risk management is part of the project management standards and its objective is to decrease the likelihood of negative events in a project (Project Management Institute 2013).

Project Management Institute (2013) enumerates several strategies to respond to risk in a project:

- risk avoidance, where the project team acts to avoid the risk and eliminate the threat or protect the project from its impact, for instance by reducing scope in case of possible unavailability of resources;
- risk transfer, where the project teams transfers the risk, for instance when liabilities are transferred to third parties;
- risk mitigation, where the project team acts to reduce the probability of occurrence or impact of a risk, for instance by setting up a prototype before starting with the development of the final product;
- risk acceptance, where the project team accepts the risk, for instance when acknowledging the risk and establishing a contingency reserve to handle it.

Risk in projects is typically evaluated in terms of the monetary effect derived from its occurrence and likelihood. This evaluation is the basis to plan and, if necessary, execute the planned response to it.

**Risk classification in projects** Project Management Institute (2013) classifies risk in project according to several criteria, such as its causes, project objectives or project phases, organised as a Risk Breakdown Structure (RBS) (see figure 2), which is a hierarchical representation of risks according to risk categories. Risks, for instance, can be structured into: technical (related to requirements, technology, complexity and interfaces); external (related to customers, market, weather, vendors); organisational (related to project dependencies, resources, funding, prioritisation) or re-
lated to project management (estimating, controlling, planning, communication).

Figure 2: Example RBS (Project Management Institute 2013)

As discussed in subsection 2.1, the wrong choice of concept will affect the long term output of the project. This can have various causes. Not being able to understand the requirements, for instance, leads to wrong concepts and it can be considered a developmental process risk, defined as the commitment of resources to uncertain outcomes (Hall & Rapanotti 2016). Such risk can be reduced or eliminated by making sure that requirements are validated and understood by stakeholders before starting with the development of the solution. Therefore, the formal approval of the project charter by the related stakeholders can be seen as a risk mitigation measure that reduces the developmental process risk. However, this mitigation may also fail because either there are related stakeholders that were not duly identified and cannot review the project or the concept is not expressed in a way that can be understood by the stakeholders.

This research will focus on the mitigation of developmental process risk, as we will discuss in subsection 4.3.
2.3 Outputs of the front-end phase

As already mentioned in the previous subsection, the activities within the front-end phase will result in two documents that will serve as a basis for the decision to ‘go’ or ‘kill’ a project: the project charter and the stakeholder register. The typical content of these documents together with their relationship to the front-end phase activities will be described in the rest of the subsection.

**Project charter**  According to Project Management Institute (2013), the project charter is a document that establishes internal agreements within an organisation with the purpose to ensure proper delivery under the contract, including the commitment of resources that precedes the project start. Accordingly, it includes a description of the initial project scope statement, deliverables, project duration, and a forecast of the resources and expected benefits. This information is based on the high level requirements identified during the front-end phase together with the evaluation of the solution alternatives. The approved project charter initiates the project, hence it is handled outside the project boundaries, and as stated by the Project Management Institute (2013), as part of portfolio processes. There are different project charters templates in use (one example can be seen in Figure 3, which differ in their appearance but have similar content. Their aim is to provide the knowledge necessary to decide on the project approval. The Project Management Institute (2013) describes the basic information that should be included in the project charter:

- goal: project purpose or justification;
- scope: measurable objectives, high level requirements, assumptions and constraints;
- deliverables: the description of the solution to be delivered;
- timeline: estimated start and end of project and main milestones;
- risks: high level risk description, necessary to be communicated to the project sponsor before deciding on starting or not the project;
- costs: cost estimation based on preliminary alternative solutions;
- quantitative benefits: quantifiable benefits resulting from the project implementation;
- qualitative benefits: non quantifiable benefits resulting from the project implementation;
- scoring: based on return on investment, fit to strategy, urgency;
• project organisation: nomination of team members and project organisational structure including assigned project manager, responsibility, and authority level;

• project approval requirements: name and authority of the sponsor or other persons authorising the project charter.

Figure 3: Example of project charter from the author’s practice

<table>
<thead>
<tr>
<th>Goals</th>
<th>Ensure validation of partner master data information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope</td>
<td>Set up a new process and system to maintain partner master data information centrally, perform online validation, approve and then transmit the validated data to the subsidiaries' systems</td>
</tr>
<tr>
<td>Deliverables</td>
<td>New master data maintenance process, central master data system, online validation tool, approval workflow, interface to subsidiaries systems</td>
</tr>
<tr>
<td>Risks</td>
<td>Acceptance of new process by subsidiaries</td>
</tr>
</tbody>
</table>

Figure 4: Example of simplified stakeholder register

Stakeholder register PMI identifies the stakeholder register as the second output of the front-end phase. This document contains all the details related to the identified stakeholders. It includes, for instance:

• identification information: such as name, organisational position, location, role in the project or contact information;

• assessment information: such as major requirements, main expectations, potential influence in the project, phase of the project with major involvement;

• stakeholder classification: if internal or external, supporter or neutral or resistor, etc.

Figure 4 depicts a simplified version of a stakeholder register based on the Volere template (Robertson & Robertson 2000).
2.4 Activities in the front-end phase

As mentioned in the previous subsections, the PMI define the front-end phase, and identify its outputs and purpose. As they consider this phase outside of the project boundary, their Body of Knowledge (Project Management Institute 2013) does not prescribe any specific approach to generate the required outputs, but only recommend some generic techniques. Specifically:

Although they consider this phase outside of the project boundary, they identify in their Body of Knowledge two key activities, together with the tools and techniques used:

- Develop the project charter: in order to develop the project charter, ‘expert judgement’ is the technique recommended to gather and assess the necessary information. Expert judgement is defined as the expertise provided by any group or individual with specialised knowledge such as: consultants, subject matter experts, project management office, stakeholders including customers or sponsors. ‘Facilitation’ techniques such as brainstorming, conflict resolution or meeting management are specific techniques in use to help teams or individuals to accomplish the required activities, in this case develop the project charter.

- Identify stakeholder: in order to complete the stakeholder register, again ‘expert judgement’ is used to gather and assess the necessary information. Additionally there are ‘stakeholders analysis techniques’
based on multiple classification models, such as power/interest grid or power/influence grid or influence/impact grid. Those techniques intend to group stakeholders based on their influence, impact or power.

In contrast to this generic advice from the PMI Body of Knowledge, some authors have attempted to provide more precise definitions of activities and techniques within the front-end phase, to overcome the ‘fuzziness’ (Smith & Reinertsen 1991) of such a phase. In particular, Nobelius & Trygg (2002) have proposed the following set of activities:

- Definition of the mission statement, or why the project is necessary and which problem is it trying to solve. This activity shows the alignment with organisational strategy and its outputs are the project goal and objectives, that will be part of the project charter.

- Concept identification, which is grounded in high level requirements (needs) that need to be elicited as part of this activity and the restrictions given by the context. The output of this phase are different alternative solutions, expressed in informal language, sometimes based on quotations obtained by the providers of these solutions, that will be evaluated as part of the next activity.

- Concept evaluation: where the best solution is chosen based on business value. This chosen concept will be then used as input for the following activities. In later phases of the project, the informal description of the concept will be replaced by a business blue-print and solution specification, where requirements and solution will be described at a much more detailed level.

- Business analysis: where the whole project is evaluated in terms of its business value and its contribution to the company’s project portfolio. At this stage, project portfolio approaches are used to generate a ranking or score that can be compared with other projects that compete for the same resources.

- Pre-planning: which outputs the identification of the preliminary project team and estimation of budget and timeline based on the chosen concept.

<table>
<thead>
<tr>
<th>Mission statement</th>
<th>Concept identification</th>
<th>Concept evaluation</th>
<th>Business analysis</th>
<th>Pre-planning</th>
</tr>
</thead>
</table>

Figure 5: Activities included in the front-end phase

The rest of this subsection is structured around these activities and provides an overview of different approaches from the literature, with focus primarily of the activities of concept identification and concept evaluation,
which are within the main scope of this research. The other activities part of the project front-end phase are addressed briefly for completeness.

