

**BUSINESS PROCESS DISCOVERY THROUGH  
CONVERSATION LOG ANALYSIS IN  
PLURALIST AND COERCIVE PROBLEM  
CONTEXTS**

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## Abstract

Business process discovery is one of the most fundamental steps of business process management (BPM) lifecycles. Incorrect, misleading or biased results of this stage can cause the whole BPM project to fail or the information systems that are created based on them to have great alignment problems with the reality of the organisation and how people carry out their work. The main problems of the business process discovery phase stem from two main sources. Firstly, the wrong attachment of BPM definitions and business process discovery techniques to the functionalist social paradigm whose only objective is the survival of the organisation through ensuring its efficiency and adaptability like a machine. This attachment to the functionalist paradigm has made BPM definitions to assume that organisations as social systems are in a unitary problem context, which means its constituents have similar beliefs and interests, they share common goals and objectives and they have all been involved in the decision-making. These assumptions are obviously far from the reality of today's organisations which are normally either in pluralist or coercive problem contexts.

The second source of problems in the business process discovery phase are BPM's definitions and techniques over-reliance on human memory and cognition that has made them suffer, like any other knowledge acquisition technique, from human memory and cognition limitations.

Using Design Science Research methodology, this research develops a conceptual framework in which new definitions for business task, business process and business process model in pluralist and coercive problem contexts will be presented. It will also be shown that conversation logs are a good source of information for business process discovery based on the new definitions and that using conversation logs can reduce the limitations caused by human memory and cognition. To develop the new conceptual framework, organisations as social systems have been analysed using the creative holism systems approach, and sound theories such as viable system model (VSM), i\* framework, speech act theory, conversation for action diagrams and episodic memory have been leveraged.

Based on the conceptual framework that consumes email messages as the conversation log and as its source of information, a method for business process discovery has been developed.

Using two case studies it has been demonstrated that the proposed definitions and the developed methods are applicable in unitary, pluralist and coercive problem contexts; and taking advantage of the conversation logs as their information source, they suffer to a lesser extent from human memory and cognition limitations. As a consequence, the resulting business process models created from applying the proposed definitions and methods are closer to the realities of the organisations and can increase the success rate of the business process management projects and reduce the information system's alignment problems.

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## List of Abbreviations

BA	Business Analyst
BPM	Business Process Management
BPMN	Business Process Modelling Notation
BPR	Business Process Re-engineering
BPSS	Business Process Support System
CSCW	Computer Supported Cooperative Work
DCE	Dependency Cycle Extractor
DSR	Design Science Research
ICT	Information and Communication Technology
IS	Information System
LAP	Language Action Perspective
PAIS	Process Aware Information System
PCT	Primary Care Trust
SOSM	System of Systems Methodology
VSM	Viable System Model

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# Chapter 1: Introduction

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Van der Aalst (2003) in his paper “Challenges in Business Process Analysis”, mentions: “reality is often very different from what is modelled or what people think. The world is not a Petri net.” and also “As long as managers and system designers take a power point reality as a starting point, information systems will remain to have serious alignment problems” (Aalst, 2003).

Extracting business process models from the stakeholders in a large organisation is a very difficult, if not impossible, task. Two types of obstacles prevent process engineers from ascertaining what the business processes actually are. Obstacles can mainly be classified as:

1. Obstacles that are related to the adopted system paradigm for organisations as a social system (functionalist paradigm) by the business process management theorists, which has had a great impact on business process management (BPM) definitions, techniques and approaches. This adopted system paradigm has caused the conventional BPM definitions and techniques to be bound to the unitary problem context, which means assuming that members of the organisation have similar beliefs and interests, they share common goals and objectives and they have all been involved in the decision-making (Jackson & Keys, 1984). This category of obstacles will be discussed further in sections 2.2 and 2.3.
2. Obstacles that are related to knowledge acquisition and human cognition limitations and shortcomings such as tacit knowledge, inaccurate descriptions of processes, human memory limitation, miscommunication and representativeness. This category of obstacles will be discussed in section 2.4 where different conventional business analysis techniques for business process discovery will be critically analysed.

In the following section, two personal experiences of the researcher as a business analyst (BA) will be put forward that will hopefully demonstrate the reality of these obstacles in real life and how they impact on the quality of business process discovery and other subsequent BPM lifecycle phases.

## 1.1 CONTEXT OF THE STUDY

I have been working as a BA for several small to large organisations over the past seven years. My main responsibility has often been to understand their current business processes, to help them optimise and to develop a support system to facilitate or automate execution of those business processes. Whilst I was working on these business process management (BPM) projects, I always thought there was something missing or even something wrong with our current practices, especially in the business process discovery phase, that causes more problems in the later BPM phases. The following two experiences, one working for a publishing company named Intellect and the other for the Saint John Ambulance, specifically demonstrate the problems I faced in my role as a BA.

My main responsibilities in Intellect were identifying the as-is business processes for creating a process support system for journal production purposes and also identifying requirements for their ecommerce system. I spent about eight months with the journal production team to be able to understand how they carry out their jobs. I had many meetings with different levels of staff, and about fifteen business process diagrams were drawn in order to clarify the process of journal production. Finally a process model was agreed upon and signed off and the development phase started. The result is now a journal tracking system named JTS, but it is hardly being used! Although I tried to use all the techniques I knew for business process discovery and requirement engineering (such as the goal-oriented requirement engineering, ethnographical approaches, RAD modelling, interviews, workshops, etc.), and although it seemed that everyone was happy about the business process model, when the product was released people felt that it did not support the way they have been doing their jobs. Critically, there were steps that were so obvious to them that they hadn't told me about, and there were also steps that they had forgotten about and were omitted.

In the Saint John Ambulance organisation I was responsible for drawing the as-is business process models, trying to optimise them and suggesting either to acquire an off-the-shelf business process support system or to design a bespoke system. I was working on this project for about a year. For such a big organisation, it was very difficult to find how they were actually doing their job. Their document repository was full of out-dated documents about the processes, and everyone had their own

point of view on what constituted the processes. It was very difficult to arrange a meeting with the high-ranking staff. The organisation operated at county levels and each county had its own work procedures – although they claimed they worked according to one set of procedures.

I visited stakeholders in different counties to elicit process information but often found I was eliciting small amounts, as people either didn't know what they were doing or they didn't want to let me know for some political reasons. Some of them were afraid of losing their jobs after the process optimisation, so they were describing what they were doing as it was more complicated than it really was. And, lastly, there were a lot of conflicts between what the county headquarters were saying about what constituted the organisation processes.

## 1.2 STATEMENT OF THE RESEARCH PROBLEM

One of the important steps of BPM is process discovery. In this step the BA tries to understand how people inside an organisation carry out their day-to-day jobs and fulfil their responsibilities and tries to model them. The business process discovery step is the basis for all the following BPM steps as identified business processes in this phase are used for optimisation, correction and automation in the later steps; and incomplete, incorrect or biased results here can mislead the whole BPM project (Dumas, La Rosa, Mendling, *et al.*, 2013).

Considering the origin and history of the development of the BPM theories, concepts and techniques, it can be deduced that BPM has evolved alongside the functional organisation theories, the process-thinking concept in factories and mechanistic organisations and business process re-engineering (BPR). BPM has eventually gained better shape and form by learning lessons from BPR projects' success and failures (Dumas, La Rosa, Mendling, *et al.*, 2013).

Having this short history of development of the BPM in mind, one can easily conclude that all the conventional business analysis techniques for business process discovery are *bound* to the unitary problem context that is the typical characteristic of functional and mechanistic organisations (this fact will be discussed further in section 2.3.2). This means that these techniques assume people inside an organisation have similar values, beliefs and interests, and that they share common goals and objectives (Jackson, 2003). The fact that this system paradigm is quite limiting and

does not represent the reality of what is happening inside many organisations has been discussed extensively in literature (Yu, 2011; Jackson, 2003; Morgan, 1997).

Furthermore, traditional business analysis techniques use different knowledge acquisition techniques as their core and suffer from these techniques' limitations and shortcomings, and, as a result, suffer from human cognitive limitations. These limitations and weaknesses include but are not limited to subjectivity, bias, limited memory, tacit knowledge, inaccurate descriptions of processes, miscommunication and representativeness (Anthony, Cossick & Zmud, 1992).

More recent techniques for business discovery, such as process mining, use event logs created by information systems (Aalst & Weijters, 2004) to tackle some of the traditional knowledge acquisition problems, but it can be argued that they are tightly coupled with the information systems that are facilitating the current execution of the business processes and the result of applying these techniques may not be a good representation of how people actually carry out their tasks.

All of these points have caused a great percentage of BPR and BPM projects to fail or the business process support systems (BPSS) to have great alignment problems with the ways people actually carry out their work (Dumas, La Rosa, Mendling, *et al.*, 2013; Aalst, 2003; Attaran, 2004).

### **1.3 AIM OF THE RESEARCH**

The aim of this study is to find a solution to the intrinsic paradigmatic limitation of conventional business analysis techniques for business process discovery and their over-reliance on human memory and cognition through:

1. Finding a definition for business processes that is not bound to the unitary problem context and, therefore, does not limit the business analysis techniques for business process discovery to be only applicable in this problem context.
2. Finding a reliable source of information that suffers to a lesser extent from knowledge acquisition shortcomings and also is not tightly coupled with information systems.
3. And finally, developing a conceptual framework for business process discovery based on the new business process definition and the new source

of information that creates models closer to the reality of the organisations and how people carry out their day-to-day responsibilities.

#### 1.4 SIGNIFICANCE OF THE STUDY

As was mentioned in section 1.2, business process discovery is one of the fundamental steps in the BPM lifecycle as all other following steps of BPM to a great extent rely on the correctness and accuracy of the business process discovery step (this point will be discussed further in section 2.4). It was also mentioned in section 1.2 (and will be discussed further in the later chapters) that current business analysis techniques for business process discovery are bound to the unitary problem context, therefore applying them to other problem contexts (pluralist and coercive problem contexts that will be discussed in section 2.2), that are closer to the realities of most organisations, cause the outcomes of these techniques to be incomplete and at points misleading and far from what is actually going on inside the organisations.

It was also mentioned that most of the conventional business analysis techniques suffer from knowledge acquisition and human cognitive limitations and shortcomings, i.e. imperfect memory.

Therefore, if

- A new definition for business processes can be proposed that applies to different problem contexts (unitary, pluralist and coercive), and
- A source of information about these business processes can be identified that:
  - Suffers to a lesser extent from knowledge acquisition shortcomings and human cognitive limitations, and
  - Is not tightly coupled with the information systems and BPSS. and
  - Has been created by people whilst they have carrying out their responsibilities, and
- A conceptual framework can be developed that uses these concepts and definitions and information sources to discover these business processes

then business analysts may have a better understanding of the realities of the organisations and the created models may be better representations of how people in the organisations carry out their day-to-day tasks. This may help the people in charge to be able to make more informed decisions about business process optimisation and automation, and may also narrow the gap between IT systems and the actual business processes. Therefore, the BPM practices can greatly improve and their success rates can significantly increase.

## 1.5 THESIS STRUCTURE

This thesis consists of seven further chapters. In chapter 2 the relevant literature will be critically reviewed. In section 2.2 the system of systems methodology will be introduced and different problem contexts for analysing social systems and their relevant paradigms and metaphors will be discussed. In section 2.3 conventional business process management and its lifecycle will be introduced and then the reasons that make the researcher believe that its practices can only be applied in the unitary problem context will be put forward. In section 2.4 different conventional (traditional and contemporary) business analysis techniques for business process discovery will be introduced and their specific limitations and shortcomings will be discussed.

In chapter 3 the research method that has been used in this study will be considered. Section 3.2 will introduce the researcher's worldview that is pragmatism. Section 3.3 introduces Design Science Research (DSR) as a pragmatic method of inquiry and discusses how this method has been adopted in this research and shows how the following chapters have been designed to be in line with this inquiry method's steps. It will be shown that the first two steps of the design science research method that are "problem identification and motivation" and "objective of a solution" has been covered in chapter 1 and chapter 2.

Chapter 4 is called "Design and development of a solution" that is the third step of the DSR. Section 4.2 elaborates on the solution's theoretical basis. It discusses how business processes can move from being a sequence of tasks that are being carried out by different business process participants towards a sequence of collaborations and dependencies between them. This section also discusses why



conversations are good candidates for extracting these collaborations and dependencies and eventually it propounds a new definition for business process that can be applied to unitary, pluralist and coercive problem contexts. Section 4.3 puts forward the proposed conceptual framework for business process discovery using the aforementioned theories. This section defines the adopted business process definition for the proposed framework, the data source that has been used for business process discovery and finally a technique for business process discovery from the selected data source. Section 4.4 introduces a method based on the proposed framework that uses email messages as its source of data about business processes and introduces a set of tools that can be used to facilitate the discovery of business processes from the email messages.

Chapter 5 that is “Case Studies” is the fourth step in DSR. In chapter 5 the demonstration step of the DSR will be covered. In this chapter using two case studies, the value of the new conceptual framework and its method as the artefacts of this research will be demonstrated. In section 5.2 the known limitations of the analysed email corpora will be discussed. In section 5.3 the first case study will be introduced, the framework’s method will be applied to its email corpus and the results will be analysed. In section 5.4 the same process will be followed for the second case study.

Chapter 6 is the fifth step in DSR that is “Evaluation”. In section 6.2 the suitability of DSR as the selected research methodology will be evaluated. In section 6.3 the research problem will be restated and the extent to which the objectives of the solution have been achieved will be discussed. In section 6.4 the applicability of the conceptual framework to different process types will be deliberated and section 6.5 is about the identified limitations and shortcomings of the proposed solution.

Chapter 7 is still related to the fifth step of DSR in which the research will be concluded and future work will be discussed and it will deliberate on how the current framework can be improved.

# Chapter 2: Literature Review

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## 2.1 INTRODUCTION

In this chapter the relevant literature will be critically reviewed. In section 2.2 the system of systems methodology (SOSM) will be introduced. This methodology puts forward different “ideal-type” problem contexts and defines their characteristics. This methodology also demonstrates how different sociological paradigms, system methodologies and metaphors for organisations as a social system can be categorised based on these ‘ideal-type’ problem contexts. In section 2.3 business process management (BPM) and its lifecycle will be introduced. In this section, using the SOSM ideal types, the history of the BPM development and BPM’s relevant concepts and definitions, it will be explored why the conventional business process management practices can only be applied to the unitary problem context. In section 2.4 commonly used business analysis techniques for business process discovery, both traditional and contemporary, will be introduced and critically analysed.

## 2.2 SYSTEM OF SYSTEMS METHODOLOGY (SOSM)

In this section different problem contexts for system analysis and their associated sociological paradigms, metaphors and system methodologies for organisations as a social system will be briefly introduced using the SOSM (Jackson & Keys, 1984).

Jackson & Keys (1984) introduced the “ideal-type” grid of problem context. This grid has been established in two dimensions: “systems” and “participants” as can be seen in Figure 1.

		PARTICIPANTS		
		UNITARY	PLURALIST	COERCIVE
SYSTEMS	SIMPLE	Simple–Unitary	Simple–Pluralist	Simple–Coercive
	COMPLEX	Complex–Unitary	Complex–Pluralist	Complex–Coercive

Figure 1. “Ideal-type” grid of problem contexts cited in Jackson (2003)

Systems have been divided into two categories simple and complex and Participants into unitary, pluralist and coercive.

Simple systems can be characterised as follows:

1. They have a few subsystems.
2. They have highly structured interactions.
3. They do not change much over time.
4. They are comparatively unaffected by the actions of their surrounding environment or their parts.

Complex systems can be characterised as follows:

1. They have a large number of subsystems.
2. They are involved in many loosely structured interactions.
3. They are adaptive and evolutionary.
4. They have purposeful parts and a chaotic environment that affect the system.

The horizontal axis categorises the relationship of the system participants. Participants whose relationships have been categorised as unitary:

- Have similar values, beliefs and interests
- Share common goals and objectives

- Are all involved in decision-making about how to achieve the common goals and objectives.

For participants whose relationships have been categorised as pluralist:

- Their basic interests are compatible.
- They don't share the same values and beliefs.
- If space has been made available within which they can have debates, arguments, conflict and disagreement and they feel that they have been involved in the decision-making, then accommodation and compromises can be found and they are happy to agree on productive ways forward towards the temporarily agreed goals and objectives.

Participants whose relationships have been categorised as coercive:

- Have few common interests
- Compromise is not possible
- Have no agreed common goals
- Take decisions based on the power structure and distribution.

Jackson (2003) then describes how different systems approaches relate to the problem context in SOSM. These descriptions are summarised in Figure 2.