**Approaches to mission statement**  The mission statement establishes why the project is necessary and which problem is it trying to solve based on the alignment of the project with organisational strategy. Mission statements are commonly employed in management, although not necessarily the subject of academic research, particularly within project management. They are relevant in the context of wider IT/business alignment approaches, such as the ‘Strategic Alignment Model’ (SAM) (Henderson & Venkatraman 1992), that draws connections between business strategy and IT, with the objective to ensure coherence between the organisational requirements and the delivery capability of IT, seen as ‘business within a business’. Approaches to formulating the mission statement are beyond the scope of this research and won’t be considered any further.

**Approaches to concept identification**  During concept identification, requirements engineering (RE) approaches can be used to ensure that the development of an IT solution is aligned to the business strategy, particularly requirements elicitation, which aims to identify the needs and constraints for the IT implementation (Ullah & Lai 2011).

Some authors, such as Yu (1997) make connection between IT and business strategy through the distinction of two different types of RE: the so-called ‘early-phase’ RE, where the requirements are defined at a very high level at the early stages of the project, and the so-called ‘late-phase RE’, that takes place much later in the project and deals with detailed requirements that are the basis for the technical specification. According to Yu (1997) knowledge-based techniques applied to early-phase RE could potentially bring about a more systematic approach to this often ad hoc, under-supported phase of system development. Yu (1997) proposed one of the better known approaches for the early-phase RE, the i* framework, which is based on goals and consists of two main modelling components: the Strategic Dependency (SD) model, used to describe the dependency relationships among various actors in an organisational context, and the Strategic Rationale (SR) model used to describe stakeholder interests and concerns, and how they might be addressed by various configurations of systems and environments (Yu 1997). Another well known approach is KAOS (Knowledge Acquisition in automated specification) (van Lamsweerde 2001), which is also goal-based but, additionally, considers various RE aspects, including elicitation, requirement analysis and management, thus helping in the detection of conflicts between IT and business stakeholders (Ullah & Lai 2011), ensuring requirements traceability (Heaven & Finkelstein 2004) and
providing an abstraction level at which decision makers can be involved in important decisions (van Lamsweerde 2001).

i* and KAOS contribute to definition of project goals, objectives and high level requirements, ensuring alignment between project and business strategy. However, they do not address directly the generation of possible solutions.

In addition to goal-based frameworks, there are other methods based on the analysis of the organisation, including its relationships with its customers, partners, and market regulators, which can be used to obtain the main requirements of an IT system. One of such frameworks is SEAM for Business (Wegmann et al. 2007) which is a Market-Driven Requirements Engineering (MDRE) approach that incorporates vocabulary and techniques from marketing methods. SEAM analyses four main aspects:

1. how companies cooperate together to achieve commercial objectives;
2. how the features provided by supplier value networks bring value to adopter value networks;
3. how companies can influence each other; and
4. how the relations between the players are maintained stable, in part by regulators.

These aspects are displayed as a Supplier Adopter Relationship (SAR), that leads to the identification of the requirements (Wegmann et al. 2007).

Like i* and KAOS, SEAM contributes to concept identification by defining project goals, objectives and high level requirements, ensuring alignment between project the business strategy, but does not contribute to the generation of solutions. However, due to the fact that it considers the relationship between stakeholders and requirements, it also contributes to one of the outputs of the front-end phase: the stakeholder register.

In order to understand business strategy and establish the link to system requirements, Bleistein et al. (2006) developed an approach, that integrates several analysis tools and frameworks. This is based on the use of VMOST (Vision, Mission, Objectives, Strategy, and Tactics) analysis (Sondhi 1999) in combination with i* to represent the business context model, together with problem diagrams (Jackson 2000) to represent real-world physical entities (domains) and their observable interactions and behaviours (shared phenomena) as a basis for the analysis of the context. In this way it is possible to relate requirements back to the strategic needs that generated them (Bleistein et al. 2006). As for the previous early-phase RE approaches, this approach does not go as far as concept definition and evaluation.
In conclusion early-phase RE approaches help with requirement elicitation and to some extent strategic alignment, but do not go as far as design methods for concept identification and subsequent evaluation.

**Approaches to concept evaluation** This initial literature review has found no evidence of specific approaches to concept evaluation. However, concepts are indirectly evaluated as part of Project Portfolio Management (PPM), a process aimed at prioritising project proposals based on their fit with business strategy (Kock et al. 2016): it can be argued that by selecting the projects to be implemented, PPM also evaluates indirectly the concept that is part of the project proposal. However, this happens only when alternative concepts within projects have already been considered and discarded. PPM will be covered in subsection 2.4.5 on business analysis.

**Approaches to concept identification and concept evaluation in use for COTS solutions** In the last few decades, companies have shown increased interest in acquiring and integrating commercial products, which can be assimilated to concepts, instead of developing systems from scratch, leading to the development of generic and domain-specific COTS (Commercial-Off-The Shelf) packages (Alves 2003). This approach provides many potential benefits if the ‘right’ product (or concept) is selected and forces to evaluate the available COTS products in the market with respect to the needs and constraints of each buyer, meaning that “COTS alternatives have to be assessed against the customer requirements” (Alves 2003). As a consequence concept identification and evaluation are done simultaneously (Alves 2003).

The success of the implementation of a COTS solution is based on the customisation process needed to adapt the generic solution to the specific organisation’s requirements; accordingly, the requirements need to be more ‘flexible’. Consequently, this process may not be able to provide a tailored solution, leading to organisational changes to be implemented by means of business process re-engineering (Alves 2003). In other words, the organisation may need to adapt to the capabilities of the COTS solution, rather than the solution being tailored to the strategic needs of the organisation.

One of the first proposed COTS selection methods was OTSO (Off-The-Shelf Option) (Kontio et al. 1995) which is a well defined process that covers the whole selection process by means of hierarchical evaluation criteria based on the set of functionality, architectural constraints and organisational characteristics. The evaluation activity consists of sub-processes: search criteria, definition of the baseline, detailed evaluation criteria definition and weighting of criteria. It also considers quality aspects that may affect the selection
but are not necessarily part of the evaluation criteria (Kontio et al. 1995). This approach has the disadvantage of not considering the requirements acquisition process because it assumes that requirements are already existent and fixed in a pre-requirements specification (Alves 2003).

Another proposed method is PORE (Procurement-Oriented Requirements Engineering), which is a template based approach that consists of an iterative process of requirements acquisition and product evaluation (Ncube & Am Maiden 1999). By using templates several times, a product list is refined until the most suitable product is selected based on fit between features and requirements. PORE integrates several techniques, methods and tools, such as: knowledge engineering techniques, multi-criteria decision making methods, and requirements acquisition technique. The templates used are derived from empirical studies about processes and problems encountered during the selection activity (Ncube & Am Maiden 1999).

CRE (COTS-Based Requirements Engineering) emphasises the importance of non-functional requirements to evaluate alternative products (or concepts) and provide guidelines on how to acquire and specify such requirements (Alves & Castro 2001). As a drawback, it is based on the evaluation of quality attributes, which cannot be easily assessed because of the incomplete description of quality aspects provided by the suppliers (Alves 2003). The modelling of non-functional requirements is done by means of the NFR Framework. NFR states for Non-functional requirements, which is a goal based RE approach (Chung et al. 2000).

CARE (COTS-Aware Requirements Engineering) is a goal and agent oriented requirements engineering approach based on the i* notation adapted to support off-the-shelf products (Chung & Cooper 2002). As the available COTS products constrain the requirements, they need to be flexible. Requirements are classified as: native or acquired from customers, and foreign or coming from the COTS, the challenge is to match both requirements, though the approach does not provide any systematic solution for possible mismatching (Chung & Cooper 2002).

New technological approaches, such as Cloud computing, have triggered in more recent times the need to review RE methods. One of those approaches is Goal Oriented Requirements Engineering (GORE) (Zardari & Bahsoon 2011), which provides systematic guidance for an organisation to evaluate the choice and risks in adopting cloud solutions. It is an adaptation of previous goal based RE approaches to cloud implementations (Zardari & Bahsoon 2011).

In summary, COTS RE approaches assist in concept identification and evaluation, but they disregard the alignment between project and business strategy, as well as requirements definition, as they assume such steps as a
Approaches to business analysis  The only approach that supports this activity appears to be Project Portfolio Management (PPM) (Cooper et al. 1999), which provides methods for selecting and managing an organisation’s projects and has its origins in the application of modern portfolio theory to the project selection problem (Kaiser et al. 2015). PPM is a commonly employed business analysis approach applied in order to achieve the alignment of project portfolio to strategy. Its goal is to maximise the portfolio financial values, the linkage of strategy to portfolio and the balancing of resources within the portfolio (Stettina & Hörz 2015). This is because organisations that have a structure in place for aligning project deliverables to organisational goals are in a better position to achieve the value defined by their business strategy (Too & Weaver 2014).

The traditional PPM employs several methods, which can be used in combination with each other. These methods, according to Cooper et al. (1999), can be classified into:

- Financial methods, where profitability, return, payback, or economic value of the project is determined, and projects are judged and ranked on these criteria.
- Business strategy methods, where the business strategy is the basis for allocating money to different types of projects.
- Scoring models, where projects are rated or scored on a number of criteria on scales, then ratings are added to yield a project score, which becomes the basis for setting up priorities to support ‘go’ or ‘kill’ decisions.
- Checklists, where projects are evaluated via a list of yes or no questions.
- Bubble diagrams, where projects are plotted on an X/Y portfolio map, where the axes are various dimensions of interest, such as reward versus probability of success.

The gathering, prioritisation and selection of possible projects are typical activities in the scope of PPM together with the evaluation of running projects concerning their continuing fit to the portfolio. The particular optimisation algorithms or management techniques involved are based on specific project selection criteria and guidelines that in the end are the most important tool in the alignment of project portfolios to strategies (Kaiser et al. 2015). As an output, the analysed project will be marked with a certain ‘score’ that will be used during the front-end phase as a key element to support the
PPM is a widely applied and mature approach that supports projects business analysis and enables the organisation to select the projects that will be part of their portfolio. However, it does not address directly concept evaluation within selected projects.

**Approaches to Pre-planning** Pre-planning activities have as objective to provide preliminary information about the proposed project team, budget and timeline that should be used for the project evaluation. This information is built up from the pre-selected concept and is the basis for the resources commitment and allocation at the project approval.

We could not identify in the literature any specific approach for this activity. PMI, however, mentions that the team, budget and timeline estimations obtained as a result of pre-planning are usually based on the project team’s experience, who set up the planned values using similar past projects as reference (Project Management Institute 2013).

In summary, the expertise of the team responsible for this activity will be the key to the quality of this activity’s output.

**2.5 Alternative view to the front-end phase activities structure**

Some industries, mostly dealing with big construction or infrastructure projects, where project failure can lead to big monetary losses, have designed their own structure for their front-end phase. They are based on the principle that higher investments at the beginning of the projects result in most successful projects. These approaches consist of performing very detailed planning steps during the front-end phase with the objective to reduce uncertainties and risks. One example is Front-End-Loading (FEL) (Weber 2014) which completes the planning activities at the beginning of the project intentionally before the decision for the investment is made. It consists of pre-planning activities clustered in three sub-phases:

- **Phase 1**: defines business objectives, investment opportunities and develops alternatives or concepts.
- **Phase 2**: marks the point where the best alternative is selected and the project scope is fixed.
- **Phase 3**: expands the alternative selected in phase 2, develops the implementation plan and prepares the final estimates of cost and schedule.
The idea behind this approach is to move the detailed planning activities which normally take place after the front-end phase to earlier phases of the project, before the decision to approve the investment is done. Due to the amount of information collected at this stage, the project approval is accelerated and uncertainties are reduced.

This approach presents some drawbacks. For instance: the amount of resources require to do the detailed planning is very high and may go to waste if the project is not approved (Weber 2014). Moreover, such detailed planning at such an early stage of the project may lead project management to react inflexible to inevitable changes, that may be required because of changes in the environment or simply errors, during the project realisation phase. Especially this last feature makes it inappropriate for IT/business alignment projects, where more flexibility is required to react to a complex and changing environment.

2.6 Conclusion

In this literature review we have discussed the project front-end phase, which includes a set of activities and outputs used by organisations to grant authorisation to start a project and commit resources accordingly. We have also provided an overview of the concept of risk and its assessment in projects, together with a brief description of standard risk management strategies.

In subsection 2.3 we have described in some detail the key outputs of the front-end phase, the project charter and stakeholders register, while in subsection 2.4, we have described specific activities within the front-end phase, with concept identification and evaluation identified as the most critical: these activities are the main focus of this research.

While the Project Management Institute (PMI) only provide some general guidance to produce the required outputs (subsection 2.4), many different approaches have been proposed in the academic literature to support front-end phase activities (see Table 2.1), but many gaps remain (see Figure 2.6). In particular, for concept identification, some relevant approaches (subsection 2.4.2) come from early-phase RE literature: generally, whereas they help with requirement elicitation and strategy alignment, they do not go as far as the identification of concepts. On the other hand, RE approaches to COTS products (subsection 2.4.4) can be used for concept identification and evaluation, but do not address requirements elicitation and the alignment between project and business strategy. Finally, Project Portfolio Management (PPM), a widely known and mature approach that supports the organisation in the selection of projects, can contribute to concept evaluation, but only as a side-effect of evaluating projects within a portfolio,
rather than alternative concepts within a project.

In some specific industries, there are alternative approaches to the front end-phase that front load the phase with detailed planning before any decision to go ahead is made (subsection 2.6). While this reduces uncertainty, it has the drawback that the amount of resources required to do the detailed planning is very high and may go to waste if the project is not approved. Moreover it may lead to rigidity in the execution of the project, which is not appropriate in volatile contexts as is the case of IT/business strategy alignment, where the need and its context may change during the project life-cycle. Therefore such approaches are not suitable to address development process risk (subsection 2.2.2) in such contexts.

We should note that in our review we were unable to find evidence of the extent any of the approaches considered have been applied in professional practice, or gain any insight of such practice, beyond the author’s own professional experience. However, the literature indicates that, particularly for software projects, failure rate remains high in organisations.

We conclude that there is still a need for approaches to the front-end phase of IT/business strategy alignment projects able to provide wide coverage of its two key activities of concept identification and evaluation, and to mitigate development process risk in volatile business contexts in a cost-effective manner.

This need is not dissimilar to that of much software and system development, which is why some early-phase software RE methods have been shown relevant to the project front-end phase.

Therefore, the approach taken by this research is to consider the extent one existing approach from software and system engineering can be applied and adapted for the front-end phase of IT/business strategy alignment projects. The chosen approach, which is put to test in our pilot research (section 4), is the Problem Oriented Engineering (POE) framework (Hall & Rapanotti 2009, Hall et al. 2008, Hall & Rapanotti 2015, 2016). Its choice is motivated by the following:

- POE spans both problem and solution spaces: as such, it covers both the span of RE methods and that of design methods, hence, in the context of the front-end phase, it may enable both requirements elicitation, context analysis and concept identification;

- POE includes a notion of stakeholder validation in both problem and solution spaces: in the context of the front-end phase, this could be used both to establish the extent requirements are aligned with business strategy, and the extent different concepts satisfy those requirements, hence contributing to concept evaluation;
• POE includes a process pattern spanning problem and solution exploration activities, and stakeholder validation: this can be used flexibly both to define activities that iterate between problem and solution spaces, and to establish the level of stakeholder validation needed to mitigate development process risk. This flexibility may be advantageous for projects in volatile business contexts.