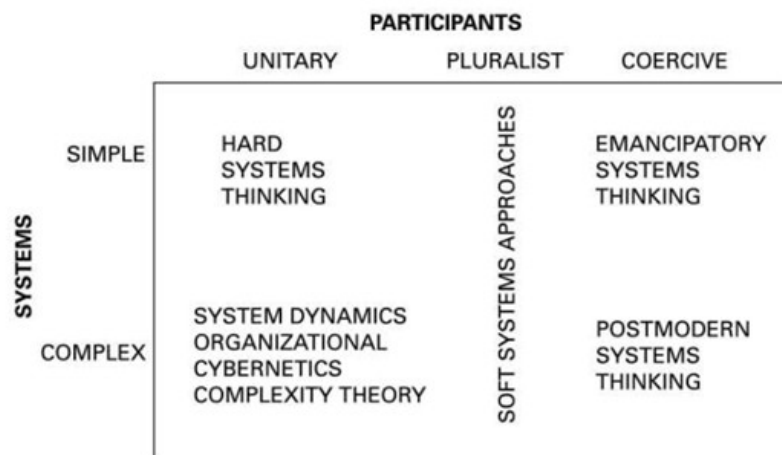


Figure 2. Systems approaches & problem contexts in SOSM cited in Jackson (2003)

Jackson (2003) believes hard system thinking is only applicable in simple unitary problem contexts. System dynamics, organisational cybernetics and complexity theory are attempts in enhancing hard system thinking, to make them applicable to complex systems but still in the unitary participants domain. Soft systems approaches have moved in the horizontal direction on the SOSM diagram and are working in pluralist, both simple and complex problem contexts. The emancipatory and postmodern system thinking works in coercive, simple and complex problem contexts, respectively.

Jackson (2003) also categorises systems approaches from two other perspectives:

1. Organisational metaphors
2. Sociological paradigms

Using the work of Morgan (1986;1997) and Alvesson & Deetz (1996), Jackson (2003) introduces the following organisational metaphors:

1. *Organisations as machines*: This metaphor represents organisations as logical, mechanical instruments for achieving the purposes of its owners and controllers.
2. *Organisations as living organisms*: This metaphor represents organisations as a whole that consists of interrelated parts that interact to ensure the survival of the organisation as an organism.
3. *Organisations as brains*: This metaphor highlights active learning rather than passive adaptability. So the focus of this metaphor is on decision-making, information processing, and control.
4. *Organisations as flux and transformation*: Using this metaphor managers are encouraged to find and extract consistent patterns that underlie the behaviour of the organisation as a complex system.
5. *Organisations as cultures*: According to this metaphor peoples' beliefs and values and philosophies are of great importance and the organisation takes form through the interaction of people and their worldviews.
6. *Organisations as political systems*: In this metaphor the concept of "power" is of great importance. This metaphor advocates the belief that people inside

the organisation can be competitive as well as cooperative, and can pursue goals and objectives that are in conflict. So, the governance is of high importance.

7. *Organisations as psychic prisons and organisations as instruments of domination*: These two metaphors put emphasis on the negative aspects of organisational life. They highlight the negative impact organisations can have on freedom of thought and other aspects of human life.
8. *Organisations as carnivals*: This metaphor emphasises the fragility of the conceived social order in other paradigms and also the importance of the “fun” factor in organisational life.

Jackson (2003) believes hard system thinking depends on machine metaphor, system dynamics and complexity theory, which are based on the flux and transformation metaphor. Organisational cybernetics has been built on organism and brain metaphors. Soft system methodologies reject machine metaphors and build their foundation on the cultural and political system metaphor. Critical systems heuristics and team syntegrity are based on psychic prison and instrument of domination metaphors. Postmodern system thinking is using the carnival system metaphor.

Jackson (2003) using the work of Burrell & Morgan (1979) and Alvesson & Deetz (1996), introduces the following four sociological paradigms and classifies the systems thinking approaches by those paradigms.

1. *The functionalist paradigm*: This paradigm gets its name from the fact that it wants to ensure that the system is efficient, adaptable, does what it needs to do to achieve its objectives, and as a consequence survives. Within this paradigm, the constituent elements of a system, their relations and the relation of the system with its environment get studied. This paradigm can be associated with, machine, flux and transformation, brain and organism metaphors. Therefore, hard system thinking, system dynamics, organisational cybernetics and complexity theory can be classified under this paradigm. **So this paradigm and its associated metaphors and system methodologies can be classified as applicable only in the unitary problem context.**

2. *The interpretive paradigm*: This paradigm takes its name from the fact that it has been built on the assumption that social systems are created from different interpretations of the people and the situations they are in. These interpretations are causes to act and interact, and also pursue the purposes that have been originated from these interpretations. Cultural and political system metaphors are usually associated with this paradigm, thus soft system methodologies can be classified under this paradigm. **This paradigm and its associated metaphors and system methodology can be classified as applicable in the pluralist problem context.**
3. *The emancipatory paradigm*: This paradigm's main concern is discrimination in all its shapes and forms, and emancipation of oppressed individuals and groups. This paradigm is usually associated with the psychic prison and instruments of domination metaphors and as a result critical systems heuristics and team synteegrity can be classified under this paradigm. **This paradigm and the postmodern paradigm that will be introduced next and all their associated metaphors and system methodologies can be classified as being applicable in the coercive problem context.**
4. *The postmodern paradigm*: This paradigm opposes the rationality that is being sought by the other three paradigms in the organisation. It believes organisations are far too complex to understand by any other paradigms. It emphasises on having fun, bringing the conflicts to the surface, and encouraging variety and diversity. This paradigm usually gets associated with the carnival metaphor. Postmodern systems approaches can be classified under this paradigm.

Jackson (2003) eventually introduces the creative holism concept and argues that by looking at the organisation from different perspectives (using different metaphors and paradigms), and using all different methods and techniques introduced in different systems approaches – despite their incommensurable paradigms – one can gain a much better understanding of the reality of the organisation. As the adopted systems approach in this research, creative holism will be discussed further in the research method and the proposed framework chapters.

### 2.3 BUSINESS PROCESS MANAGEMENT (BPM)

In this section business process management (BPM) will be introduced and the intrinsic paradigmatic limitation that is inherent in its definitions and techniques will be discussed.

Weske (2007) defines business process management as “concepts, methods and techniques to support the design, administration, configuration, enactment and analysis of the business processes”. He defines a business process as: “A set of activities that are performed in an organisational and technical environment to jointly realise a business goal”.

He outlines the most important goal of BPM: “better understanding of the operations that a company performs and its relationships”. He also believes the main BPM goals are the following:

- Increasing the flexibility of the organisation to respond to change
- Creating a repository of business processes as a valuable asset
- Continuous process improvement, and
- Narrowing the gap between business processes and their realisation using software systems.

Dumas, La Rosa, Mendling, *et al.*, (2013) define BPM as: “art and science of overseeing how work is performed in an organisation to ensure consistent outcomes and to take advantage of improvement opportunities”. They state that business processes are “what companies do whenever they deliver a service or a product to customers”. They believe business processes are built of activities, events, decision points, actors and one or several outcomes. Using these ingredients they define business processes as: “a collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer”.

Using the above business process definition they define BPM as: “a body of methods, techniques and tools to discover, analyse, redesign, execute and monitor business processes”. They also mention that one of the main characteristics of BPM is having business processes and business process models at its core and its emphasis on using business process models in all the different stages of the BPM lifecycle.



Dumas, La Rosa, Mendling, *et al.*, (2013) also believe that if one is concerned with the quality of product or service or the speed of its delivery to a customer, using BPM concepts seems quite intuitive.

Dumas, La Rosa, Mendling, *et al.*, (2013) and Harmon (2007) also introduce the origins and history of BPM and show that BPM concepts have emerged through the rise of functional organisations that had the specialist workers, who had their focus on a single part of the product or process, at their core. They demonstrate that the shortcomings of functional optimisation in functional organisations leads to the birth of process thinking and then later on to business process re-engineering. It can be inferred that they also believe BPM has been developed from the lessons learned from BPR project failures and also its relevant technological advancement in IT.

### 2.3.1 Business process management lifecycle

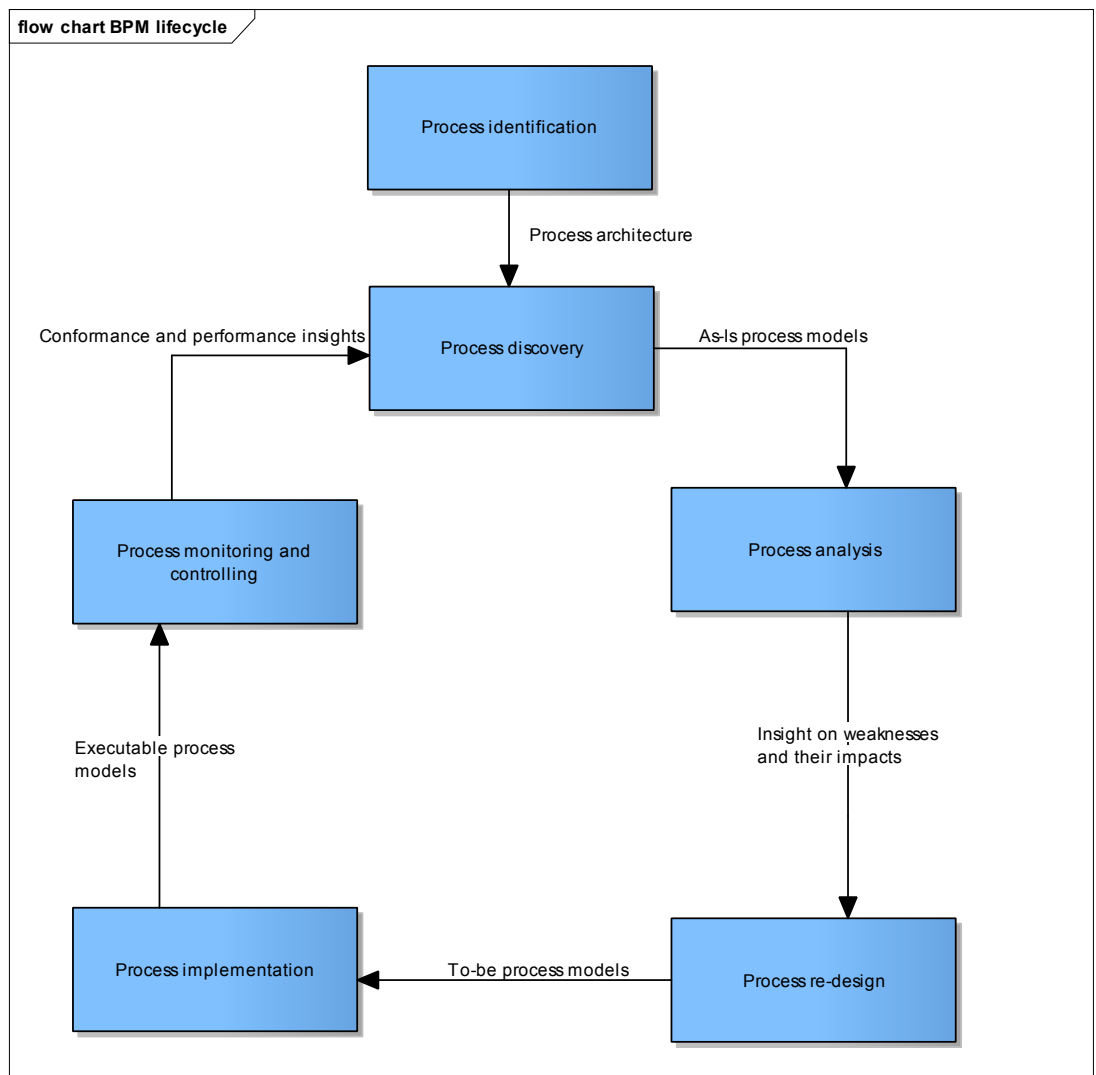


Figure 3. BPM Lifecycle

Figure 3 from Dumas, La Rosa, Mendling, *et al.*, (2013) illustrates different phases of the business process management lifecycle, which starts from process identification and cycles through process discovery, analysis, redesign, implementation and monitoring and controlling.

- *Process identification*: In this phase a business problem gets postulated and the relevant business process to that business problem gets identified, their boundaries created and their relationships defined. The outcome of this phase is the process architecture that illustrates the overall view of the business processes in the organisation relevant to the business problem and their relations.
- *Process discovery*: In this phase the current status of the identified business processes is documented (as-is business process models).
- *Process analysis*: In this phase issues associated to the as-is process models are identified and documented and quantified against the performance measurements.
- *Process re-design*: In this phase the changes necessary to address the issues of the as-is process are identified to help the organisations achieve their performance objectives.
- *Process implementation*: In this phase the changes that were identified in the previous phase that are necessary to move from as-is business processes to to-be business processes are prepared and implemented.
- *Process monitoring and controlling*: While the re-designed processes are running, relevant data to process performance is gathered and analysed to determine how well the process is performing and if it is achieving its performance objectives or needs more improvements.

It is worth mentioning that considering the BPM lifecycle phases, it can easily be concluded that after process identification that is about understanding the business problems, business process discovery that leads to the creation of the as-is business processes is the most important phase of the BPM efforts. As, if the as-is business processes are not discovered correctly all other phases of the BPM lifecycle will be based on incorrect or incomplete information and assumptions.

### **2.3.2 Conventional business process management and the paradigmatic limitation**

Having in mind the history and origin of the BPM and looking at its main goals and objectives and also characteristics and definition it can easily be established that the current BPM definitions, tools and techniques look at an organisation from a functionalist sociological paradigm. Reviewing recent literature from key academics in the field of BPM, such as Dumas, La Rosa, Mendling, *et al.* (2013); Dumas, Aalst & Hofstede (2005); Harmon (2007); Weske (2007), better illustrates this paradigmatic limitation.

As was mentioned in section 2.2, the functionalist sociological paradigm is mainly concerned with a system's efficiency and adaptability (Jackson, 2003), which can be considered the main goals of the BPM as well (Weske, 2007; Dumas, La Rosa, Mendling, *et al.*, 2013; Harmon, 2007). It was also mentioned in section 2.2 that the functionalist paradigm can be associated with machine, flux and transformation, brain and organism metaphors.

SOSM shows that those metaphors associated with functionalist paradigms are related to a number of system methodologies (hard system thinking, system dynamics, organisational cybernetics, and complexity theory) that are only applicable in the unitary problem context (Jackson, 2003).

The participants' relationships in a unitary problem context, as was mentioned in section 2.2, have the following characteristics:

- They have similar values, beliefs and interests.
- They share common goals and objectives.
- They are all involved in decision-making about how to achieve the common goals and objectives.

The characteristics of relationships in a unitary problem context are prevalent in the current BPM from description and definition to ultimate goals and objectives. All these definitions assume the process participants have a shared understanding of the organisational goals and they try to realise these goals and objectives by implementing business processes that can be changed and improved (Weske, 2007; Dumas, La Rosa, Mendling, *et al.*, 2013; Ould, 2005; Harmon, 2007).

Ould (2005) states: “In an organisation, people do things not because they are themselves but because they have a responsibility in the organisation; they are perhaps paid to carry out that responsibility: they have a role in that organisation.”

Harmon (2007) at the beginning of his book “Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals” talks about organisations as systems. He states “in essence, the systems perspective emphasizes that everything is connected to everything else and that it’s often worthwhile to model businesses and processes in terms of *flows and feedback loops*.”

According to System Dynamics methodology, in order to get an appropriate understanding of a complex system, it is essential to form an understanding of the following four phenomena (Wright & Meadows, 2009):

- System boundary
- Feedback loop networks
- Level or stock and rate or flow variables
- System leverage/ intervention points

It is quite clear, therefore, that in the above statement, Harmon (2007) is specifically referring to System Dynamics methodology for analysing organisations as systems.

As was discussed earlier, this systems analysis methodology, System Dynamics, has been categorised as a methodology only applicable in unitary complex problem contexts by Jackson & Keys (1984).

Interestingly, where Dumas, Aalst & Hofstede (2005), talk about Person-to-Person Processes, they initially discuss the larger problem context. They mention that people processes are very complex, semi-structured, variable and dynamic and they talk about organisational structure, power distribution, context and cultural settings’ impacts on these processes. However, as they continue their discussion they attempt to reduce the problem under investigation to a problem in the unitary problem context. They introduce “certain emergent regularities and patterns of group behaviour” and structures that the process participants reproduce repetitively as a result of *shared belief and value system*. They conclude that seemingly unstructured interactions are to a large extent, *dictated* by linguistic, cultural and social norms.

Finally they discuss “formalized interactions” and the fact that interactions develop into routines as they mature. It is important to mention that they don’t consider this formalisation as a way to mechanise the interactions but to define the “structural backdrop, against which complex and diverse interactions unravel”.

The above quotations, statements and discussions better illustrate the viewpoint of the current BPM theorists and better demonstrate that they are still working in the unitary problem context.

It is obvious that not all relationships in the organisation are bound to the unitary problem context (Jackson & Keys, 1984; Morgan, 1986, 1997; Jackson, 2003), so limiting our definitions and techniques to this problem context causes the outcome of our analysis efforts to be far from the reality of the organisation, incomplete and even misleading.

This paradigmatic limitation that was mentioned in the above paragraph is the common limitation of the conventional BPM practices, and therefore the common limitation of all business analysis techniques for process discovery that work according to the conventional BPM descriptions and definitions. In the next section, commonly used business analysis techniques will be introduced and their more specific limitations and shortcomings apart from the paradigmatic issue will be analysed and discussed.

## **2.4 CRITICAL ANALYSIS OF COMMONLY USED BUSINESS PROCESS ANALYSIS TECHNIQUES FOR BUSINESS PROCESS DISCOVERY**

In this section commonly used business process analysis techniques have been categorised into two categories:

1. Traditional business process analysis techniques that include:
  - Interviews
  - Workshops
  - Questionnaires
  - Observation
  - Document analysis
  - Special purpose records
2. Contemporary business analysis techniques that include:

- Process mining
- Email mining

Each of these techniques will be introduced and analysed in the following subsections.

#### **2.4.1 Traditional business process analysis techniques: their limitations and shortcomings**

Traditional business analysis techniques for investigating the current situation, process discovery, and creating the as-is business process models can be divided into two categories (Cadle, Paul & Turner, 2010):

- Qualitative investigations
- Quantitative investigations

Qualitative investigations are mainly concerned with transferring the business process knowledge from the knowledgeable workers and business stakeholders to the business analyst. Interviewing, workshops and observation are the main techniques within this category.

Quantitative investigation is mainly concerned with gathering quantitative data about business processes. Data such as the number of invoices that are produced each day, per month, per annum; the amount of time spent on dealing with complaints as opposed to taking new orders, etc. Questionnaires, sampling, special purpose records and document analysis are the main techniques within this category (Cadle, Paul & Turner, 2010).

##### **2.4.1.1 Interviews**

In this technique the business analyst interviews senior managers, end users and any other stakeholders whose job is somehow related to the business domain under investigation. The main purpose of the interview is to better understand the current situation by asking different types of questions such as open or closed questions, limited choice questions, leading, probing, and link questions. Each type of question sheds light on the business process from a different angle and should be selected with care for different types of interviewees (Cadle, Paul & Turner, 2010). Different approaches to interviewing have been introduced in literature such as teach-back interviewing, in which the outcomes of the interviews with each

interviewee will be shared for criticism, or open interviews, in which the analyst lets the expert go ahead and talk freely about his experiences about the processes under investigation (Anthony, Cossick & Zmud, 1992).

#### **2.4.1.2 Workshops**

In this technique the business analyst brings together a number of stakeholders to agree the scope and direction of the project, identify and agree business or system requirements, examine possible solutions, and approve and agree on the analysis outcomes. In fact in this method the business analyst is trying to look at the problem from the point of view of each participant and overcome the limitation of one-to-one interviews which analyses the problem from one angle.

In the interview technique, in each interview session the business analyst tries to understand the business processes from the interviewee's point of view. After consulting with all the interviewees, one by one he tries to combine these understandings and come up with one consistent as-is business process model.

In the workshop technique the responsibility of negotiation and coming to a consensus about the business processes has been delegated to the stakeholders themselves. The business analyst uses many techniques to facilitate the workshop in a way that enables the workshop participants to reflect on the matter, consult, negotiate and ultimately come up with a common solution (Cadle, Paul & Turner, 2010).

#### **2.4.1.3 Questionnaires**

Questionnaires are used to gather information or validate the requirements with a wider group that are already elicited via other techniques such as interviews or workshops. Questionnaires usually become the main means of fact finding when the user population is numerous and widely distributed and it is not possible to use other techniques such as one-to-one interviews (Cadle, Paul & Turner, 2010).

#### **2.4.1.4 Observation**

The observation technique has various forms such as structured observation, STROBE (Structured Observation of the Business Environment), shadowing, protocol analysis and ethnographic study. All of these techniques are common in one thing that is the business analyst has to go and look by himself at how people carry out their day-to-day tasks (Cadle, Paul & Turner, 2010). By using this technique

business analysts try to overcome some of the shortcomings of the previous techniques.

In the previous techniques the business analyst is solely relying on the business process stakeholders to describe what they do and how they carry out their tasks; however, the following points outline the drawbacks of this approach (Hughes, O'Brien, Rodden, *et al.*, 1995):

- It is usually difficult for business users to describe clearly and accurately the tasks they do on a day-to-day basis.
- Tacit knowledge: people usually don't know what they know!
- People usually don't necessarily do in practice what they say, or are told to do. People are usually quite inventive and find shortcuts or workarounds to make their jobs easier.

By spending some time to observe people doing their task, the business analyst might be able to overcome a percentage of the discussed problems (Cadle, Paul & Turner, 2010; Anthony, Cossick & Zmud, 1992).

#### ***2.4.1.5 Special Purpose Records***

These techniques are trying to solve the subjectivity of other techniques by gathering and logging and measuring some actual records from people's day-to-day jobs. The business analyst usually logs the time spent on each task by each individual, or uses any available actual log of the business-related data and then tries to validate some of the previously stated process steps (Cadle, Paul & Turner, 2010).

#### ***2.4.1.6 Document Analysis***

Document analysis is the systematic examination of available business process-related data sources, usually: forms, screen layouts and reports or any business process data available in computerised information systems. By document analysis the business analyst tries to complement and validate his findings by means of other techniques using a less subjective data source (Cadle, Paul & Turner, 2010). It can be argued that process mining and the proposed framework in this research can be categorised as an advance document analysis method.



Hence, business analysts use these techniques to transfer the knowledge that exists, inside the organisation boundaries and in the knowledge experts' heads, to their knowledge repository.

#### ***2.4.1.7 Limitations and shortcomings of traditional business analysis techniques***

Interviews, workshops and questionnaires are the first techniques that will be investigated. In these methods the business analyst is trying to ask people to remember what they do in their day-to-day jobs. In other words, the business analyst is trying to extract fragments of knowledge from the participants by communicating with them, and understanding their underlying knowledge about the process (Anthony, Cossick & Zmud, 1992).

Studies (Harris & Brown, 2010) show that participants can simultaneously have conflicting ideas and views that can cause them to respond in an ambiguous and inconsistent way. Some participants might respond according to what they think is socially or politically acceptable, rather than what they know that is actually happening. And others may intentionally hide the reality. Poor or incomplete memory of events, external influences and lack of time to recall the information can contribute to the unreliability of these techniques.

Observation is the next technique that will be explored (Cadle, Paul & Turner, 2010). In this technique the business analyst is trying to overcome the subjectivity of the previously discussed techniques by observing the actual work and also relying more on his or her own expertise of observing enactment of fragments of business processes (business process fragment instances), and being able to match the patterns in his own expert mind and to come up with an as-is business process model. Leaving aside the extensive time that this technique needs, it is impractical even to analyse the business processes inside a medium-size business – the following is a list of problems that the business analyst will encounter whilst using this approach (Cadle, Paul & Turner, 2010):

- *Heisenberg principle*: People usually do not work in the same way when they are being observed. The results of the observation are affected by the presence of the observer.

- *Interrupt “business-as-usual”*: This means someone is watching and asking questions which will interrupt people’s usual way of working and might decrease their performance.
- It is difficult to observe knowledge workers’ work without asking many questions.
- Not observing a typical working day that is a good representative of a typical work pattern.

And finally, conventional document analysis techniques should be analysed. Although this approach seems like a good start to find a more reliable and objective source of data, there are two major problems with this technique:

- *Out-dated documents and data sources*: Experience shows that the documents that are generated to clarify business processes get out-dated quite quickly. Organisations usually do not have a systematic approach for keeping these documents up-to-date.
- *Moving away from people-oriented business processes towards more dry data-oriented business processes*: Most of the written documents, forms, data sheets and timesheets are not good representatives of people’s actual way of working. People often don’t work according to the documented business processes. They are creative and find workarounds and shortcuts (Aalst, 2009).

Apart from all the aforementioned problems, most of the business analysis techniques suffer from the common obstacles of knowledge acquisition. These obstacles can be categorised as follows:

- *Cognitive obstacles (intrinsic to all people that are involved in the knowledge acquisition process)*: This category is related to all human cognitive shortcomings. As human beings, people involved in knowledge acquisition have limited memory and recall, as well as information processing biases such as selective perception and representativeness (Anthony, Cossick & Zmud, 1992).
- *Communication obstacles (Obstacles between knowledge engineers and the experts)*: Cognitive limitations and the lack of a common language

cause communication problems for people involved in knowledge acquisition (Anthony, Cossick & Zmud, 1992).

- *Conflicting viewpoint obstacles (Obstacles among the people who hold fragments of knowledge)*: These are the problems associated with multiple knowledge holders and the conflicts that exist between their viewpoints. Each individual looks at the process from a different angle. As the number of process actors increases, the individual ways of understanding the process, describing it, and even enacting it, causes difficulty for the process engineer (knowledge engineer) to find a common business process model that satisfies the perceptions of all the process actors (Anthony, Cossick & Zmud, 1992).

## **2.4.2 Contemporary business process analysis techniques: their limitations and shortcomings**

In this subsection, two more recent business process analysis techniques for business process discovery will be introduced and analysed.

### **2.4.2.1 Process mining**

One of the complementary techniques that has been introduced to overcome some of the issues previously discussed in business process analysis for investigating the current situation is process mining (Aalst & Weijters, 2004).

Process mining is about extracting information from event logs (usually produced by information systems) to discover business processes as they take place. The main challenge of process mining is to create a process model that is consistent with the observed dynamic behaviour of the organisation. It is assumed that it is possible to record events, such that the information about the event and the sequence of their execution are available (Aalst & Weijters, 2004).

Process mining introduces a set of analysis techniques to mine process models from the recorded logs. These techniques assume that each event refers to an activity (a defined step in the process) and is related to a particular process instance. Other information that can be helpful is: performer or originator of the event, event timestamps and any other data that is recorded with the event (Aalst & Weijters, 2004).

This method can only be used in organisations where all or part of their business processes are being supported by information systems. Further, it can be argued that there are three important criticisms to be considered by the developers of a conventional process-mining technique:

1. *Information system log files and reality of the work processes*: The main question here is how much information do information system log files reveal about the actual business processes that are being followed by the people inside an organisation? Usually the information systems (workflow management systems, etc.) are quite restrictive and people usually work around them by using emails or phone calls to break the imposed restrictions. Thus, the information system log files are not necessarily a good representative of how the business processes are actually being carried out by the people inside the organisation.
2. *Current imposed restrictions on the way of work by information systems*: Even if people actually follow the steps that information systems impose on them, it does not show that this is the way they would prefer to work, or that they believe is the best way to work.
3. *Over-reliance on previously modelled business processes that have been used to implement the current information systems*: The business processes that have been extracted from analysing the information system log files are not the business processes that have been evolved from people preferences, or ways of work-around for the goals and objectives of the organisation, but are the fragments of business processes that have been used to implement the previous information systems.

This reality is getting more importance every day that business processes are more about the people than anything else. One of the main reasons why some of the business process re-engineering efforts fail is because they fail to recognise the importance of people (Attaran, 2004).

#### **2.4.2.2 Email mining**

As an attempt to overcome one of the aforementioned shortcomings of process mining, the inability to cover organisations that do not have information systems that produce structured log files, Aalst & Nikolov (2007) introduced the email analyser, a

plug-in for their process-mining tool that could convert email messages to event logs which could then be used for process mining. They argued that since emails are one of the most popular tools used for computer-supported cooperative work (Ellis, 2000) and are widely used for communication inside organisations and between them, it would be useful if process-related information could be extracted from them, for the organisations that either are not supported by workflow management systems (or any other system that creates structured logs), or for the part of the business processes that are being executed using simple email tools. They believe “a normal email message does not contain any explicit information that allows making a conclusion about its relations to a particular process instance or task or its relevance to the organisation’s business process at all” (Aalst & Nikolov, 2007). Therefore, they have concluded the email messages should be tagged by one of the following methods before they can be used as system logs:

1. Process-aware transaction systems
2. Manually by users
3. Extracted automatically from email subjects under the assumption that the email subject contains the task name and the event type (manually created).

The whole mining process consists of four steps:

1. *Extract email logs*: In this step, the emails are transformed from an email system format like Outlook’s to an XML format.
2. *Pre-processing Stage*, which by itself consists of two steps:
  - a. Find all email addresses that are owned by one person.
  - b. Select the emails that are needed for analysis.
3. *Mine the process logs*: This is based on the tags created by one of the aforementioned methods in the subject line of the email. In this step the emails are translated to standard logs, which can be used by process-mining tools.
4. *Analyse the logs using process-mining tools and techniques*.

The method introduced by Aalst & Nikolov (2007) can be considered one of the first attempts to use email messages as a source for extracting business process-related information. It does not argue deeply why email messages can be a good source of finding business process-related information, apart from mentioning that emails have been the most popular CSCW tool. It leaves the decision-making to the user about the business process cases either from email threads, email senders, email recipients or by the tags previously created; however, it does not justify why the developers of the technique think these concepts are good representatives of a business process case. Apart from these fundamental problems, the authors introduce two tagging techniques where each introduces a new problem:

1. *Tagging by process-aware systems*: This method in most cases is in contradiction to the main reason they have introduced the plug-in for – that is, for organisations that do not have information systems that can produce structured logs. In other words, if an organisation possesses a process-aware system that can tag the email messages, most probably the structured logs of that system can be used for process mining. It should be mentioned that in that case (using automatic tagging) all the previous process-mining criticisms still apply to the email-mining technique.
2. *Manual tagging by users*: This solution does not seem practical as people need to start tagging all the emails they have sent retrospectively and obviously such a task is not an easy one. Even if they manage to do so, the technique would not be able to solve the subjectivity problem, as people will tag their emails as they want (again by considering, organisational social and political factors).

Another shortcoming of this technique is its focus on email subjects that do not necessarily contain all the required information for analysing the email message and creating an event log.

The interesting part of this method is that, because it is trying to translate the email messages into an information system event log format, after the translation all the previous process-mining tools and techniques can be used.

Stuit & Wortmann (2012) have introduced another technique for discovery of email-driven business processes from email messages. This method is based on

finding interaction within email threads. They describe email threads as “sets of messages, which are replies to each other and together form a conversation. The messages within a thread are usually sorted by date, and are usually grouped together in parent-child relations” (Stuit & Wortmann, 2012). Their method consists of four steps and the results are being modelled in TALL modelling notation. They have also developed a tool called Email Interaction Miner for their technique. The four steps are as follows:

1. *Manual pre-processing of emails*: Like the Aalst & Nikolov (2007) technique, they have a manual pre-processing phase in which the email owners are asked to filter out all the non-relevant emails.
2. *Identification of interactions and their composition relations*: In this step interactions are identified using email threads or in other words each email thread becomes an interaction. Email threads are being extracted using only email subject and email reference meta-data. In this step they have also introduced some weakly justified heuristics for extracting different types of threads as well.
3. *Identification of routing relations between interactions*: The routing relations between interactions (threads) are identified using their start-end times. It means the interactions that have happened simultaneously in time are considered parallel and the rest are sequential.
4. *Identification of actors and roles*: In this step the actors and roles are being extracted using some heuristics from email senders and recipients and also some external resources like the companies’ employee website or database.

Although the Stuit & Wortmann (2012) technique is more automated than the Aalst & Nikolov (2007) technique, it is based on a less robust theoretical basis and it can easily be argued that it has some fundamental flaws in its design. The following is a list of points that is worth considering in regards to the proposed technique by Stuit & Wortmann (2012):

1. They have never argued or justified why they have chosen email threads as their most granular part of the business process. Email threads (as has been defined in their paper) can never show the bigger picture, as they are localised conversations around a focused topic.
2. If email threads are accepted as the units of interaction, as these interactions do not necessarily follow the same higher-level objective, their sequence or parallelism should not be considered a sequential or parallel interaction to achieve the same business objective.
3. By asking the participant to filter out their email addresses the technique is drifting back to the subjectivity and bias problems.
4. The technique claims to create business process models using the TALL modelling notation by using a very limited number of emails and without even considering patterns or process cases. It is impossible to be sure that the number of emails that have been gathered is a good representative for creating the business process models using business processes and the business process model's traditional definition. It can be debated that even if all the previous problems with this technique are accepted, the outcome of this method can be fragments of business process instances, and not business process models.

## 2.5 CHAPTER SUMMARY

In this chapter, system of systems methodology (SOSM) and, based on that, “ideal-type” problem contexts were introduced first. SOSM categorises problem contexts based on participants' relations to unitary, pluralist and coercive “ideal-type” problem contexts. Different sociological paradigms were then introduced and it was demonstrated that the functionalist paradigm can be categorised as only applicable in the unitary problem context. Conventional BPM and its lifecycle was introduced next and, using its history and concepts and definitions, it was argued that it is based on the functionalist paradigm and therefore is only applicable in the unitary problem context. Finally, commonly used business analysis techniques for business process discovery were introduced and critically analysed and their strengths and shortcomings were explained.



In the next chapter, the researcher's philosophical worldview will be presented and based on that the research methodology that has been adopted for this research will be introduced.

## Chapter 3: Research Method

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### 3.1 INTRODUCTION

In this chapter the adopted research methodology will be discussed. In section 3.2 the researcher's philosophical worldview – pragmatism – will be introduced and its compatibility with the adopted system methodology – creative holism – will also be explained. In section 3.3 Design Science Research (DSR) methodology will be presented as a pragmatic research methodology and ultimately in section 3.4 the design of the research based on the DSR methodology will be discussed.