POE technical details will be discussed in subsection 4.1.2 in the context of our pilot research.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Purpose</th>
<th>Short description</th>
<th>Activity in focus</th>
<th>Contribution to deliverable</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAM (Henderson and Venkataraman, 1989)</td>
<td>Business/ IT alignment</td>
<td>Ensures alignment between organization and IT capabilities</td>
<td>Mission statement</td>
<td>Goal</td>
<td>Addresses alignment as general organizational topic not to project</td>
</tr>
<tr>
<td>KM (Yu, 1997)</td>
<td>Early PE</td>
<td>Based on business goals, UML notation, traceability of requirements</td>
<td>Concept identification</td>
<td>Goal, scope, stakeholders’ identification and assessment</td>
<td>Does not include the generation of alternative solutions</td>
</tr>
<tr>
<td>SEAM (Friedmann et al., 2007)</td>
<td>Early PE</td>
<td>Based on analysis of organization and its relationship with the environment</td>
<td>Concept identification</td>
<td>Goal, scope</td>
<td>Does not include the generation of alternative solutions</td>
</tr>
<tr>
<td>Integrated approach (Brisson, 2003)</td>
<td>RE</td>
<td>Linked to strategy, combines use of VMODER, I* and problem frames</td>
<td>Concept identification</td>
<td>Goal, scope</td>
<td>Does not include the generation of alternative solutions</td>
</tr>
<tr>
<td>FPM (Cooper et al., 1999)</td>
<td>Project prioritization</td>
<td>Selects projects to be implementing based on different criteria such as return on investment or fit to strategy</td>
<td>Business Analysis / Concept evaluation</td>
<td>Scope</td>
<td>Does not include either requirements identification or generation of alternative solutions</td>
</tr>
<tr>
<td>GTSU (Korto et al., 1991)</td>
<td>COTS selection</td>
<td>Selects COTS products based on different criteria, considers requirements as fixed and pre-defined</td>
<td>Concept evaluation</td>
<td>Deliverables</td>
<td>Does not include requirements identification or fit to strategy</td>
</tr>
<tr>
<td>POE (Kuchera and Am Madien, 1999)</td>
<td>COTS selection</td>
<td>Based on templates, developed empirically, consists of iterative process of requirements acquisition and product</td>
<td>Concept identification and evaluation</td>
<td>Scope, deliverables</td>
<td>Does not include aspect fit to strategy</td>
</tr>
<tr>
<td>CRE (Chung et al., 2000)</td>
<td>COTS selection</td>
<td>Emphasizes importance of non-functional requirements to assess alternative products and provide guidelines on how to acquire and specify such</td>
<td>Concept identification and evaluation</td>
<td>Scope, deliverables</td>
<td>Does not include explicitly fit to strategy</td>
</tr>
<tr>
<td>CARE (Chung and Cooper, 2003)</td>
<td>COTS selection</td>
<td>Goal and agent oriented, adapted to support off-the-shelf products, considers COTS as a</td>
<td>Concept identification and evaluation</td>
<td>Scope, deliverables</td>
<td>No systematic approach to mismatching between requirements and COTS</td>
</tr>
<tr>
<td>CCORE (Zardav and Balsamo, 2019)</td>
<td>COTS selection (Cloud)</td>
<td>Goal and agent oriented, identifies risks and is adapted to support cloud applications</td>
<td>Concept identification and evaluation</td>
<td>Scope, deliverables</td>
<td>Specific coverage of cloud application selection process</td>
</tr>
</tbody>
</table>

Table 1: Approaches relevant to the project front-end phase
3 Methodological approach

This section describes the methodological approach for the research.

3.1 Research questions

The aim of this research is to investigate approaches to the front-end phase of IT/alignment projects, and specifically its concept identification and evaluation activities, which allow appropriate mitigation of risk, hence contribute to project success.

From our literature review, we have concluded that there is still a lack of approaches to the front-end phase of IT/business strategy alignment projects able to provide wide coverage of its two key activities of concept identification and evaluation, and to mitigate development process risk in volatile business contexts in a cost-effective manner. We have also concluded that one existing approach from the software and system engineering literature, the Problem Oriented Engineering (POE) framework, exhibits promising characteristics for application to the front-end phase of IT/business strategy alignment projects. This is what we are going to investigate in our research.

Specifically, the research aim will be addressed by answering the following research questions:

Q1: Which activities are included in the front-end phase of IT/business alignment projects and what are their related risks?
Q2: To which extent do approaches currently proposed or adopted in project management provide coverage for those activities and are able to mitigate those risks?

Q3: To which extent the Problem Oriented Engineering (POE) framework can be applied and adapted for use in the front-end phase of such projects?

Q4: To which extent is such an application and adaptation fit to the needs of real-world IT/business alignment projects?

The first two questions have been partially addressed by the literature review in section 3. However, a deeper investigation will be needed to include further relevant approaches from a wider literature, gain a better understanding of specific risks in the key activities of the front-end phase, and elicit knowledge of current professional practice. Developing such an understanding will allow us to establish more precisely where the knowledge gaps are and ways in which current practice may be improved. Interviews (Oates 2005) will be used primarily to elicit knowledge from practitioners.

Question 3 is partially addressed by our pilot research in section 5, where POE is applied retrospectively to a case study from the author’s professional practice. Further primary research will be needed to address this question. Case studies (Yin 2015) in the context of a design and creation method (von Alan et al. 2004) will be used to address this question.

Question 4 has yet to be addressed. Case studies in the context of a design and creation method will also be used to address this research question.

3.2 Interviews

Semi-structured interviews (Oates 2005) will be conducted with participants that belong directly or indirectly to the author’s own professional network, particularly, project managers and consultants with experience of complex IT/business alignment projects from different countries such as Germany, US, China and Argentina. This should provide some in-depth data from a relatively small number of participants (Oates 2005), hence be viable within the constraints of a PhD.

Such interviews are yet to be planned in detail, but the intention is to cover the following themes, emerged from the literature review, with participants:

- their general approach to the front-end phase
- the extent they apply generic techniques recommended by the PMI
• the extent they apply specific techniques from the literature
• their approach to risk mitigation
• strengths and weakness of their current practice

Depending on the outcome of such interviews, a follow-up questionnaire could be published in online practitioners’ communities and international networks, such as LinkedIn or the PMI community. This would provide an opportunity to reach a wider constituency of international participants, although the risk of low participation may be high.

3.3 Design and Creation Method

The design and creation method focuses on the creation of artefacts that address specific problems, together with the demonstration of the capabilities of such artefacts, and evaluation of their potential benefits and limitations (von Alan et al. 2004).

Accordingly, the main activities in the design and creation method are build and evaluate. Build refers to the construction of the artefact, while evaluate to the development of criteria and assessment of the artefact against those criteria (Oates 2005).

The main steps are: the recognition of the problem to be solved, the suggestion of a tentative solution, the development or implementation of the tentative solution, the assessment of that solution in relation to expectations, and the conclusion or consolidation of results (Vaishnavi & Kuechler 2004). This process is expected to be iterative.

When applied to this research:

1. problem recognition was achieved in the literature review, which has highlighted the lack of approaches to the front-end phase of IT/business strategy alignment projects able to provide wide coverage of its two key activities of concept identification and evaluation, and to mitigate development process risk in volatile business contexts in a cost-effective manner;

2. a tentative solution is the acknowledgment that an existing approach from the software and system engineering literature, the Problem Oriented Engineering (POE) framework, exhibits promising characteristics for application in the front-end phase of IT/business strategy alignment projects;

3. a first step toward the development of the tentative solution is the retrospective application of POE to a case study from the author’s
professional practice in the pilot research (section 4);

4. a first assessment of the solution is the initial evaluation within the pilot study, with conclusions to inform the next stage of research.

Steps 3 and 4 will be repeated in subsequent primary research to reach a POE-based approach to the project front-end phase which meets expectations.

3.4 Case Studies

A case study is “an empirical study that investigates a contemporary phenomenon within its real life context especially when the boundaries phenomenon and context are not clearly evident” (Yin 2015). It is a deep analysis that takes place in its natural setting, is holistic and focuses on the complexity of the context (Oates 2005).

Case studies will be used in the context of the design and creation method just outlined to inform the development of a POE-based approach to the project front-end phase, and its evaluation.

We plan to collect data through real-word cases from the author’s professional practice, where projects are used to solve problems related to complex IT/business alignment. Case studies will involve the application of POE techniques, as in the pilot study.

In future studies, various project stakeholders will also be involved. Such an involvement has yet to be planned in detail and may take many forms, including their use of POE techniques on live projects followed by semi-structured interviews for evaluation, or workshops and/or focus groups to discuss the ideas.

3.5 Method applied to the pilot research

The pilot research is a first step towards addressing research questions Q3 and Q4.

Through one iteration of the design and creation method, POE was tentatively applied retrospectively to a real life IT/business alignment project from the author’s professional practice, with a first assessment of the outcomes used to formulate conclusions and inform future research. As such, this was an exploratory case study (Oates 2005): POE had not been applied in this context before, so there was no relevant literature to start with.

The pilot research is detailed in section 4.
3.6 Ethical considerations

As this research will involve human participants as well as organisational case studies, the OU ethical guidelines will be applied with regard to informed consent and data protection. The research has already been registered with the OU HREC, with the ethical checklist completed and submitted. Submission of questionnaires and procedures will follow.

This pilot research did not involve any direct participation of people and was entirely based on public domain documentation from one company. Accordingly, no clearance from HREC was required in advance. Nevertheless, an explicit consent from the company was obtained.