### 3.2 PHILOSOPHICAL WORLDVIEW

One of the important factors that help researchers in choosing an appropriate research method of inquiry is the philosophical worldview they adopt. This worldview helps them to explain why they chose qualitative, quantitative or mixed research methods (Creswell, 2008).

The pragmatic worldview is this researcher's adopted worldview. "Pragmatism as a worldview arises out of actions, situations, and consequences rather than antecedent conditions" (Creswell, 2008).

The main concern of the pragmatic worldview is what works and how the problem at hand can be solved. Instead of focusing on the inquiry methods, the researcher focuses on the problem and applies any methods that help him understand the problem better, and can find a solution to that problem. Pragmatism is the philosophical worldview supporting the mixed methods of inquiry. "Pragmatism is not committed to any one system of philosophy or reality" (Creswell, 2008). Inquirers who use mixed methods follow the same path. They use both qualitative and quantitative assumptions when they are carrying out their research so they are not committed to any one system of philosophy or reality. They have the liberty to choose any methods, techniques or procedures of research that help them best in carrying out their research (Creswell, 2008).

In addition to the worldview, the adopted approach to system analysis for analysing organisations as a social system has a great impact on the research path.

Creative holism, which is the commitment to use a plurality of systems approaches, their related methodologies and appropriate systems methods (Jackson, 2003), has been chosen as the systems methodology for this research. In the next subsection (3.2.1) the reason why this system methodology has been selected will be discussed and its compatibility with the pragmatic worldview will be pondered.

### 3.2.1 Pragmatism and creative holism

It was discussed in the previous chapters that one of the main shortcomings of the conventional BPM practices is that its theorists have only analysed organisations as social systems from the functionalist social paradigm. This has caused conventional concepts and definitions and techniques to be bound to the unitary problem context. In order to address this shortcoming, the organisation should be analysed from different social paradigms, and by using different metaphors, and based on that analysis new BPM concepts and definitions and techniques should be proposed that not only work in the unitary problem context but also in pluralist and coercive ones. Creative holism, introduced by Jackson (2003), is a systems approach that has this objective at its heart. It believes that organisations should be analysed from different perspectives using different social paradigms as in reality they show characteristics of all different paradigms in different situations.

“Pluralism” has centrality in creative holism and it has been contrasted against isolationists, who believe in one systems methodology; imperialists, who tried to use different systems methodologies within their preferred system’s theoretical orientation; and finally pragmatists, who, as Jackson (2003) believes, forgot about theoretical distinctions and tried to develop a toolkit out of different systems methodologies, methods and techniques.

Creative holism is concerned with pluralism at both the methodological level, and the theoretical level. Pluralism respects the different strength of divers systems thinking approaches and encourages their theoretical development and suggests how they could be appropriately tailored to different problem situations.

Talisse & Aikin (2005) discuss three different types of pluralism:

1. *Shallow pluralism*: Truth cannot be judged, so differences should be tolerated.

2. *Deep pluralism*: Conflict is endless, there is no moral reason to adapt any particular view so the only prescription is to secure or defend one's value using power.
3. *Modus vivendi pluralism*: "Live and let live politics" by "(a) ignoring and remaining indifferent towards competing values or by (b) recognising and respecting the competing values".

Although they argue that the only meaningful and correct pluralism is deep pluralism that has incompatible doctrines with pragmatism, it does not seem that creative holism has adopted that type of pluralism as its central worldview, which "takes power as its main condition for decision, not reason or rational persuasion"(Talisie & Aikin, 2005).

The specific worldview adopted for this research is pragmatism. It means that, unlike deep pluralists, the researcher doesn't believe that, in an absolute sense, the truth doesn't exist and disagreement and conflict are always towards the world, rather than human's mistakes or moral weaknesses. The anticipation to find the truth using any practical tools and techniques, and the strategy of inquiry, is the main ethos of this research.

It can be argued that the type of pluralism that Jackson (2003) is supporting for creative holism is modus vivendi pluralism type (b). Talisie & Aikin (2005) and Misak (2005) believe that other types of pluralism rather than deep pluralism are not incompatible with the pragmatism worldview. Misak (2005) believes that pragmatists like pluralists "can and must celebrate and encourage the diversity of views".

It can also be shown that contemporary pragmatists are not eschewing theories anymore. "Contemporary pragmatists often maintain that their doctrine is intrinsically allied with pluralism" (Talisie & Aikin, 2005). And the following definition of pragmatism by Hevner & Chatterjee (2010) confirms this to some extent: pragmatism argues that theories and useful artefacts (truth and utility) are equally important. In other words, "the practical relevance of the research result should be valued equally with the rigor of the research performed to achieve the result".

The above argument supports the view that the adopted worldview and systems approach are not intrinsically in conflict, and a pragmatist can still use the creative holism systems approach.

### 3.3 DESIGN SCIENCE RESEARCH

Having the pragmatic worldview, an inquiry method should be chosen in line with the pragmatism philosophy.

Simon (1996) in his book “The science of the artificial” tries to draw a distinct line between the natural and artificial worlds and their relative sciences. He states that natural sciences try to show how the world can be understood, to reveal hidden patterns and to show that “complexity has been woven out of simplicity”. Natural science methods of analysis do not particularly focus on purpose or adaptation. They are concerned with “how things are”. On the other hand, artificial science is more concerned with purpose and objectives. The science of the artificial (which is also known as “design science”) tries to combine “the objects and phenomena in which human purpose as well as natural law are embodied”. Design sciences are concerned with “how things ought to be, with devising artifacts to attain goals.”

Behavioural sciences and design sciences are the two corresponding paradigms that Information System (IS) research has used to generate knowledge. Behavioural sciences, which have their roots in natural sciences and try to find the truth, start with a hypothesis and then the research efforts revolve around proving or disproving the hypothesis. On the other hand, design science is a problem-solving paradigm and its main objective is to produce, build and evaluate an artefact (Hevner & Chatterjee, 2010).

Having studied different quantitative and qualitative research methodologies in the behavioural science paradigm, particularly archival research, case study, ethnography, action research and grounded theory (Ghauri & Gronhaug, 2010; Saunders, Lewis & Thornhill, 2012; Creswell, 2008) and a number of approaches in the design science paradigm (Hevner, March, Park, *et al.*, 2004; Venable, 2006; Peffers, Tuunanen & Gengler, 2006; Mckay, Marshall & Heath, 2008; Miah, Gammack & Kerr, 2012), the researcher came to the conclusion that the nature of this research is more in line with the design science research paradigm. This research

has a problem solving approach and is trying to develop an artefact that can, to some extent, solve the identified problems.

Hevner (2007) claims that design science research method has a pragmatic nature and he associates it with pragmatic philosophy.

“Design science research is a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence. The design artefacts are both useful and fundamental in understanding that problem” (Hevner & Chatterjee, 2010).

According to the DSR method, the focus of the research is on the problem to be solved and the artefact that needs to be produced, implemented and evaluated. In the evaluation step, the extent to which the problem has been solved and the objectives have been met will be analysed and evaluated.

The work of Hevner, March, Park, *et al.* (2004) sets the de facto benchmark of the DSR in IS. This paper has been one of the most influential works in this field and has developed a framework and guidelines for performing and reporting design science research. (Venable, 2010)

Despite its great importance and influence, the work of Hevner, March, Park, *et al.* (2004) has been criticized for being too “mechanistic”, “focused on a narrow, functionalist nature of research” (Venable, 2010) and “having an exclusive focus on technical artifacts” – IT artefacts versus IS artefacts – and forgetting the socio-technical nature of most of the problems in the IS domain (Venable, 2010; Mckay, Marshall & Heath, 2008)

Peffer, Tuunanen & Gengler (2006) have introduced a process model for applying the design science research method in the information system research paradigm. They have considered the following points as the main objectives of their conceptual process (Peffer, Tuunanen & Gengler, 2006):

1. Creating a nominal process for performing design science research
2. Being compatible and consistent with the prior DSR theory and practices
3. Providing a mental model for the characteristics of DSR outputs

This process model consists of the following steps (Peffer, Tuunanen & Gengler, 2006):

1. *Problem identification and motivation*: In this step, a research problem is identified and the value of a solution to that research problem is justified. Resources required for this step are knowledge of the state of the problem and the significance of its solution.
2. *Objectives of a solution*: In this step the objectives of a solution are derived from a defined research problem. The objectives can be quantitative, in terms of how much the proposed solution is better than current solutions, or qualitative, if the created solution is trying to answer a research problem that has not been previously addressed. So the required resource for this step is knowledge of the state of the problems and the efficacy of the available solutions if any exists.
3. *Design and development*: The third step involves designing and developing the artefactual solution. The solution should be designed and architected, and then developed, using the available sound theories. Therefore the required resources for this step are knowledge of theory such that the solution can be developed on its bases.
4. *Demonstration*: In this step, the value of the solution artefact should be demonstrated using simulations, case studies, experimentation, or proof. Required resources for this step are knowledge of how to use the solution artefact to address the research problem.
5. *Evaluation*: At this stage, the results of the demonstrated solution will be evaluated to see how well the artefact supports a solution to the research problem. At the end of this step, the researcher might decide to go back to step 3 and improve the effectiveness of the artefact, or leave further improvement to other research projects.
6. *Communication*: In the final step, the problem and its importance, and the solution artefact and its original contribution, design accuracy and its usefulness to the community of researchers are disseminated.

Figure 4 depicts the design science research methodology process model put forward by Peffer, Tuunanen & Gengler (2006).

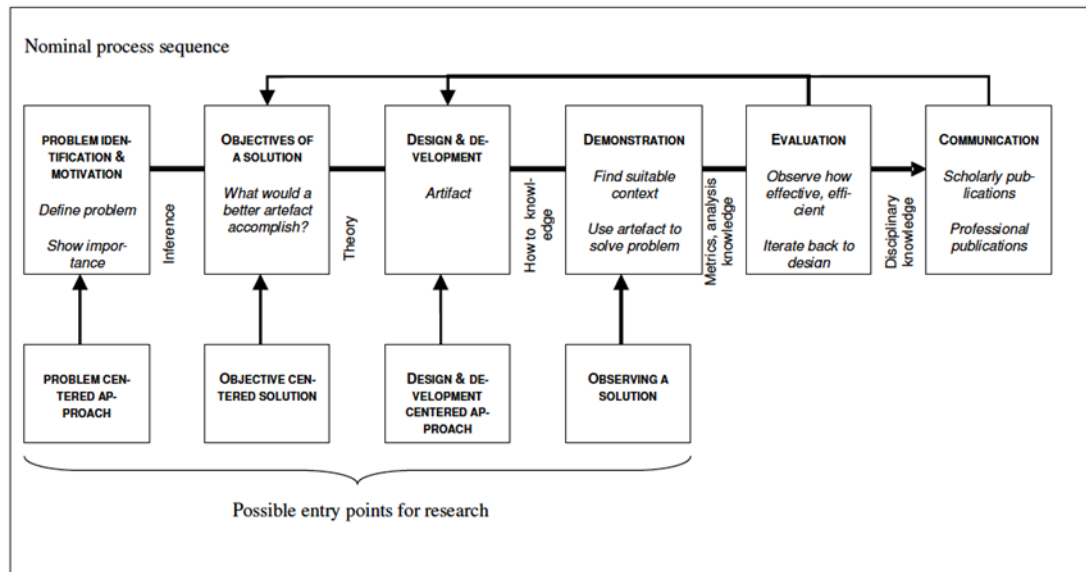


Figure 4. Design science research method cited in Peffers, Tuunanen & Gengler (2006)

Peffers, Tuunanen & Gengler (2006) have used the conceptual process introduced in their paper to produce the paper itself. In the evaluation phase they have presented the extent to which they have been successful in achieving the objectives of their solution mentioned in the above paragraphs. Particularly, they have discussed how their approach is consistent with DSR theories not only in IS but across disciplines.

It can easily be established that Peffers, Tuunanen & Gengler's (2006) conceptual process has not only been developed by leveraging the framework and guidelines introduced by Hevner, March, Park, *et al.* (2004). This process model has been shown to be consistent with wider DSR theories and techniques and it has also been well demonstrated not to be bound to designing IT artefacts (Peffers, Tuunanen & Gengler, 2006; Peffers, Tuunanen, Rothenberger, *et al.*, 2007). Therefore, the criticisms of the work by Hevner, March, Park, *et al.* (2004) do not apply to this process model.

The artefact of this research, which is a conceptual framework for extracting business processes from conversation logs in pluralist and coercive problem contexts, can definitely be considered more an IS than an IT artefact and therefore, following the above discussion, Peffers, Tuunanen & Gengler's (2006) conceptual process model seems like a good fit for the purpose of this research.



### 3.4 DESIGN OF THE RESEARCH

Using Peffers, Tuunanen & Gengler (2006) conceptual process model for DSR, this research has been designed in the following steps:

1. *Problem identification and motivation and objectives of a solution:* The first two steps of DSR have been covered in chapters 1 and 2. In chapter 1, the context of the study was introduced, the aims and objectives of the research were presented and the significance of the study was discussed. In chapter 2 conventional BPM, its lifecycle and related concepts, definitions and techniques were introduced and their shortcomings and problems debated and analysed.
2. *Design and development:* This step of DSR will be covered in chapter 4. In this chapter, the theoretical foundations of the solution will be laid, and the proposed conceptual framework for business process discovery and its concepts and definitions based on those theoretical foundations will be put forward. Following this a method based on the proposed conceptual framework will be designed and developed.
3. *Demonstration:* In chapter 5 the demonstration step of the DSR will be covered. In this chapter, using two case studies, the value of the new conceptual framework and its method as the artefacts of this research will be demonstrated.
4. *Evaluation:* The framework and its method, which are the artefacts of this research, will be evaluated in chapter 6 and the extent to which the research objectives have been met will be argued.
5. *Communication:* This is the last step of DSR according to the Peffers, Tuunanen & Gengler (2006) process model, will be covered by publishing this thesis and some other research papers.

### 3.5 CHAPTER SUMMARY

In this chapter the pragmatic worldview was introduced as the researcher's adopted worldview and creative holism as the adopted systems approach for analysing organisations as a social system. The compatibility of pragmatism and creative holism that has pluralism at its core was also discussed. Design science

research (DSR) as a pragmatic methodology was introduced as the research methodology and the design of the research using this methodology was elaborated.

The next chapter will cover the third step of the DSR methodology that is the design and development of the solution. In that chapter the theoretical foundations of the solution will be laid, and the proposed conceptual framework for business process discovery and its concepts and definitions based on those theoretical foundations will be put forward. Following this, a method based on the proposed conceptual framework will be designed and developed.

# Chapter 4: Design and Development of a Solution

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## 4.1 INTRODUCTION

This chapter covers the design and development step of the Peffers, Tuunanen & Gengler (2006) process model for DSR methodology. It will discuss the design and development of the solution based on sound theoretical foundations to achieve the aims and objectives of the research. As was discussed in chapter 1 a new definition of a business process and business process model will be proposed first, and then, based on those definitions, a conceptual framework will be developed for business process discovery in pluralist and coercive problem contexts.

Section 4.2 introduces the theoretical bases on which the solution will be built. The following points and concepts will be discussed in this section:

- The importance of people and their interaction and collaboration in business processes and business process modelling: migrating from a sequence of tasks to a sequence of collaborations and dependencies
- The main means of collaborations in organisations
- The proposed new definition for a business process and a business process model in pluralist and coercive problem contexts
- Conversation logs, a new information source for business process discovery

Section 4.3 presents the conceptual framework using the proposed new definitions and introduces the framework's data source and techniques and heuristics for business process discovery.

Section 4.4 demonstrates how a method can be derived from the proposed conceptual framework that uses email messages as a data source. This section elaborates on the method's steps and outlines a number of tools to facilitate the application of the method in real-world process discovery endeavours.

The key artefacts of this research according to DSR methodology are the conceptual framework and its method.

## **4.2 THEORETICAL FOUNDATIONS**

In this section the theoretical foundation of the proposed conceptual framework will be laid. At the beginning, the advantages of adopting creative holism (Jackson, 2003) as the systems approach will be discussed, and after that concepts and definitions from the Viable System Model (VSM) (Espejo & Reyes, 2011), i\* framework (Yu, Giorgini, Maiden, *et al.*, 2011), Conversation for Action theory (Winograd & Flores, 1987) and Episodic Memory (Hasselmo, 2011) will be introduced and used to develop a new definition for business processes and business process models. These definitions will then form the basis of the proposed new conceptual framework and its method.

### **4.2.1 Organisations as social systems and creative holism**

In the literature review section the SOSM methodology (Jackson & Keys, 1984) was introduced and it was discussed how different systems approaches can be classified according to the ideal-type problem contexts. It was also discussed how an organisation as a social system can be analysed using different system metaphors and sociological paradigms. Then creative holism (Jackson, 2003) was briefly introduced and it was discussed that this approach believes that, in order to be able to understand the reality of the current situation of an organisation, a plurality of system approaches, their methodologies and system methods should be used. This approach also argues that an organisation should be analysed from different perspectives by using all the different system metaphors and sociological paradigms. As a result one would argue that the adopted system approach, and the perceived problem context, has a great impact on the business analysis techniques selected for business process discovery.

Creative holism has been adopted for approaching the problem of understanding the current situation of the organisation for business process discovery. Adopting creative holism as the system approach has got two important advantages (Jackson, 2003):

1. It acknowledges the value of all conventional business analysis tools and techniques. This means all different business analysis tools and techniques that work in different problem contexts (including the proposed framework) are of great value, and should be used in conjunction with each other to give a better understanding of the current situation of the organisation.
2. It enables the researcher to use the definitions, methods and tools created for different paradigms and problem contexts, although they may seem incommensurate and different paradigmatically and metaphorically.

Having the above two important facts as the starting point, the following subsections develop the theoretical foundation of the new conceptual framework by leveraging different sound theories and techniques.

#### **4.2.2 Business processes: from a sequence of tasks to a sequence of collaborations and dependencies**

In this subsection the Viable System Model (VSM) (Espejo & Reyes, 2011) definition of the organisation will be introduced and then i\* framework (Yu, 2011) definitions will be presented and finally two new BPMN models (Briol, 2010) - choreography and conversation models will be discussed. This subsection is trying to demonstrate that the BPM world's business process definition is gradually moving from "a sequence of tasks and decision points" to a more complete definition that is actually people centric and involves people and their collaborations and interactions and is closer to the reality of the organisation and how people carry out their day-to-day jobs.

##### ***4.2.2.1 Organisations as a closed network of collaboration***

Considering the organisation as a social system, and analysing it from different sociological paradigms, and using different metaphors, it can be realised that the common denominator of all their definitions of an organisation is a whole that its constituents are in some sort of relationship, interaction and collaboration, which have certain characteristics and can be distinguished from their environment (Espejo & Reyes, 2011).

Espejo & Reyes (2011) argue that organisations materialise when their constituent members "produce a closed network of recurrent interactions or

relations”. These interactions can be everyday *conversations* or an indirect coordination of actions, as a result of a shared common context. They believe through interaction, people coordinate their actions and assign meaning to them.

#### **4.2.2.2 i\* framework**

Yu (2011) in his work, “Modelling Strategic Relationships for Process Reengineering”, introduces the i\* framework. He states that the “i\* offers a framework for modelling, analysing, and designing business processes in terms of intentional, strategic actor relationships”. He believes that the conventional modelling notations do not contain all the knowledge that is needed for a complete understanding of the business processes. These models only answer the “what” questions about the business processes not the “whys”.

The central unit to be modelled in i\* framework is the intentional, strategic, autonomous actor who, in relationship with other actors, and by considering different dependency configurations based on different short-term and long-term factors, fulfils his or her own goals and responsibilities. An intentional actor does not mechanistically carry out tasks and produce entities, but according to his motivations, intentions and rationales, chooses a different relationship configuration with other actors to fulfil an objective (Yu, 2011).

Yu (2011) believes: “Organisations are made up of social actors that have goals and interests which they pursue through a network of relationships with other actors...*A richer model of a business process should therefore include not only how work products progress from process step to process step, but also how the actors performing these steps relate to each other intentionally.*”

#### **4.2.2.3 Object Management Group (OMG) realisation of the importance of collaboration and interaction and addition of choreography and conversation diagram to BPMN 2.0**

It seems that the Object Management Group (omg.org) has also realised the importance of the collaborations and conversations in understanding the business processes of an organisation, and its latest version of business process modelling notation BPMN 2.0 (Omg.org, 2011) has introduced these two new diagrams:

- a. Choreography diagram
- b. Conversation diagram

These two models quite significantly move away from only modelling tasks, events and decision points towards modelling people's conversations and collaborations to achieve the business goals.

Briol (2010), in his book "*BPMN 2.0 Distilled*", introduces the choreography diagram as "definitions of expected behaviour as procedural contract between interacting participants". He also states that the meaning of an activity changes from its conventional meaning to "an interaction representing a set of one or more message exchanges between two or more participants ... The choreography diagram defines the interaction's sequence between participants". He also defines the conversation diagram as an abstract view of the conversations that are relevant to the domain that is being modelled.

Briol (2010) suggests that business process modelling efforts should start by modelling the conversations to define the big picture. Then choreography diagrams should be created to elaborate the interaction between people and lastly conventional business process models should be created to flesh out the business process for each participant. The complete definition of BPMN 2.0 modelling notations, including Choreography and Conversation models can be found on the OMG website(Omg.org, 2011).

So the paramount characteristic of organisations is their constituents' recurrent patterns of relation, collaboration and interaction; and business processes within these organisations are the dependencies that these constituents create intentionally on each other through interactions and collaborations to achieve their goals and objectives.

### **4.2.3 Conversations: the main means of collaboration and dependency creation**

In this subsection, conversations will be introduced as the main means of collaboration and dependency creation in organisations. It will also be argued that for process discovery, one of the best data sources can be a logged history of organisational conversations.

Flores & Ludlow (1980) argue that human beings are linguistic beings. They not only exchange information using language, but they also perform actions using it, like: promising, declaring, ordering, etc. (Schoop, 2001).

Language action's main focus is on what people do when they communicate, how language is used for the creation of a common understanding of the world in which the communication partners are communicating, and also how language helps them coordinate their activities. Here the emphasis is on the pragmatics of the language. It means: to understand how language is used in a specific situation to achieve an objective. The Language Action Perspective (LAP) is based on Searle's speech act theory as the philosophical foundation (Schoop, 2001) (see section 4.2.3.2).

#### **4.2.3.1 *Speech act theory***

According to Searle (1969), a speaker performs three different acts by saying a sentence:

1. Utterance, which is the act of saying something (saying a sentence).
2. Propositional act, which is referring and predicating.
3. Illocutionary act, which is the complete speech act containing the utterance, propositional act and, in addition to them, the way it is uttered such as a promise, request, order etc.

So the main components of an illocutionary act are

1. Propositional content
2. Illocutionary force

Searle (1969) categorises the illocutionary forces into 5 categories:

1. *Assertives*: The illocutionary point is to convince the hearer about the truthfulness of the expressed proposition.
2. *Directives*: The illocutionary point is to get the hearer to do something.
3. *Commissives*: The illocutionary point is to commit the hearer to some future course of action.
4. *Expressives*: The illocutionary point is to express the speaker's feelings or psychological attitude about the state of the propositional content.
5. *Declaratives*: The illocutionary point is changing the state of the world through utterance of the speech act.



### 4.2.3.2 Conversation for action theory

Winograd & Flores (1987) put forth the conversation for action theory based on Searle's speech act theory or, in the computer science world, the language action perspective (LAP). They argue that business processes are networks of conversations that are happening inside and outside the organisation about the organisational goals. They introduce the conversation for action diagram (See Figure 5) and believe that almost every network of conversation for action happens according to the pattern introduced in that diagram. They believe that "speech acts are not individual unrelated events, but participate in large conversational structures" (Winograd, 1988).

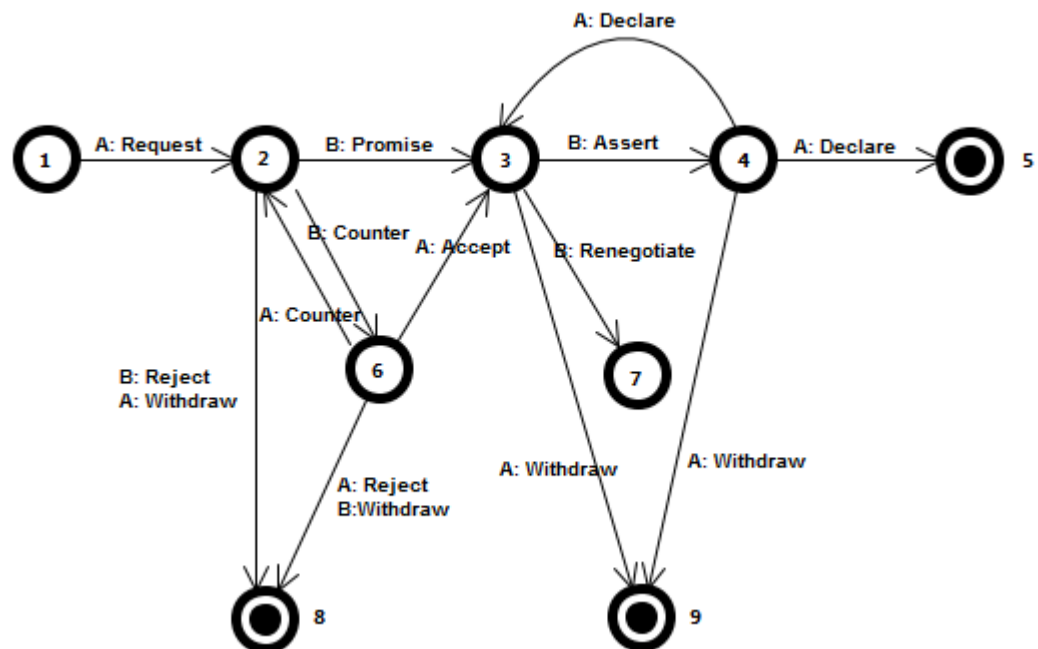


Figure 5. Conversation for action diagram cited in Winograd & Flores (1987)

### 4.2.4 Definition of business processes and business process models using collaboration and conversation as the main construct in the unitary problem context

Adopting the definition of a business process based on the conversation for action theory, that is: networks of conversations that are happening inside and outside the organisation about the organisational goals (Winograd & Flores, 1987) and the definition of an activity from Briol (2010): "an interaction representing a set of one or more message exchanges between two or more participants" and accepting the i\*'s perspective about business process participants that is: the intentional,

strategic, autonomous actor who, in relationship with other actors, and by considering different dependency configurations based on different short-term and long-term factors, fulfils his or her own goals and responsibilities (Yu, 2011), the following definition can be created for business processes in the unitary problem context:

***A business process in a unitary problem context is a sequence of interactions and collaborations and dependencies between process participants, through exchanging messages, to achieve a particular business goal.***

The reason that this definition is still bound to the unitary problem context based on SOSM (Jackson & Keys, 1984) is that the definition is still assuming that the process participants:

- Have similar values, beliefs and interests.
- Share common goals and objectives.
- Are all involved in decision-making about how to achieve the common goals and objectives.

Being in the unitary problem context has an advantage for the business process models. As shared goals and objectives exist and all the participants have been involved in decision-making, the interactions turn into expected behaviours that follow a pattern like a procedural contract.<sup>1</sup> This means by analysing enough instances of the business process and finding the similar patterns, a model can be created that represents the future instances of that business process. So a business process model is a unified representation of the business process, something like a blueprint that the future instances of the business process can be created from. In this definition participants can be categorised in roles and instances can be unified in a model.

Figure 6 shows a simplified model of a business process in the unitary problem context. It shows that the participants are collaborating in a pre-defined sequence ( $C_1$  to  $C_n$ ) to achieve a common business goal (G).

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<sup>1</sup> Briol (2010) defines a choreography as a concept that “describes the definition of expected behaviour as a procedural contract between interacting participants”.

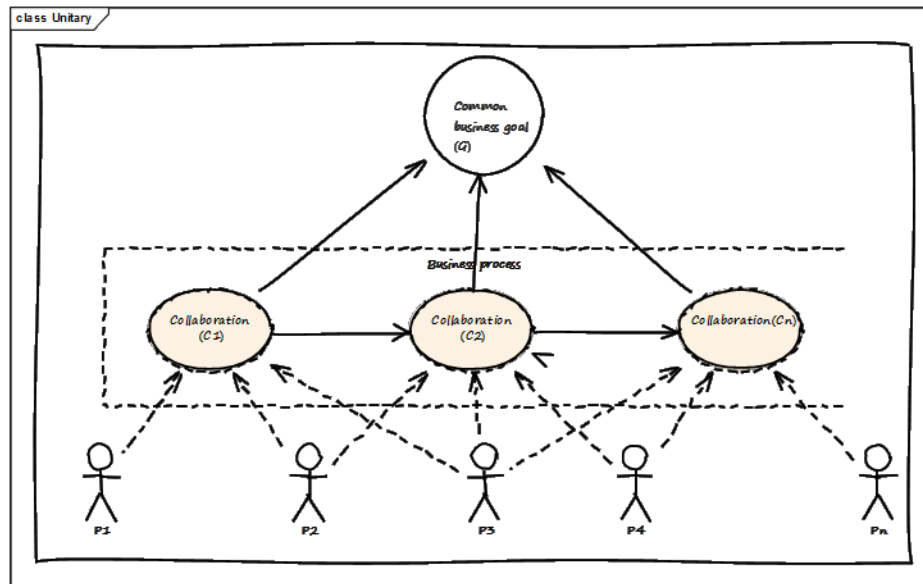


Figure 6. A business process in unitary problem context

#### 4.2.5 Definition of business processes and business process models in pluralist and coercive problem contexts

In order to apply the definition of the business process in pluralist and coercive problem contexts, the pre-assumption of shared goals and objectives and participation of everyone in decision making should be removed based on SOSM (Jackson & Keys, 1984). As was mentioned in section 2.2, the participants in pluralist and coercive problem contexts have the following characteristics:

In pluralist problem context:

- Participant's basic interests are compatible but
- Participants don't share the same values and beliefs but
- If space has been made available within which participants can have debates, argument, conflict and disagreement and they feel that they have been involved in the decision making, then accommodation and compromises can be found and they are happy to agree on productive ways forward towards the temporarily agreed goals and objectives.

In coercive problem context:

- Participants have few common interests
- Compromise is not possible for participants
- Participants have no agreed common goals

- Decisions are taken by participants based on power differential

These new assumptions change the business processes to look something like the diagram depicted in Figure 7:

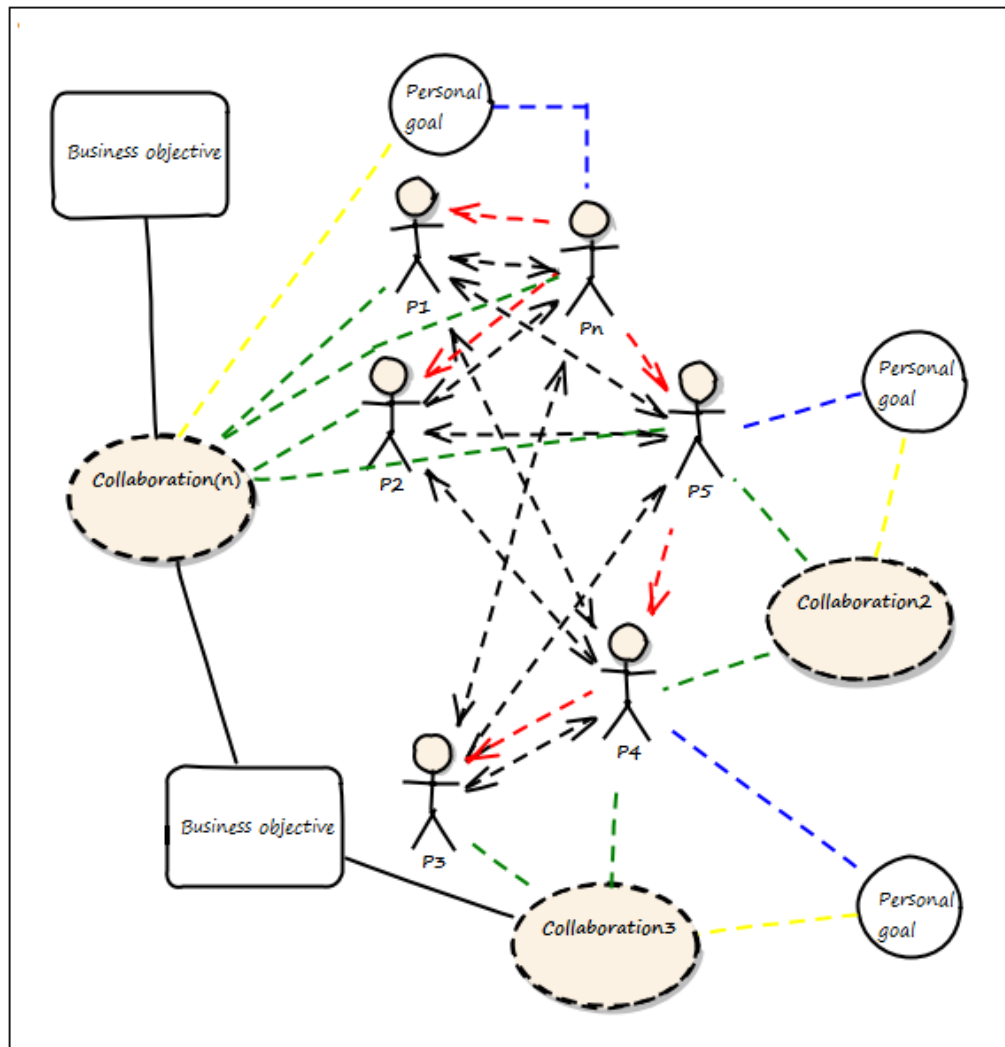


Figure 7. Business processes in pluralist and coercive problem contexts

Figure 7 illustrates that not only a number of common business goals exist but also personal goals and distribution of power have a great impact on the collaborations and interactions. The red arrows show the influence of power, so for example Figure 7 shows that Pn is influencing P5, P2, P2 to collaborate to achieve his or her own personal goal as well as a business objective, black arrows show dependencies so it can be seen in Figure 7 that all participants have some kind of dependency on each other, green lines show participation in collaboration around personal or business objectives. Collaboration can be influenced by power and can happen around personal goals, business objectives or both.