4 Pilot research

The pilot research in this section makes an initial contribution towards addressing research question Q3, and to a lesser extent research question Q4. It consists of an exploratory case study related to the author’s professional practice in the context of a medium-size multinational company.

4.1 Case study background

**IT/business alignment in multinational companies**  Bartlett & Ghoshal (1999) pointed out that a most critical issue faced by a multinational corporation (MNC) is that of “coordination and integration among its dispersed organisational units” and that this issue is “increasingly important in today’s competitive environment where MNCs must achieve both local responsiveness and global integration”. An NMC’s IT infrastructure needs to support its extended business processes (Hunter 2009), enabling global data visibility and transactional interoperability without spatial restriction (Shiang-Yen et al. 2013), and be aligned with the company’s international strategy (Madapusi & D’Souza 2005). Hence, if a company changes international strategy, their IT must be aligned.

Changes in international strategy normally involve changes in the structure of the organisation (Madapusi & D’Souza 2005), and can only be realised if the management information required is available and befits the new organisational structure. Related IT projects, in consequence, are either facilitators or even drivers for the changes in the organisational structure (Kelzenberg et al. 2010).

Such projects are complex as they need to deal with the interests of a large constituency of stakeholders, often with conflicting goals (Artto et al.
Collaboration can be a particular challenge as team members from various subsidiaries may have priorities and interests that differ from those of the central team (Klimkeit 2013).

The problem chosen for the exploratory study is an example of such complex IT/business alignment problems.

**Problem oriented engineering (POE)** Problem Oriented Engineering (Hall & Rapanotti 2009, Hall et al. 2008, Hall & Rapanotti 2015, 2016) is a framework for tackling complex real-world problems through engineering solutions, with roots in software systems engineering. POE has been applied in real-world case studies as a systematic approach to address a wide range of engineering and organisational problems (Hall et al. 2008, Hall & Rapanotti 2009). In this subsection, we briefly recall some characteristics of POE which we have exploited in the case study.

A POE problem is defined as a recognised need in a (real-world) context. To solve a problem in POE, a solution artefact is designed which will satisfy that need in context. Arriving at the solution is a systematic process in which need, context and solution are progressively ‘explored’ to the satisfaction of a wide range of stakeholders. Therefore, when applied to the project front-end phase, POE has the potential to be able to address both requirements in context (covering both requirement elicitation and their alignment to business context and strategy) and the design of solution (addressing concept identification).

During problem solving, four types of stakeholder interact with each other in the basic POE Process Pattern (PPP) of Figure 7. They are called problem explorers, problem validators, solution explorers and solution validators. In the pattern, explorations of the problem (i.e., need and context) and of the solution are interleaved with validation points in which stakeholders express their judgement on descriptions generated during problem and solution explorations.

For complex problem solving, the PPP combines to generate complex processes in which many instances of the pattern can be combined in various ways, from sequential to nested, as illustrated in Figure 8, where a problem solving instance is embedded in the initial problem exploration. We will discuss some such combinations in the context of our research in subsection 4.2.

Therefore, when applied to the project front-end phase, POE has the capability to include diverse stakeholders’ interests throughout the whole problem solving process, whether to establish requirements and their strategic alignment (problem explorations), or designing and evaluating alterna-
tive concepts (solution explorations), with validation activities and explicit checkpoints as the means to mitigate development process risk. Specifically, both problem and solution explorations commit resources to uncertain outcomes thus leading to developmental risk. A rejection by the validators, for instance, will lead either to rework in case of a rejected solution, or to a solution exploration with little chance of success in case of an invalidated understanding of the problem. In both cases there will be loss of resource. The more frequent the validations, the smaller is the developmental risk. In the end, there is a trade off between the cost of the validations and risk of losing resources for advancing in a solution without validation that is a function of the complexity of the problem.

At each step of the process, a notation is provided in POE to represent problems and their solution, in the form of a ‘problem diagram’. This is a
structured model of the phenomena which are relevant to the problem and its solution. We will see many examples in the case study later on, with a summary of the notation given in Appendix A.

In summary, POE provides a systematic approach to problem solving with the POE process pattern addressing developmental risk by explicitly including validation by a range of stakeholders. Moreover, it provides a notation: the problem diagram, in which relevant phenomena can be represented and analysed at each step of the process.

These characteristics seem to indicate that POE may well be a suitable candidate approach for our research. This is what we wanted to test in the pilot research.

4.2 A problem interpretation of projects

PMI defines projects as “a temporary endeavor undertaken to create a unique product, service or result” (Project Management Institute 2013). This takes place in the context of an organisation trying to meet its strategic goals. Such goals are motivated by many factors, including meeting changes in market demands, customer requests, or organisational requirements and in this way adapt to the changing business environments.

As instruments by which solutions are produced, projects work within the organisational context towards organisational goals. In terms of POE, then, projects can be seen as problem solving activities and as such, they can be captured in POE and be structured by means of POE Process Pattern. The Figure 2.1, we have seen how a project can be seen in terms of four phases, the result of which is the project’s outcome. Closer inspection shows that each of these four phases is structured as a project each with deliverables and respective context and needs. For instance:

- ‘Starting the project’ is a problem solving activity in order to provide a solution to the need of having the relevant information to go or not for the project in the organisational context. The problem should be validated by the board or customer and the solution by the budget owner, the IT architect and the stakeholders affected by the solution. The solution for this problem are the deliverables of the phase: the project charter and stakeholder register.

- ‘Organising and preparing the project’ has, as context, the organisational context and includes the project charter as output of the first phase. The problem should be validated by the project manager and the solution by the stakeholders providing resources, its need is to organise the project and the solution is a detailed project management
plan by which the remainder of the project is organised.

- ‘Carrying out the work’ produces the artefacts and changes need to meet the project’s objectives in the organisational context. The problem should be validated by the project manager, project team and vendors and the solution by the customers and stakeholders affected by the solution. The solution are the artefacts and changes (deliverables) accepted by the customers.

- ‘Closing the project’ has, as context, the organisational context. The problem should be validated by the project manager, project team and vendors and the solution by the Board (customer) and stakeholders providing resources, and has a need to close all open activities, re-allocate resources to other projects or tasks, evaluate the team and vendors' performance and document all issues relevant for future projects; the solution are the duly archived project documents.

These four phases can be modelled using the PPP as in Figure 9. The relevant need, validators and flow of information, formed by the deliverables of each, is also shown.

Figure 9: Projects as a collection of problem solving activities

The front end phase (starting the project in Figure 9) ends with the project charter. As described in subsection 2.1, an important element of
this phase which is critical for the project to be successful is the delivery of a viable concept, obtained as a result of the activities concept identification and evaluation. A concept can be considered ‘viable’, if it is acceptable for all stakeholders. Of course, the ultimate validation of concept comes only when the outcomes are delivered and accepted. Intermediate validation, therefore, can only act as a proxy for this ultimate validation. However, the effect of a poor choice of concept can be lessen the earlier that validation is sought. This is effectively illustrated in the pilot study.

Figure 10 provides a POE interpretation of concept identification and evaluation (CIE) in the front-end phase. This interpretation gives us the opportunity to structure the activities of the front-end phase using the process pattern and to identify and include the validations for the solutions or outputs, that will be the input for the next phases or problems. There are many problems to solve in determining the project charter, each of which will be considered in the problem exploration. For this problem the validator will be the business analyst that determines if the problem lies within the organisation’s business expertise envelope while the solution validator will be the technical analyst that determines if the solution lies within the organisation’s technology expertise envelope.

Figure 10: Concept identification and evaluation as a POE problem
Finding the right solution to these problems or in project management terminology, finding the right concept, will have a big impact in reducing the developmental risk during the project. Stakeholder validation is one way to manage this risk. When concept identification and evaluation are carried out during the front-end phase with appropriate stakeholders, the risk of committing resources to poorly understood problems is reduced. In this case, validation will not ensure that the chosen concept is the best one but will ensure that a bad concept is rejected as early as possible, avoiding spending resources on non-viable concepts.

The work completed as part of the front-end phase should also be able to identify stakeholders conflicts. As validation from the affected stakeholders is needed to take place before being able to continue, stakeholders conflicts will need to be resolved so that the validation can be completed. Following the author’s experience as a practitioner, project managers tend to avoid involving too many stakeholders in validation, especially in the early phases, as it consumes time and resources and may lead even to cancel the project. However, this missing validation may lead sooner or later to project failure or expensive rework.

4.3 Exploratory case study procedure

The exploratory case study deals with a project for the implementation of a global partner master data validation and maintenance process in the context of an international corporation and its subsidiaries, and included the set up of a new system and related process together with the corresponding organisational set up. The project team included 40 international members that belonged to the corporation and its subsidiaries. The project duration was 18 months and was ultimately successful in providing a stable and well accepted solution, but required a number of interactions and costly reworks as we will discuss.

Starting from project documentation, obtained with permission from the corporation, we proceeded as follows:

• we modelled all the process steps from the real-life project using the PPP, to ascertain whether the whole process could be captured in POE;

• we matched stakeholders from the project, to PPP stakeholder roles, to ascertain the ability of the POE stakeholder taxonomy to cover the full constituency of stakeholders involved in the project;

• we modelled requirements, context information and identified concept using problem diagrams, to ascertain whether this notation is suffi-
• we considered the ability of such models to anticipate potential problems, including shortcomings in identified concepts or lack of appropriate validation at specific points, comparing with what happened in the real-life project;

• we presented the approach to a practitioners’ audience to gain some early feedback on its appeal in the context of current practice.

4.4 PPP modelling of the project process and its stakeholders

Initial situation  Company A is a German medium-size multinational company with subsidiaries worldwide initially owned by Company B, a German large-size multinational company.

Initially, Company B implemented a global partner master data validation process in order to reinforce compliance in all its subsidiaries, ensuring that no business was carried out with non-existing partners. This global partner master data validation process consisted in the daily extraction and transmission of name and address data from the subsidiaries to a central system provided by Company B, where this data would be validated against internal and external databases to find proof of the existence of the relevant partner. Basically the subsidiaries’ ERPs were sending data for validation to the central validation application (CMD B) and were receiving an ID as a proof of validation or an amend request in case of incorrect data. This master data validation process was mandatory for all subsidiaries. Company A’s subsidiaries (in this example Subsidiary X and Subsidiary Y) participated directly in the validation process provided by company B, meaning that all data was transmitted by interfaces between the subsidiaries and this company.

When the company acquired a new customer, for instance, a master data record needed to be created in order to be able to operate with the customer. The record was entered in the subsidiary’s ERP system and blocked for usage. A batch process at night delivered the address data to the central application, where the data was validated. If the validation was successful, an ID was sent and the masterdata was released for usage.

The rationale for this initial set-up was that:

1. It was a mandatory requirement from the parent company B, whose fulfilment was strictly monitored by the top management.
2. The process had a minor influence on the subsidiaries’ local processes, as only minimal data was exchanged using a shared protocol

**Motivation for the change** Parent company B decided to start an initial public offering (IPO) in order to turn company A into an independent company listed on the stock exchange. One of the preconditions was to separate systems and processes belonging to both companies. In this context, the partner data validation could not continue to be executed by Company B for Company A’s subsidiaries.

As company A’s board decided to keep a partner validation process at least as compliant as the one provided by company B, a new concept needed to be implemented. A feasibility study was set up in order to explore different concepts, estimate costs, timeline, benefits and required team to start a project. The next two concepts were identified and evaluated.

**Step 1: First identified concept** The first concept identified was to reproduce the validation process provided by company B and replace it with a similar process provided by company A.

In Figure 11, we can see the POE process pattern as applied to this step, which shows that the concept was rejected by the board at the beginning of the exploration of the first problem due to its high costs. We can also visualise that due to the early rejection there were low sunk costs.

**Step 2: Second identified concept** After rejecting the first concept, the designated project manager organized a workshop with the relevant headquarter stakeholders. During this workshop, another concept was identified. It consisted of the implementation of a harmonized and centralized partner data creation application, where the subsidiaries could initiate the partner data creation and the data would be replicated in the subsidiaries ERP systems after an automatic validation.

Following the example mentioned above, when a new customer record needed to be created, the data would be directly introduced in a new application following the application’s data structure, validated according to the internal system rules and then retransmitted to the subsidiary’s ERP. This would force the data structure to be harmonised between all systems. Other subsidiaries entering customers, for instance, would need to share the structure too.

This concept had some additional benefits for company A, such as the global visibility of partner data while the data to be transferred needed to be harmonized to reduce complexity in the central master data application.
As a result of the feasibility study it was decided to present the project for approval based on the estimated costs and benefits to implement this concept, following a financial PPM approach. The project was approved based on this estimation, although there was not any validation from the subsidiaries (solution validation P1). One of the first tasks in the project was to introduce the chosen concept to the subsidiaries, though initially, they were not able to evaluate how this new process would affect their existing systems and processes.

Once a prototype was set up at the validation of the solution to P3, the subsidiaries were able to understand the impact of the new process and hence requested additional programming to reduce the impact on their ERPs and processes and refused to continue with the implementation should these not be considered. After an escalation, the project scope and costs needed to be reviewed. Due to the late rejection the sunk costs were high. In Figure 12, we can see the POE process pattern as applied to this step:

**Step 3: Third identified concept** After considering the requirements from the subsidiaries, a third concept was identified and after a very short analysis, discarded. It aimed at reducing the changes in the subsidiaries’
ERPs using a data converter. This data converter would adapt the partner
data records generated centrally, converting them into formats that could be processed by the local domains by means of translation tables.

This concept was discarded at the first solution validation of P1 by the IT architect due to the high effort required to implement and maintain the translation tables and the risks that if this maintenance were missing, data could not be transferred from the central to the local applications. Due to the early rejection the sunk costs were low.

In Figure 13, we can see the POE process pattern as applied to this step:

**Step 4: Implemented concept** The implemented concept was an adaptation of the concept in step 2. It was based on a review of the needs and on a negotiation between the stakeholders in headquarters and subsidiaries.

It was possible to reduce the impact of the new application in the subsidiaries’ ERPs and processes through the reduction of harmonization requirements. They were restricted to the part of the partner master data record that needed to be validated, such as the approval procedure, the partner name and address and the verification of the existence of the part-
ner. The rest of the master data record was to be entered in the central application following the local requirements and local ERP configurations, that were reproduced in the central application.

Again following the initial example, when acquiring a new customer, the subsidiary would enter the data in the central application. There would be part of the data structure to be shared between all the subsidiaries and part that would be specific for each subsidiary.

This concept was finally accepted because of the following reasons:

1. The board’s objective of validating data was fulfilled.
2. Data transparency was achieved by the central application.
3. Local domains needed to change slightly to accommodate to the central configuration only for data requiring validation, and this change was accepted by the subsidiaries.
4. The maintenance of the configuration did not generate high risks, because of the central data maintenance. This means that if the configuration was not changed centrally, data could not be entered using this new configuration, thus the subsidiaries would take care to inform headquarters about changes accordingly.
In Figure 14, we can see the POE process pattern applied to this step:

Figure 14: PPP concept 4

Table 2 summarises the relevant stakeholders, and Table 3 the sequence of identified concepts. Figure 15, indicates where validation failed, highlighting where the process has to be backtracked. Specifically: concept 1 was rejected after the first problem validation, still within the front-end phase; concept 2 went through many validations before being rejected during the validation of P3, causing the process to backtrack to the initial project step; concept 3 was rejected during the validation of S1; finally, concept 4 was implemented in its totality.

4.5 POE diagrams modelling of concepts in context

The various concepts considered in the project were modelled using POE problem diagrams. These are very detailed diagrams, including all relevant phenomena identified at each step of the process. For brevity, we will discuss only the first step in this subsection, while all other problem diagrams are given for completeness in Appendix A.

Figure 16 illustrates the initial situation by means of a POE problem diagram, where boxes indicate relevant domains and their sub-domains,
### Table 2: Relevant stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board company A</td>
<td>Keep same compliance level as provided by the initial solution while minimising costs</td>
</tr>
<tr>
<td>Corporate IT</td>
<td>Implement stable solution while minimising costs</td>
</tr>
<tr>
<td>Corporate process owners</td>
<td>Obtain a stable solution while minimising costs, additionally obtain benefits from process harmonisation, for instance: global transparency</td>
</tr>
<tr>
<td>Subsidiaries</td>
<td>Be compliant to what is requested by the board, with the less possible changes in local systems and processes</td>
</tr>
</tbody>
</table>

Figure 15: Validation of the different concepts represented in POE Process Pattern

arrows between boxes represent relevant shared phenomena. The associated table provide some related descriptions.