Figure 7 illustrates that in pluralist and coercive problem context all people has some kind of dependency on each other. It also shows for instance that collaboration(n) has been formed to achieve two business objectives and the personal goal of Pn. It shows that people who are collaborating, which are P1, P2, P5 and Pn, to achieve collaboration(n)'s goals and objective are directly influenced by Pn power as well. Therefore, each collaboration about a specific subject matter that has been created by participants to achieve their goals (business and personal); can be considered a piece of the final business process that will be completed at infinity when all of these collaborations and dependencies have been materialised. This means, due to the dynamic nature of interactions, collaborations, and goals around the subject matter – and also the distribution of power, in each interaction, at each moment of time, an incomplete picture of the business process model can be drawn which is a compilation of all those pieces.

So the definition of a business process changes to: *sequences of collaborations for achieving personal and business goals relevant to the subject matter under investigation based on personal intentions and motivations and distribution of power. The ultimate business process forms when all instances of collaboration around the subject matter have been materialised and at each moment of time before then, only a business process fragment is at hand.*

This new definition of the business process is in line with i\* framework's (Yu, 2011) definition of an organisational actor which is the central unit of all their models:

An intentional, strategic, autonomous actor who, in relationship with other actors, and by considering different dependency configurations based on different short-term and long term factors, fulfils own goals and responsibilities. An intentional actor does not mechanistically carry out tasks and produce entities, but according to his motivations, intentions and rationales, chooses a different relationship configuration with other actors to fulfil an objective. (Yu, 2011)

The definition of a business process model should be changed according to the definition of a business process.

It can be concluded that every instance of collaboration around the subject matter under investigation will be unique. This is due to the continuous changes of

specific actors, their purposes, goals and objectives, environment, and system configuration and also power distribution.

Therefore, in pluralist and coercive problem contexts, the process model should not be reduced to time-framed similar patterns, as the next instance can completely negate the previous observations. It means at each moment of time, an incomplete snapshot of the current business process model will be at hand that is a compilation of collaboration instances. The business process model will be completed at infinity when all the instances (executions) have been gathered.

Hence, the business process model definition in pluralist and coercive problem contexts is:

***Compilation of all instances of “sequences of collaborations” – the new activity or business task definition – for achieving personal and business goals relevant to the subject matter under investigation based on personal intentions and motivations and distribution of power.***

Due to the dynamic nature of the business process definition, the ultimate business process model is formed when all instances of the collaboration have been modelled, so at each moment of time, the extracted model is a snapshot of the *evolving business process model* and represents a *business process fragment*.

Schumm, Karastoyanova, Kopp, *et al.* (2011) define a business process fragment as “a connected process structure with significantly relaxed completeness and consistency criteria compared to an executable process graph.” They argue that the concept of a business process fragment has started to attract a lot of attention in BPM research and they also claim that these process fragments make the development of process-based applications easier and faster.

In their paper, Schumm, Karastoyanova, Kopp, *et al.* (2011) confirm the importance of business process fragments and illustrate by examples that although business process fragments are not complete or consistent enough to be executed but they are of great value in developing process-based applications.

In pluralist and coercive problem contexts, the reason for extracting business process fragments (according to their new definition) might not be the development of a process based application but these constructs can help the analyst understand the current situation of the organisation better and with this understanding guide

them through the process of creating a support system for parts of their processes if necessary.

It is worth mentioning here that the definition of business process in pluralist and coercive problem contexts is compatible with the business process definition in the unitary problem context. In other words, if we reduce the number of business goals to one and ignore the personal goals, and intentionality and autonomy of the participants, the business process will turn to a compilation of repetitive sequences of collaboration, to achieve a business goal, and, because it is repetitive, the unified business process model can be created in each moment of time, by finding the pattern of repetition after gathering enough process instances.

#### **4.2.6 From human memory to a more reliable source of information: conversation logs**

As was mentioned in chapter 2, human memory and cognition limitations have always been one of the important shortcomings of the conventional business analysis techniques even with their functionalist approach towards analysis of the organisation (Anthony, Cossick & Zmud, 1992; Aalst, 2003; Cadle, Paul & Turner, 2010; Harris & Brown, 2010).

Even the *i\** framework that started to work in the pluralist problem context by talking about strategic, intentional, and autonomous agents who have different goals and objectives, as it is still focused on human memory for the source of information, it has eventually ended up being used mostly as a requirement engineering technique, which is clearly about the ideal situation rather than as-is or, in other words, process discovery. People usually talk about their ideal situation or what is expected from them rather than the reality of the situation. This fact has been deduced from the application of the *i\** framework mentioned in Yu, Giorgini, Maiden, *et al.* (2011) and a number of publications mentioned in *i\** wiki (2013) about its use in requirement engineering and business process analysis, which shows vividly that this framework has been adopted more for requirement engineering than business process analysis in real life.

The above points support the idea that the source of data that is being used for process discovery has a great impact on the success or failure of this effort. In the following paragraph, using episodic memory, it will be shown what conventional techniques have been trying to extract about business processes from human memory

and it will be discussed if the same information can be extracted from a different data source.

Hasselmo (2011) in his book, *How We Remember: Brain Mechanisms of Episodic Memory* introduces the episodic memory. He believes that most of the times when we think of an individual memory we are thinking of this type of memory. The term “remember” usually refers to retrieval of the episodic memory. The term ‘episodic memory’ refers to the memory of events happening in a specific place at a specific time.

Hasselmo (2011) introduces different types of memories and contrasts the episodic memory against them:

1. *Semantic memory*: Memory for general facts and world knowledge like the memory of London being the capital of the United Kingdom.
2. *Working memory*: Actively keeping recent information in memory
3. *Procedural memory*: Memory of how to do things (e.g. how to brew coffee).
4. *Episodic memory*: Memory of events happening in a specific place at a specific time (e.g. remembering an event in London like going up in the London Eye).

He states that there is a general acceptance that the question: “What did you do at Time T in Place P” (Tulving, 1984) is a retrieval query directed at the episodic system of the brain.

Other qualities of the episodic memory have been discussed by other researchers such as Conway (2009). He believes that “visual episodic memories represent short time slices of experience with beginning and end points, often related to achievement of a specific goal”.

There is a popular view about knowledge acquisition, which can be considered one of the main tools that business analysts use for learning about the current situation of the business processes. That is, “expert’s minds are filled with nuggets of information about their specialised domains. The knowledge engineer then mines these nuggets of knowledge from the head of the expert, one nugget at a time” (Anthony, Cossick & Zmud, 1992).



This view may not be fully complete or comprehensive, but it directed the research to try and find the answer to the following questions: how the knowledge engineers or business analysts try to mine or extract the knowledge out of the expert's head. What type of questions do they usually ask and if there are any commonalities between these questions.

By analysing different conventional techniques such as interviews, questionnaires and even workshops it has been concluded by the author that almost all of them are trying to ask people to remember how they carry out their day-to-day jobs. They are actually asking different alternatives of the same question: "What have you been doing at time T in place P," and as discussed in the previous paragraphs, this is the retrieval query for episodic memory (Tulving, 1984). And interestingly, the answers to the kinds of questions that are directed towards the episodic memory are "short time slices of experience with beginning and end points often related to achievement of a specific goal" (Conway, 2009).

The answer to the retrieval query for episodic memory that is "the short time slices of experience with beginnings and end points related to achievement of a specific goal" (Conway, 2009) is very close to the definition of *a fragment of a business process instance* according to the conventional definition of a business process. It defines a process because it has a beginning and an end, it shows what happens from the beginning to the end and it is related to achieving a specific goal, more specifically it defines a "process instance" because it is an experience, it is not abstract, and finally it defines a "fragment" of the business process instance, because it is a short time slice of experience.

Another interesting point is that because the question is usually asked in a generalised form: "What do you do in your day-to-day job?", people's minds process the outcomes of their episodic memory and creates a more generalised answer. It means that they remember several fragments of business process instances, try to find similar patterns between them, turn them into a more holistic process, and describe it in an abstract way. So they try to create a business process from those fragments of business process instances in their minds, and that is when the whole problem occurs, as follows.

- Bias in selecting the fragments of business process instances

- Incorrect generalisation
- Forgetting important steps
- Forgetting a lot of the important fragments and instances
- Incorrect or even forced pattern matching between fragments of business process instances

Therefore, the outcome of such questions are usually subjective, poorly created and incomplete business process models that the business analyst bases his business process models on.

It was explained in the previous section that in pluralist and coercive problem contexts each instance of the business process is of great importance and value so apart from the shortcomings of the human memory and cognition, the type of questions that the business analyst used to ask that made the participant turn the instances into an unrealistic model has been a problem as well and has had a great impact on the incompleteness and unreliability of the results.

It was clarified in the previous sections that the concept of an autonomous, intentional being is the central concept of business processes in pluralist and coercive problem contexts, so a source of information should be used that is created by people but suffers to a lesser extent from the human memory and cognition shortcomings and is close to the realities of how people carry out their day-to-day jobs. The extracted information from this data source should be reliable, impartial and correct.

Having these two concepts in mind from the previous section,

- Organisations as a closed network of relation
- Business processes as the network of conversation inside the organisation

and also the new definitions for activity, business process and business process models, “the conversation logs” or “conversation histories” of an organisation seem like a good and viable source for extracting the instances of collaboration as the most granular unit that can be extracted in pluralist and coercive problem domains and can be used as the main construct of the business processes.

Conversation logs (such as emails)

- Have been created from people’s interactions and collaborations

- Persist how people carry out their tasks (business activities – with the new definition)
- Show how people rely on each other to achieve an objective
- Are impartial as they represent the reality of the interactions

So the required knowledge of the business processes – according to the new definition of the business process – can be acquired from the conversation logs as the new source of information.

### **4.3 PROPOSED CONCEPTUAL FRAMEWORK FOR BUSINESS PROCESS DISCOVERY IN PLURALIST AND COERCIVE PROBLEM CONTEXTS**

In this section the proposed conceptual framework for process discovery in pluralist and coercive problem contexts will be introduced. Firstly, the adopted definitions for activity, business processes and business process models will be discussed, and then the conceptual framework's preferred data source will be presented and finally the conceptual framework's technique for extracting business processes and creating business process models from its preferred data source will be explained.

#### **4.3.1 Conceptual framework's concepts and definitions**

It was discussed in the previous section that it is being realised by theorists in the BPM field that business processes are more about people and their interactions and business process models should illustrate these interactions and collaborations to be a closer abstraction to the reality of the organisation (Yu, 2011; Briol, 2010; Winograd & Flores, 1987). According to these facts and discussions that were presented in the previous section (4.2 Theoretical foundations) the following list outlines the new conceptual framework's definitions for relevant concepts in the BPM's business process discovery phase:

- *Activity (AKA business task)*: The Briol (2010) definition of activity for choreography diagrams has been adopted for this conceptual framework: "An activity is an interaction representing a set of one or more message exchanges between two or more participants."

- *Business process*: As the framework is to be applicable in pluralist and coercive problem contexts, a business process definition should be adopted that is not bound to the unitary problem context. Therefore, as was discussed in the section 4.2.5 the following definition has been adopted for a business process: “Business processes are sequences of collaborations – the new activity or business task definition – for achieving personal and business goals relevant to the subject matter based on personal intentions and motivations and distribution of power. The ultimate business process forms when all instances of collaboration around the subject matter have materialised and at each moment of time before then, only a business process fragment is at hand.”
- *Business process model*: As was mentioned in section 4.2.5, based on the new definition of a business process, business process models are defined as: “*Compilations* of instances of sequences of collaborations and interaction (activities) for achieving personal and business goals relevant to the subject matter under investigation based on personal intentions and motivations and distribution of power.” One important point about this definition is that the instances cannot be reduced to a unified model as, due to the dynamic nature of the process definition, each instance will be different and they don’t follow a pre-defined pattern. So the model is a set of distinct instances. Another important point about this definition is that at each point of time we will only have an incomplete model based on the extracted instances and the complete model only forms when all instances have been extracted. This incomplete model is a fragment of the ultimate business process. Therefore at each moment of time, the created business process is a business process fragment. The importance of the business process fragments was discussed in section 4.2.5, where it was mentioned that although these fragments are not complete and consistent enough to be executed, they are of great value for understanding the current situation of the organisation.
- *Adopted modelling notation*: The BPMN 2.0 choreography diagram notation(Omg.org, 2011; Briol, 2010) has got all the elements needed for modelling the business processes based on the new definition. As was discussed in the previous section, this modelling notation is about modelling

interactions and collaborations between different process participants and it is exactly what is needed for this framework.

- *Data source:* As was discussed in subsection 4.2.6, conversation logs are a very good data source for extracting business processes. They are created by humans while collaborating and interacting and they don't suffer from a great part of the human memory and cognition limitations.

In the next subsection a technique will be proposed, based on the above definitions that can be used to extract business processes from conversation logs.

### **4.3.2 Proposed technique for business process discovery**

The proposed technique has been based around the concept of a dependency cycle. The dependency cycle concept has been developed from the definitions that were explained in the previous subsection in conjunction with the conversation for action theory and, more specifically, the conversation for action diagram and also the i\* framework's strategic dependency model. Strategic dependency models will be briefly introduced here and then the definition of a dependency cycle will be presented.

#### **4.3.2.1 i\* strategic dependency model**

“The Strategic Dependency model is a network of dependency relationships among actors” (Yu, 2011). Dependency means how a depender relies on a dependee for something (the dependum) to fulfil an objective or carry out a task that could not have been achieved or was hard to achieve without this dependency. Multi-level dependencies could exist, and if any of the dependees for some reason do not provide the dependum at any level, all the upper-level dependers will suffer. Several dependency types exist based on how dependers would constrain dependees' freedom, and the extent to which they are vulnerable in their dependency, and the type of the dependum. Dependency types that are based on dependum are as follows (Yu, 2011):

1. *Goal dependency:* In goal dependency, the depender relies on a dependee to achieve a goal or objective. The dependee is free to some extent to choose the methods or ways of achieving this objective.

2. *Task dependency*: In task dependency, the depender relies on the dependee to carry out a task. The depender specifies how the task should be carried out but not necessarily why.
3. *Resource dependency*: In resource dependency, the depender relies on the dependee to make a resource available. This resource can be a physical entity or an informational entity.
4. *Soft-goal dependency*: In soft-goal dependency the depender relies on the dependee to carry out a task that meets a soft-goal. A soft-goal is usually a sort of attribute that the depender should have in mind, whilst pursuing the achievement of the objective. Examples of such attributes include fast, prompt, and so on.

Three types of dependencies exist based on the dependency strength (Yu, 2011):

1. *Open dependency*: In this type of dependency failure to obtain the dependum may have some impacts on the depender for achieving his goals, but the impacts are not serious.
2. *Committed dependency*: In this type of dependency the goal achievement process will be significantly affected if the dependee cannot deliver the dependum. The dependency is so strong that it cannot be reversed without a significant cost.
3. *Critical dependency*: In this type of dependency, if the dependee cannot provide the dependum, there is no other configuration of relationships available for the depender to achieve that particular goal. Hence, a depender is not only concerned about his own dependencies, but also the dependencies between all different levels, like dependee's dependencies and dependee's dependee's dependencies.

Figure 8, below, from the work of Yu, Giorgini, Maiden, *et al.* (2011), is intended to clarify the concept of a strategic dependency model. It illustrates how five different actors depend on each other to carry out their tasks and achieve their objectives. The main actors of this specific simplified scenario in the health care domain are: Patient, Physician, Insurance company, Lab and Claims manager. This strategic dependency model shows that the Patient has a goal dependency on the

Physician to be treated. A goal dependency has been chosen for this dependency because the Patient is relying on the Physician to find the most suitable method of treatment and is happy as long as the issue is being treated by medical methods. On the other hand, the Physician has a dependency on the Patient to take the prescribed medicine. Obviously the dependency type here is a task dependency as the Physician does care about how the Patient takes the medicine, but has specified how this task should be carried out (frequency, time intervals, period, etc.).

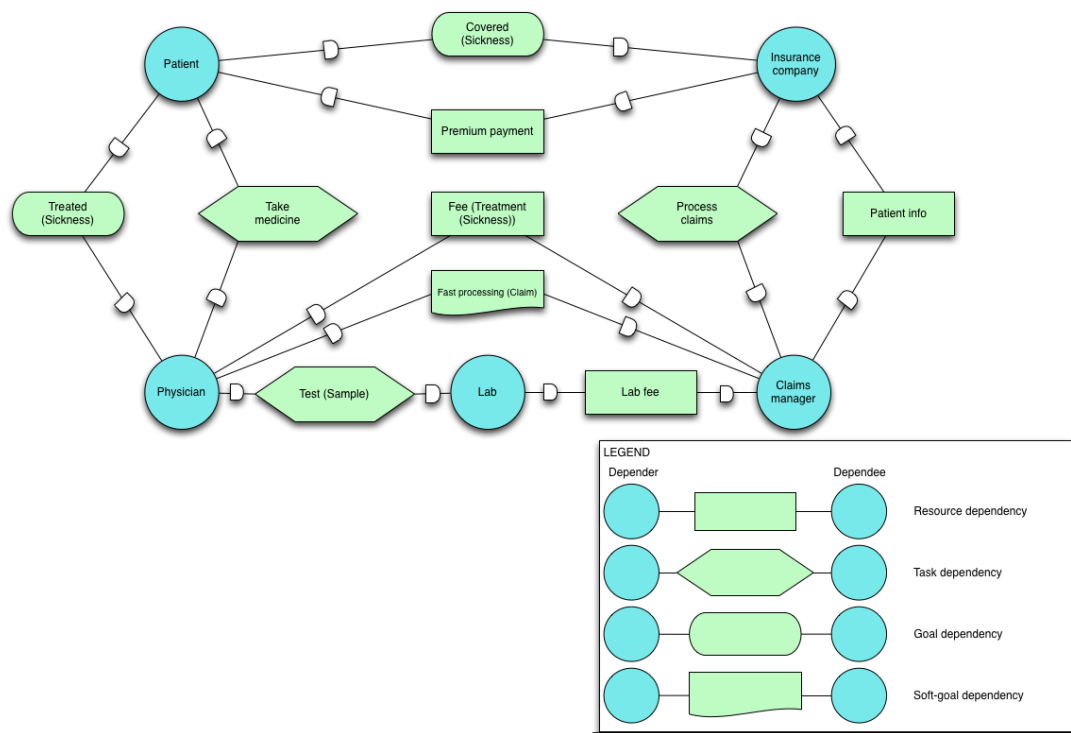


Figure 8. Strategic dependency diagram cited in Yu (2011)

The Patient has a goal dependency on the Insurance company to be covered, and the Insurance company has a resource dependency on the Patient for paying the insurance premium. As an example of soft-goal dependency, the Physician depends on the Claims manager to process the claims rapidly. These types of dependencies, which qualify the quality of a requirement and are non-functional, are called soft-goal dependencies.

#### 4.3.2.2 Definition of a dependency cycle

The  $i^*$  strategic dependency model (Yu, 2011) and conversation for action diagram (Winograd & Flores, 1987) – Figure 5 – have inspired the concept of a dependency cycle. The dependency cycles show how different organisational role

instances (people working in the organisation) depend on each other to fulfil an objective. The dependency cycles represent collaboration pieces as they show how people converse, and with conversing, how they depend on each other to fulfil their goals and objectives.

A dependency cycle starts with a request and ends with either a withdrawal, i.e. a rejection of the result, or a declaring of fulfilment of the objective of the dependency cycle, or in other words the dependum of the dependency cycle. Dependency cycles have the same types as dependency types in the  $i^*$  framework. So the framework will have goal dependency cycles, task dependency cycles, resource dependency cycles, and soft-goal dependency cycles.

The type of the dependency cycle depends on the conversation that contains the request concept. A request defines if the initiator is asking for some sort of objective to be fulfilled, a resource to be delivered, a task to be done, or it is a soft goal that restricts the qualities of one of the other dependency types.

#### ***4.3.2.3 Language action perspective criticisms and their relevance and applicability to the concept of a dependency cycle***

As was mentioned before, the conversation for action diagram and LAP (Winograd & Flores, 1987) has been one of the theories that has inspired the dependency cycle concept. This theory has attracted a number of criticisms (Bowers, 1992; Bowers & Churcher, 1988; Dignum, Dietz, Verharen, *et al.*, 1997; Suchman, 1993), two of which specifically seem quite relevant to the concept of the dependency cycle and will be discussed here.

Bowers (1992) talks about the concept of formalism, he states that formalism is “a representational systems of a certain sort. A formalism generates representations through the operation of rules over some vocabulary. ... Systems which support embody or express formalisms (are) formal systems”. He believes formal systems can persuade people to behave according to a specific representation. Bowers (1992) also believes LAP through the conversation for action diagram imposes formalism on systems.

Suchman (1993) uses “categorisation as discipline” in the social sciences to criticise LAP. She believes the conversation for action diagram proposes such a strict categorisation of the conversations which extremely restricts individuality and



creativity of communication patterns. She states: “Rather than being a tool for the collaborative production of social action...Coordinator (a tool that has been developed based on LAP and the conversation for action diagram) ...is a tool for the reproduction of an established social order.”

These above two points are closely related to the criticism brought out by this research. The current BPM definitions are only applicable in the unitary problem contexts. As not all organisational matters are in the unitary problem context, the outcomes of the current BPM practices are distant to the reality of the organisational business processes. Also, the business process support systems that are developed oppress the users and do not allow for creativity.

So how can a concept that seems to have fundamental conflicts with the objectives of the research be used in one of the main constructs of its proposed conceptual framework?

Two main points illustrate that the mentioned criticisms about LAP do not apply to the way it has been used in Dependency Cycles:

1. The main component of the dependency cycle concept is the dependency itself not the conversation pattern that has created the dependency. This means that Dependency Cycles try to model the multi-level nested dependencies that people create to achieve their goals and objectives. It tries to show people’s inter-dependencies and interrelations based on organisational and personal goals and distribution of power. Conversation for action theory has only been used as a heuristic for identifying a dependency cycle’s start and closure. As the dependency cycle shows the depender’s attempt to achieve the dependum by relying on a dependee, it might be a good example of the conversation for action in its pure sense - the pragmatics of the language, to understand how language is used in a specific situation to achieve an objective (Schoop, 2001). The dependency cycle does not dictate that the conversation for action diagram steps must be followed.

2. Dependency cycles are being used in the process discovery phase rather than business process design or enactment. Therefore, they do not impose any communication patterns on people but they attempt to extract these patterns, if they at all exist, from the conversation history of an organisation. From the ethical point of view, this means that the proposed framework does not try to promote any specific social order but it tries to extract it from the conversation history. If the dependency cycle concept is too restrictive or formal and is not close to reality, it won't be able to extract the dependencies and, based on that, the business processes. This will cause the proposed method to fail in practice. (In Chapter 5: Case Studies it will be shown that this concept has successfully been applied to real life conversation logs)

In the next subsection some heuristics for creating the dependency cycles will be introduced.

#### **4.3.2.4 Heuristics**

The following principles and heuristics have been identified for creating the dependency cycles and then by using them to create the business process models:

1. Conversations that contain some form of "request" start a new dependency cycle. This heuristic has been put forward based on the fact that some sort of dependency is usually created when we ask someone to do something for us. The conversation for action diagram starts with a "request" too, which can be another indication of the correctness of this heuristic.
2. A dependency cycle can have one or more nested dependency cycles. This heuristic has been put forward based on the fact that to deliver a dependency's dependum the dependee may need to create more dependencies. For instance, the root dependency cycle might be a goal dependency between two actors. Then the dependee may create a few resource dependencies to obtain the necessary resources for achieving the goal, and a few task dependencies to carry out some of the steps. In turn, the resource providers may have task dependencies, and soft-goal dependencies with other actors to create the resources in time and with a certain quality.

3. Conversations containing some forms of reject, withdraw or declare concepts, will end a dependency cycle. These concepts show that the dependee has either delivered the dependum or has failed to provide the requested outcome. According to the conversation for action diagram (Winograd & Flores, 1987), two different “declare” types exists. One, a satisfaction declaration and the other dissatisfaction declaration. satisfaction declaration ends the dependency cycle but a dissatisfaction declaration ends the current dependency cycle and as it has got an inherent change “request”, a new dependency cycle gets created there as well.
4. Each dependency cycle can be considered a fragment of the business process instance as they show steps towards fulfilment or failure of achieving an objective. That objective can be obtaining a resource, achieving a goal, a soft-goal, or carrying out a task.
5. The intermediate steps in a dependency cycle are similar to the intermediate steps in the conversation for action diagram. The main point is that not all the intermediate states will be explicitly traversed. For instance, usually after a request the dependee fulfils the requested responsibility and goes to the assert state without explicitly promising to do the job, and the depender starts using the provided outcome without explicitly going to the declare state. The withdraw state is also complicated. Sometimes people withdraw from a dependency by just not responding. The main point here is that it can be argued that the intermediate steps are not as important as the first and last steps for a dependency cycle. It means, as long as it can be found that a dependency cycle has started, and the sub-dependency cycles can be defined, and the dependency cycle can be finished by a result, then the intermediate steps can be ignored since it has been accepted that they will follow the pattern introduced in the Winograd & Flores (1987) conversation for action diagram.

6. Recognising the start and termination of a dependency cycle is fairly easy by using the heuristics “1” and “3”; or finding the requests and reject, withdraw or declare concepts in conversations. However, the need to define if a new dependency cycle is a nested cycle inside the main dependency cycle or an independent dependency cycle is a subjective task and needs human expert intervention.
7. Main dependency cycles represent more coarse-grained business processes.
8. The sequence of dependency cycles, nested within a main dependency cycle, can be concluded from their start and finish times. The start of the dependency cycle is when a request has been made, and interestingly, the end of the dependency cycle is when the result has been asserted by the dependee (not declared by the depender) or the dependee has withdrawn or rejected to provide the dependum. It can even be inferred that dependency cycles, which have a time overlap, can be considered parallel.
9. With reference to dependency cycles and BPMN 2.0 choreographies, as was mentioned earlier, a task in BPMN 2.0 choreography diagrams has been defined as “an interaction representing a set of one or more message exchanges between two or more participants” (Briol, 2010); and sub-choreography has been defined as “a compound choreography activity involving two or more participants” (Briol, 2010). According to these two definitions, compound dependency cycles (dependency cycles that have nested dependency cycles) can be translated to sub-choreographies, and simple dependency cycles to activities in a choreography diagram. For a short tutorial on how to interpret choreography diagrams for dependency cycles please refer to Appendix E.

Using the aforementioned technique, a very specific choreography model can be created from the history of conversations that have happened in the organisation. These models have got two dimensions: in one dimension they show the sequence of choreography tasks and sub-choreographies that have been carried out to achieve a goal; and in another dimension it shows how people fulfil the tasks by depending on each other. The first dimension is represented by the sequence of choreography tasks

and sub-choreographies, and the other dimension is represented by the multi-level nested sub-choreographies and tasks.

#### 4.3.2.5 *Dependency cycle example<sup>2</sup>*

Consider the following simple scenario – an instance of a business process fragment:

*Mr. X who is the manager of Mr. Y who has asked him to write a report on subject S. Mr. Y sets up a meeting with Mrs. P and Mr. Q who have a better understanding of the subject S and consults with them to learn more about the subject. Mr. Y then writes up the report and asks his assistant Mr. T to type it and then he ultimately sends it to his manager Mr. X. There are some mathematical calculations in the report. Therefore Mr. T, in order to be able to type the report, needs a special word-processing module that he buys from the Supplier1.*

The first dependency cycle starts when Mr. X asks Mr. Y for a report on subject S and it finishes when Mr. Y provides Mr. X with the report. It can be tagged a resource dependency cycle and using the choreography notation the following model can be created (Figure 9):

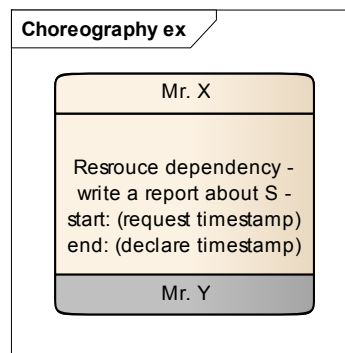


Figure 9. Process instance from Mr. X's point of view

This model is complete by itself from Mr. X's point of view. He has asked for something and he has received it. The model can delve deeper though, it can now show the process from Mr. Y's point of view, that is:

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<sup>2</sup> For a short tutorial on how to interpret choreography diagrams for dependency cycles please refer to Appendix E.

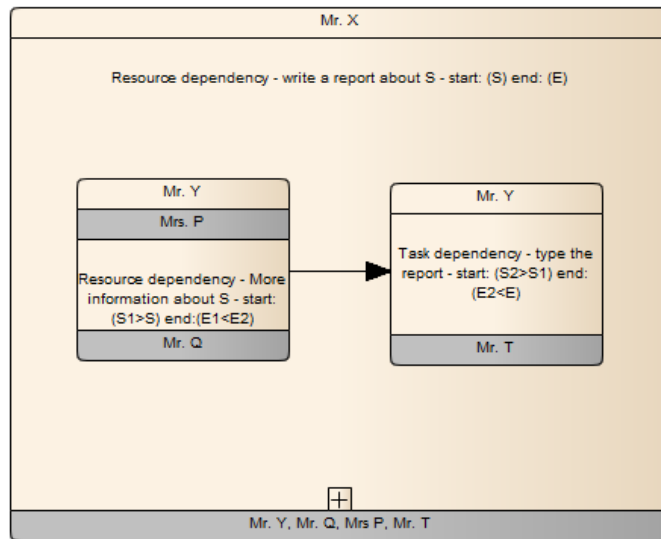


Figure 10. Process instance from Mr. Y's point of view

The above diagram (Figure 9) illustrates that from Mr. Y's point of view, as he has broader information about the process, Mr. X has a dependency on Mr. Y, Mr. Q, Mrs. P and Mr. T.

Mr. X's dependency on Mr. Y is a direct dependency as he has asked Mr. Y directly to do something but he has an indirect dependency on the rest of the people through Mr. Y. Mr. X was not probably even aware of these indirect dependencies.

Figure 9 also shows that Mr. Y, to fulfil the task requested from him by Mr. X, has created three other dependencies: two dependencies on Mrs. P and Mr. Q for consultation and one dependency on Mr. T for typing the final report. It can be seen in Figure 9 that Mr. Y is not aware of Mr. T's dependency on Supplier1.

We can now create the model from Mr. T's point of view. As there are some mathematical calculations in the draft of the report, Mr. T needs to buy a module for his word processor in order to type it, he sees the process as:

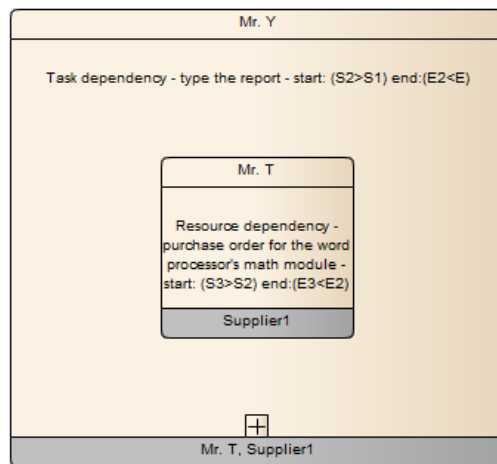


Figure 11. Process instance from Mr. T's point of view

Figure 11 shows that the process instance starts for Mr. T when he is asked to type the report and finishes when he delivers the typed report to Mr. Y. It also shows that in order to fulfil the dependency, Mr. T has to create a new dependency on Supplier1.

Comparing the process from Mr. Y's perspective and Mr. T's perspective it can be seen that Mr. Y might not even be aware of the dependency he has on Supplier 1 through the dependency that Mr. T has created with them.

So by combining different viewpoints the model in Figure 12 can be created:

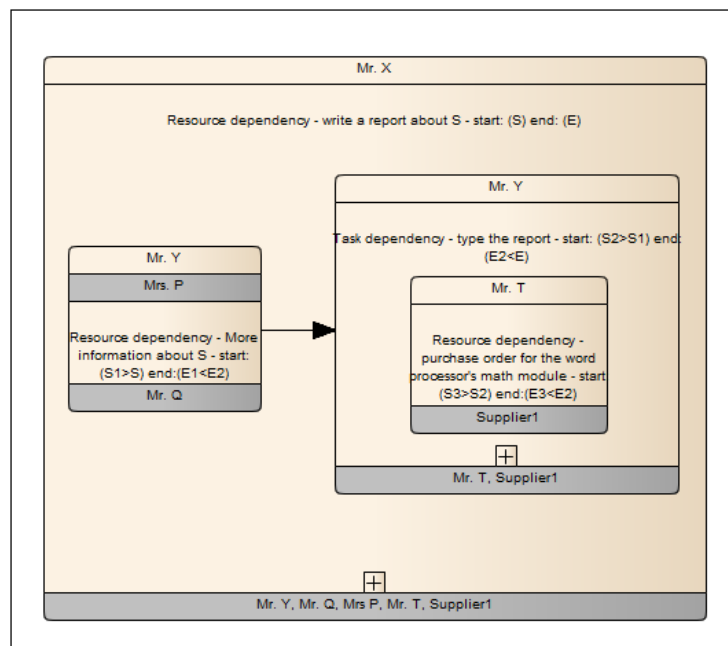


Figure 12. Combined viewpoints – business process instance

Figure 12 shows the complete process instance. It shows that a dependency cycle has been created by Mr. X with Mr. Y directly and with Mr. Q, Mrs. P, Mr. T (indirectly through Mr. Y) and Supplier 1 (indirectly through Mr. Y and Mr. T), the dependum of the dependency cycle is the report on subject S and the type of the dependency cycle is a resource dependency. In order to deliver the dependum of the main dependency cycle, the report on subject S, Mr. Y has created a dependency cycle with Mrs. P and Mr. Q to consult about the report's subject S. The type of the dependency cycle is a resource dependency cycle and the dependum of it is "information" about the subject of the report. Mr. Y creates another dependency cycle with Mr. T (directly) and with supplier1 (indirectly through Mr. T) to type the report. The dependency cycle type is task dependency and the dependum of this dependency cycle is "typed report". Finally Mr. T, to deliver the dependum of the dependency cycle that is "typed report" creates a dependency cycle with Supplier 1. The type of the dependency cycle is resource dependency and its dependum is a word-processor module.