In particular, in the figure, the involved companies were company B (domain CB), which is the parent company, and company A (domain CA),
<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
<th>Validator</th>
<th>Reasons for approval or rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reproduce initial concept, replace company’s B application with a similar application owned by company A</td>
<td>Board company A, Corporate IT, Corporate process owners</td>
<td>High costs and no additional benefits compared with initial concept</td>
</tr>
<tr>
<td>2</td>
<td>Concept based on a central application, with harmonization of processes and data</td>
<td>Board company A, Corporate IT, Corporate process owners</td>
<td>Additional benefits such as data transparency; decided without validation from subsidiaries, who requested additional requirements and forced to review project scope and costs</td>
</tr>
<tr>
<td>3</td>
<td>Concept based on a data converter that would convert data entered centrally according to the local configurations</td>
<td>Central IT</td>
<td>High costs and risks to keep conversion tables in sync.</td>
</tr>
<tr>
<td>4</td>
<td>Concept based on a central application with harmonisation of data and processes relevant to the validation, further data and process to be adapted to the local requirements inside the central application</td>
<td>Board company A, Corporate IT, Corporate process owners</td>
<td>Concept was a trade-off between stakeholders. The validation objectives were reached, transparency was obtained, while the changes in local ERPs’ and processes were reduced to a minimum</td>
</tr>
</tbody>
</table>

Table 3: Sequence of identified concepts

which belongs to company B and owns subsidiaries X (domain SX) and Y (domain SY). Each company owns its own information system, corresponding to sub-domains CMB B, ERP X and ERP Y in the figures.

The data exchanged by these systems, that is the master data that need to be validated together with their global ID and status, are modelled by shared phenomena, which annotate the arrows between the domains: for instance, ERP X shares partner name and address (phenomena partner_name and partner_address) with CMD B.

A problem diagram includes a description of the particular need satisfied by the configuration of domains and their shared phenomena. In this case, the initial situation modelled in Figure 16 satisfies the need that “on a
daily basis, when validation of partner name, partner address is received by Company A, either a global id is issued AND the status is unblocked OR an amend request is issued”.

Each step of the process was described in a similar fashion, with all models given in Appendix A.

Initial situation – solved problem

Figure 16: Initial situation - POE problem diagram

Each step of the process has been described in a similar fashion.

4.6 Reflection on findings

The exploratory case study demonstrated, in subsection 4.4, that the PPP could be used to model all the process steps in the real-life project, identifying related relevant stakeholders and their involvement in the process. Specific validations points and their outcomes could be modelled, providing an indication of when development risk was accumulated and the extent of related sunk risk when concepts were rejected by stakeholders. Concepts 1 and 3, for instance, were rejected at early validation steps, in consequence the sunk costs were low. The rejection at early steps was possible because all relevant validators were included in early validation. For concept 2, however, the affected stakeholders were excluded from the first solution validation. The project then continued and at a later stage (solution validation P3) the validation failed because of the rejection by the affected stakeholders; in consequence the sunk costs were high. The PPP model was able to show clearly the accumulation of development risk prior to rejection, based on the lack of an appropriate intermediate validation point.
In subsection 4.5 (and related Appendix) the case study demonstrated that problem diagrams can provide suitable models of concepts in their organisational context, with associated requirements to be satisfied. The step-wise modification of such models was able to capture very precisely and systematically the impact of each concept considered on its organisational context. By means of the notation, it was possible to identify subdomains that needed to be created or changed. For instance, the first concept (Figure A.3) was modelled as a new solution domain (the new system) to be designed from scratch. This clearly identified the scope of the development, which in real-life was rejected due to high costs. When moving onto the second concept, through various refinements of the model (Figures A.4, A.5 and A.7 in the Appendix), it was possible to identify which domains in the organisational context needed to change based on their shared phenomena, hence giving an indication of the scope of the change and the related development effort and risk. The lack of such an analysis in the real-life project resulted in the company not being aware of development risk related to the sharing of phenomena between domains in the organisation, and consequent needs for adaptation in the subsidiary systems, which resulted in key stakeholders not being involved in concept validation. This subsequently led to accumulation of risk and high sunk cost when the prototype was finally rejected.

Note that problem diagrams can be used as the basis of rationale and arguments to be validated by various stakeholders. While stakeholders are not modelled within problem diagrams, the link between models and validating stakeholders is through the process model of subsection 4.4: the problem diagrams are output of exploration activities, and can be used as the basis for discussion with stakeholders during validation.

The case study was presented by the author at the DSAG Globalisation Symposium in Berlin on June 10th, 2016. DSAG stands for “Deutsche SAP (Systeme, Anwendungen, Produkte in der Datenverarbeitung) Anwender Gruppe”; in English: German SAP (Systems, Applications and Products in Data Processing) User Group. The participants were all practitioners working for German companies, which had implemented SAP as core software and were interested in globalisation topics.

The presentation and follow-up discussion was meant to generate some early feedback on both the research problem (the lack of fit-for-purpose approaches to the front-end phase); and the approach taken in the case study (application of POE to this domain).

There was general agreement on the research problem, particularly the lack of systematic approaches to the front-end phase. There was interest in the approach taken in the case study, with participants asking when it might become available for us in practice. However, questions were asked on the extent the approach could be used to identify conflicts or risks related to ‘soft
issues’, such as stakeholders conflicts of interest, and how time consuming concept identification and evaluation might be on a running project. Indeed, these are important questions for our next stage of research.

5 Conclusions and future work

5.1 Implication of literature review and pilot research in relation to the research questions

As indicated in section 3, subsection 3.1, the research will attempt to answer the following questions:

Q1. Which activities are included in the front-end phase of IT/business alignment projects and what are their related risks?

Q2: To which extent do approaches currently proposed or adopted in project management provide coverage for those activities and are able to mitigate those risks?

Q3: To which extent can the Problem Oriented Engineering (POE) framework be applied and adapted for use in the front-end phase of such projects?

Q4: To which extent is such an application and adaptation fit to the needs of real-world IT/business alignment projects?

The literature review in section 2 has provided a partial answer to Q1 and Q2, by demonstrating that there is still a lack of approaches to the front-end phase of IT/business strategy alignment projects able to provide wide coverage of its two key activities of concept identification and evaluation, and to mitigate development process risk in volatile business contexts in a cost-effective manner. Moreover, knowledge of current practice is very limited hence more primary research is needed to address question Q2 fully, with semi-structured interviews with practitioners proposed in subsection 3.2 as a possible research method.

From the analysis of the literature, we have also concluded that one existing approach from the software and system engineering literature, the Problem Oriented Engineering (POE) framework, exhibits promising characteristics for application to the front-end phase of IT/business strategy alignment projects, and have started to investigate this extent this is the case in our pilot research (section 4), where POE was applied retrospectively to an IT/business alignment organisational problem from the author’s own practice, hence starting to address Q3 and Q4.
The outcome of the pilot research is encouraging. POE could be used to model: all the process steps in the real-life project, identifying related relevant stakeholders and their involvement in the process; specific validations points and their outcomes, providing an indication of when development risk was accumulated and the extent of related sunk risk when concepts were rejected by stakeholders; individual concepts in their organisational context, with associated requirements to be satisfied; the impact of each concept on its organisational context, including scope of any organisational change needed and related risk.

A limitation of this exploratory study was that the analysis was retrospective, hence the project outcomes were known in advance. Future case study research will need to establish the extent POE can be used to help prevent wasteful rework on live projects, by mitigating early on the project risk related to insufficient analysis and/or validation. If that were possible, then there would be a clear benefit to practice for projects dealing with complex IT/business alignment problems.

Additionally, future research should assess the extent POE models can be used in practice to allow stakeholders to understand better the identified concepts, the rationale for their choice and impact on the organisation. As it was observed in this case study, the actual impact of the changes related to the 2nd concept were realised by stakeholders quite late in the project, only when a prototype was available, wasting effort that might have been predicted by exposing the risk during the problem exploration. This type of analysis has the potential to become a project management tool that can be applied to the front-end phase of project, with the purpose of systematising concept identification and evaluation, and in this way reducing development risk.

5.2 Reflection on research methodology

The literature review needs to continue, on the one hand, to deepen the analysis, on the other hand, to be updated in terms of similar or complementary research that could enrich the results of the review.

Further case studies need to be set up, as the obtained results need to be repeated in order to ensure that they were not influenced by the author, who led the project on which this study was based and could have unintentionally influenced them. To avoid this possible bias, the framework could be applied to further case studies by third parties, for example experienced project managers, that were not part of the original project.

Moreover, we note that getting an accurate representation of each concept consumed quite a long time, because the process was manual and too many
details needed to be considered not to make mistakes. In the next phase, a
template could be developed to make the approach more operational by
reducing repetitive tasks and the probability of mistakes, and as a practical
way to enable practitioners to apply the framework in real life projects.

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A Pilot research

Figure 17: POE - Graphical conventions in use in exploratory case study

Analysis using POE diagrams representation

Initial situation The need was defined (in terms of phenomena) as “on a daily basis, when validation of Partner_name, partner_address is received by Company A, either global_id is issued AND status_unblocked OR amend_request is issued”

First identified concept The need was defined (in terms of phenomena) as “on a daily basis, when validation of Partner_name, partner_address is received by Company A, either global_id is issued AND status_unblocked OR amend_request is issued”

Second identified concept The need was defined in terms of phenomena as follows “partner_master_data_records are processed, approved and validated in MDG A and then transmitted to ERP X and ERP Y for further usage in transactions”

Third identified concept The need was redefined as follows “partner_master_data_record are processed, approved and validated in MDG A, transmitted to the con-
Initial situation – solved problem

![POE Diagram](image)

**Glossary**

Glossary of main terms used in this report

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**B**

Glossary of main terms used in this report
Domain: in POE, a set of related phenomena that are useful for the problem analysis.

Concept: in project management, “a mental construction meant to help solve a problem or satisfy a need” Williams & Samset (2010); same as ‘solution’.

Context diagram: a diagram showing the structure of a problem in terms of phenomena and the connections between them.
Phenomenon: in POE, any observable which are relevant to a problem.

Problem: in POE, a need in context.

Problem diagram: in POE, a diagram showing the structure of a problem in terms of its domains, phenomena and need.

Front-end phase: in project management, the set of activities necessary...
Figure 24: Second identified concept, context and solution interpretation - Domain and phenomena descriptions 1/2

<table>
<thead>
<tr>
<th>Domain</th>
<th>Domain description</th>
<th>Phenomenon</th>
<th>Phenomena description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company (CA)</td>
<td>Direct parent company - inner subsidiaries A and B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsidiary Y (SY)</td>
<td>Child company belonging to CA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whistle-blowing (WW)</td>
<td>Individuals within company A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master data governance (MDG)</td>
<td>Necessary for partner data maintenance, approval and validation established by company A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master data application (MDA)</td>
<td>Application that supports the data entry for the creation, approval and validation of partner master data record according to the defined master data fields and defined master data fields</td>
<td>Global_partner_master_data_record</td>
<td>Partner data necessary to perform systems transaction, validated and configured according to master record.</td>
</tr>
<tr>
<td>Configured master data tables (MDT)</td>
<td>Tables that control the behaviour and possible context of the partner master data during the data entry in the master data application, configured according to the definition of CA</td>
<td>number_ranges mandated_optional_fields</td>
<td>Number ranges for the configured master data record (definition of mandatory and optional fields during the data entry) list of values displayed as options for the filling of the fields during the data entry validation rules applied during the data entry such as address validation or parent validation.</td>
</tr>
<tr>
<td>Configured approval steps (CAS)</td>
<td>Approval steps configured according to the definition of CA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 25: Second identified concept, context and solution interpretation - Domain and phenomena descriptions 2/2

<table>
<thead>
<tr>
<th>Domain</th>
<th>Domain description</th>
<th>Phenomenon</th>
<th>Phenomena description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERP X</td>
<td>Machine supporting transaction needs to change partner master data record</td>
<td>local_partner_master_data_record</td>
<td>Partner data necessary to perform systems transaction, validated and configured according to master record.</td>
</tr>
<tr>
<td>MDA</td>
<td>Application that supports the data entry for the creation, approval and validation of partner master data record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Config, Tables ERP X (MT)</td>
<td>Tables that control the behaviour and possible context of the partner master data during the data entry in the master data application, configured according to the definition of CA</td>
<td>number_ranges mandated_optional_fields</td>
<td>Number ranges for the configured master data record (definition of mandatory and optional fields during the data entry) list of values displayed as options for the filling of the fields during the data entry validation rules applied during the data entry such as address validation or parent validation.</td>
</tr>
<tr>
<td>Transactions including MDR record (TR)</td>
<td>Transactions in ERP X that require partner master data record and support MDR processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDR</td>
<td>Machine supporting transactions needs to change partner master data record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Config, tables ERP Y (CM)</td>
<td>Application that supports the data entry for the creation, approval and validation of partner master data record</td>
<td>local_partner_master_data_record</td>
<td>Partner data necessary to perform systems transaction, validated and configured according to MDR.</td>
</tr>
<tr>
<td>Config, Tables ERP Y (CT)</td>
<td>Tables that control the behaviour and possible context of the partner master data during the data entry in the master data application, configured according to the definition of CA</td>
<td>number_ranges mandated_optional_fields</td>
<td>Number ranges for the configured master data record (definition of mandatory and optional fields during the data entry) list of values displayed as options for the filling of the fields during the data entry validation rules applied during the data entry such as address validation or parent validation.</td>
</tr>
<tr>
<td>Transactions including MDR record (TY)</td>
<td>Transactions in ERP Y that require partner master data record and support MDR processes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 26: Second identified concept, context and solution interpretation - Domain and phenomena descriptions 3/2

to grant the authorisation by an organisation to start a project and commit resources accordingly; also referred to as ‘ideation phase’, ‘pre-project’ or ‘pre-project planning’.

- **Need**: in POE, something that a solution needs to satisfy in a particular context.
- **Stakeholders**: individuals, groups or organisations who may affect,
be affected by, or perceived themselves to be affected by a decision, activity or outcome of a project.

- Solution: in POE, an artefact that satisfies a need in context; in project management, same as ‘concept’.
The need was re-expressed as follows:

```
partner_master_data_records_relevant_validation are processed, approved and validated in MDG A following corporate requirements for validation,
partner_master_data_records_X_no_relevant_validation and
partner_master_data_records_Y_no_relevant_validation are processed and approved in MDG A following the configuration of ERP X and ERP Y
then transmitted to MD Aplic. ERP X and MD Aplic. ERP Y for further
usage in transactions
```

### Changed situation – CA separated from CB

implemented solution with partial harmonisation requirements – final solution

![POE Diagram](image-url)
<table>
<thead>
<tr>
<th>Domain</th>
<th>Scenario description</th>
<th>Phenomenon</th>
<th>Phenomenon description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample (0)</td>
<td>Sample parameter</td>
<td>Sample value</td>
<td>Sample value description</td>
</tr>
<tr>
<td>Sample (0)</td>
<td>Sample parameter</td>
<td>Sample value</td>
<td>Sample value description</td>
</tr>
</tbody>
</table>

Changed situation – CA separated from CB architecture diagram with partial harmonisation requirements final solution 1/2

<table>
<thead>
<tr>
<th>Domain</th>
<th>Scenario description</th>
<th>Phenomenon</th>
<th>Phenomenon description</th>
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<tr>
<td>Sample (0)</td>
<td>Sample parameter</td>
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<td>Sample value description</td>
</tr>
<tr>
<td>Sample (0)</td>
<td>Sample parameter</td>
<td>Sample value</td>
<td>Sample value description</td>
</tr>
</tbody>
</table>

Figure 30: Implemented concept - Domain and phenomena descriptions 1/2

<table>
<thead>
<tr>
<th>Domain</th>
<th>Scenario description</th>
<th>Phenomenon</th>
<th>Phenomenon description</th>
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<tr>
<td>Sample (0)</td>
<td>Sample parameter</td>
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<td>Sample value description</td>
</tr>
</tbody>
</table>

Figure 31: Implemented concept - Domain and phenomena descriptions 2/2

<table>
<thead>
<tr>
<th>Domain</th>
<th>Scenario description</th>
<th>Phenomenon</th>
<th>Phenomenon description</th>
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<tbody>
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<td>Sample (0)</td>
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60