In the next section, a method based on this conceptual framework will be introduced that uses emails as the conversation logs. This method and later on the case studies will further clarify the conceptual framework and its definitions and how it can be applied in real-life situations.

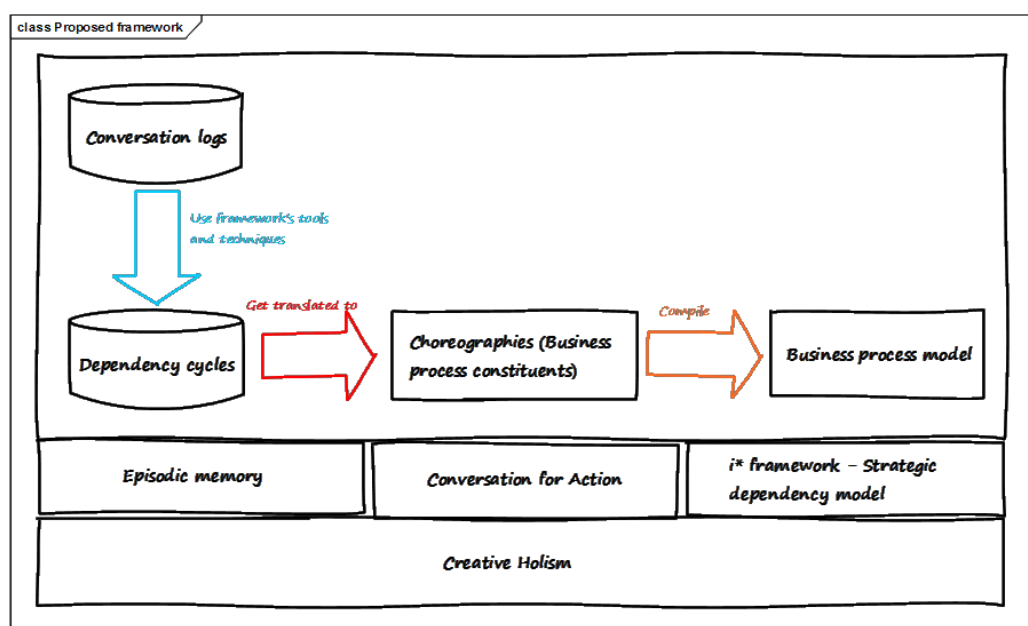


Figure 13. Proposed conceptual framework



#### 4.4 A METHOD BASED ON THE PROPOSED FRAMEWORK FOR BUSINESS PROCESS DISCOVERY THROUGH EMAIL MESSAGE ANALYSIS

In this section a method (Figure 15) for the new conceptual framework (Figure 13) will be introduced that uses emails as the source of data. Email can be noted as the most popular tool used for computer-supported cooperative work (CSCW) (Ellis, 2000). Carvalho (2011) also believes that one the important usages of emails at work places are to negotiate and delegate business tasks. So emails can be a good candidate for extracting business processes (with the new business process definition).

Initially, it will be discussed how dependency cycles can be created from email messages, and then the method's steps for extracting dependency cycles from email messages will be introduced and then a set of tools will be presented to facilitate the application of the method.

##### 4.4.1 Dependency cycles and email messages

Carvalho (2011) proposes a taxonomy of email acts for work-related email exchanges by analysing a large number of emails and analysing a number of dialogue acts taxonomies. His work has been inspired by speech act theory (Searle, 1969). Table 1 and Figure 14 that has been adopted from the work of Carvalho (2011), lists these verbs in the email acts and their meanings and shows the verb taxonomy respectively:

<i>Request</i>	A request asks (or orders) the recipient to perform some activity. A question is also considered a request (for delivery of information).
<i>Propose</i>	A propose message proposes a joint activity, i.e., asks the recipient to perform some activity and commits the sender as well, provided the recipient agrees to the request. A typical example is an email suggesting a joint meeting.
<i>Commit</i>	A commit message commits the sender to some future course of action, or confirms the sender's intent to comply with some previously described course of action.

<i>Deliver</i>	A deliver message delivers something, e.g., some information, a Power Point presentation, the URL of a website, the answer to a question, a message sent, or an opinion.
<i>Amend</i>	An amend message amends an earlier proposal. Like a proposal, the message involves both a commitment and a request. However, while a proposal is associated with a new task, an amendment is a suggested modification of an already proposed task.
<i>Refuse</i>	A refuse message rejects a meeting/action/task or declines an invitation/proposal.
<i>Greet</i>	A greet message thanks someone, congratulates, apologises, greets, or welcomes the recipient(s).
<i>Remind</i>	A reminder message reminds recipients of coming deadline(s) or threats to keep commitment.

Table 1. Verbs in email act taxonomy cited in Carvalho (2011)

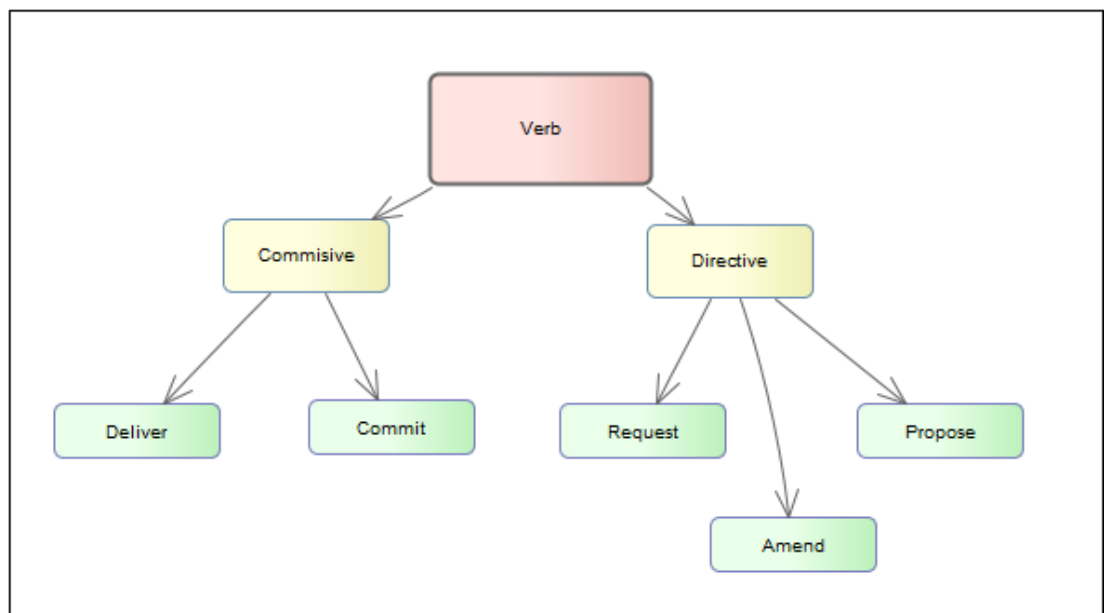


Figure 14. Taxonomy of email acts' verbs cited in Carvalho (2011)

As this verb taxonomy is quite in line with the concepts that were proposed in the conceptual framework, it can be adopted for creating dependency cycles using email messages with the following amendments:

- A “Request” act starts a new dependency cycle as it both shows that the sender is depending on the recipient to deliver something.
- A “Propose” act consists of a “Request” act and a “Commit” (Sender’s commitment) act so it starts a dependency cycle as well.
- A “Declare” verb should be added to the Commissive thread of the email acts verb taxonomy. A “Declare” act happens after a “Deliver” act and shows satisfaction or dissatisfaction of the recipient of the email with a “Deliver” act. A “Declare” act and “Refuse” act (which contains the “withdraw” and “reject” concepts as well), both explicitly end a dependency cycle. A “Declare” act and a “Refuse” act can be implicit. It means the recipient of the email with a “Deliver” act usually expresses his satisfaction by not responding or the recipient of an email with a “Request” act might refuse it by not responding.
- If the “Declare” act is implicit, the “Deliver” act ends the dependency cycle.
- An “Amend” email act verb ends one dependency cycle and starts a new one.
- “Commit”, “Greet” and “Remind” as intermediate states of a dependency cycle can be ignored in the analysis.

In the next section the method’s steps for extracting the dependency cycles will be elaborated on and some examples will be given, having the above points in mind.

#### 4.4.2 Method steps

The method consists of four main steps:

1. Pre-processing
2. Extracting dependency cycles
3. Translating the dependency cycles to BPMN2.0 choreography diagrams
4. Creating a business process fragment model from the created choreography diagrams

Figure 15 illustrates these main steps and their sub-steps that will be introduced and elaborated in the following paragraphs.

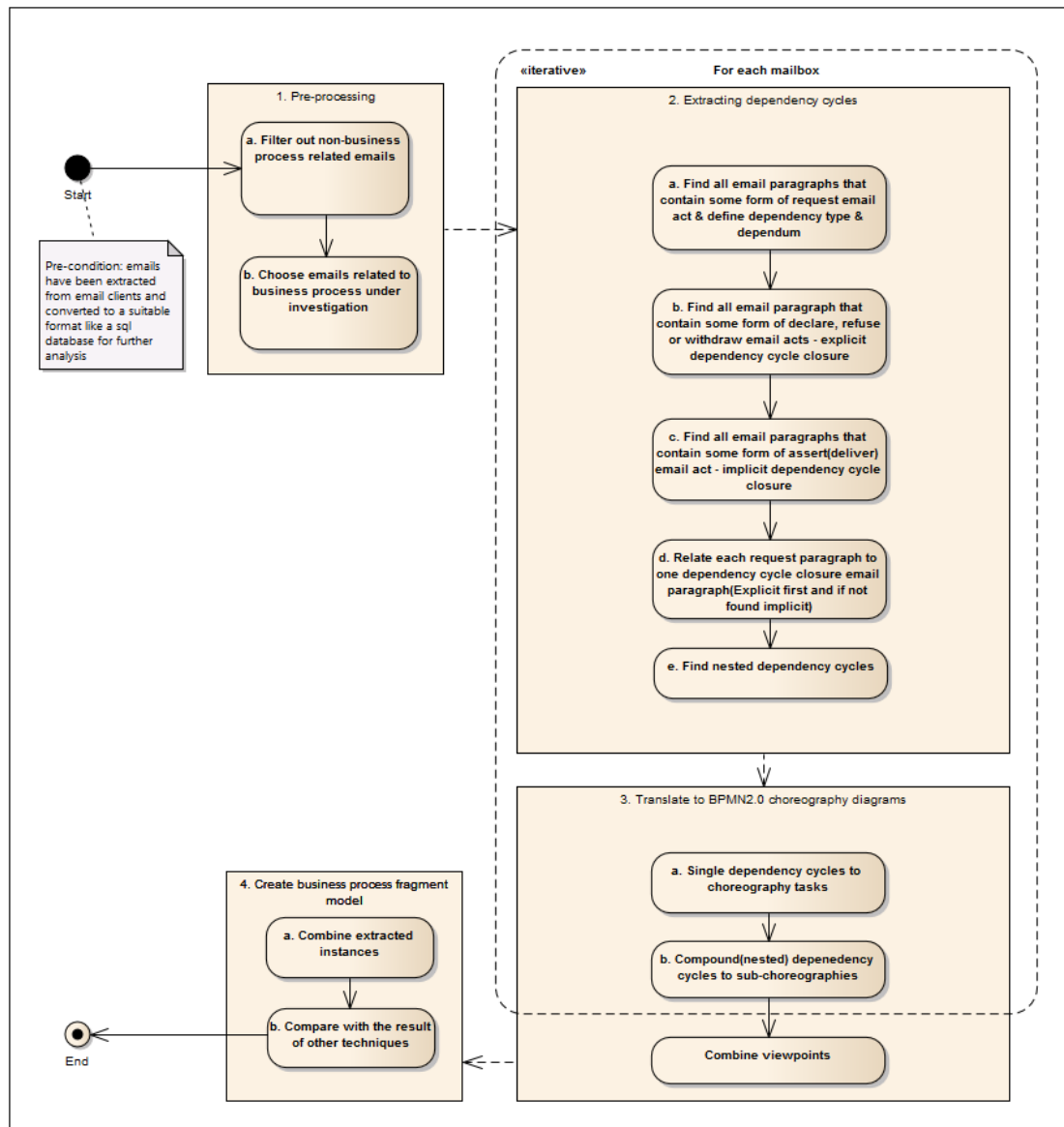


Figure 15. The proposed method

1. *Pre-processing the email corpus*: In this step, the business analyst should narrow down the number of emails to the ones that are related to the process (subject matter) under investigation. Gathering some domain knowledge, by using any other analysis techniques, about the process under investigation can greatly help the analyst in this step and also in the steps where he has to tag the emails and extract dependency cycles. The pre-processing can be done in two stages:

- a. Deleting all the non-business related emails; this can be a text classification (spam filtering) task.
  - b. When all of the non-business related emails have been filtered out, the remaining emails will contain the dependency cycles that are constituents of different business processes. In this step all emails that are related to the business process under investigation should be identified. In section 4.4.3, a few methods to automatically perform this task will be introduced; however, this can be done manually by going through each email and selecting the ones that are relevant.
2. *Extracting the dependency cycles*: Dependency cycles can be extracted from the remaining emails in each participant's mailbox following the steps a, b, c, d and e. These steps should be repeated for each mailbox. (Each mailbox shows the part of the process that is visible to each participant):
- a. Find all the email paragraphs that contain some form of "Request" act – each email might contain more than one request act. As was previously discussed, each "Request" act starts a dependency cycle. By analysing the content of the email, the dependency type and the dependum of the dependency cycle can be defined. For instance consider the following email:

"Dear Mr. X

Could you please give us a rough estimate for developing the software the specification of which is attached as an SRS?

Best,

Y"

This email contains a request and shows Mr. Y is asking Mr. X for a quote on developing a piece of software. At this stage Mr. Y is depending on Mr. X to provide him with a quote. This dependency can be analysed in two different ways. It can be considered a goal-dependency, since the depender has not defined what the dependee should do to provide him with that information, so to achieve his objective of “having a quote for developing the software” is satisfied. This can also be considered as resource-dependency, since the depender is depending on the dependee to provide him with some sort of resource (the quote) to be used in some other processes. Choosing either of these approaches does not invalidate the method, but the important matter is consistency. The business analyst should be consistent in identifying the dependency types across different dependency cycles.

- b. Find all email paragraphs that contain the “Refuse” (withdraw or reject) and “Declare” acts – each email might have more than one of these speech acts – these acts will end a dependency cycle, as they usually mean that the dependee has either fulfilled the responsibility or has failed to provide the requested outcome. One of the important points here is not to mistakenly end a dependency cycle by email paragraphs containing the “Deliver” act (assertion concept) instead of the “Declare” act (declaration concept) if there is an email paragraph relevant to the “Request” email paragraph and contains the “Declare” act explicitly. Consider the following email:

“Hi Mr. Y

Please find attached the requested information.

Best,

X”

This email shows that something that has previously been requested has been delivered, but is it the end of the dependency cycle? What if the depender is not happy with the outcome? What if he is not happy and he asks the dependum to be created again (starting a new sub-dependency cycle)? Therefore, a dependency cycle may only end when the depender declares that he is either happy with the dependum or has withdrawn from asking it. Thus, the following email would be a better dependency cycle closure email:

“Mr. X

Thank you very much. We have reviewed your quote and unfortunately at this instance we have decide not to proceed

Best regards,

Y”

As was mentioned in the previous section, there is an important point here, which is, not all declarations, withdrawals or rejections are explicit. For instance, when the assertion email had been sent, the recipient just by not responding may declare his acceptance of the outcome. Or sometimes when something is requested, by just not responding to the requester the recipient declares his withdrawal. The positive point about the dependency cycle concept is that all the dependency cycles can be extracted even if their closures are implicit, because the dependency cycle will be extracted by the request concept.

- c. Find all email paragraphs that contain the “Deliver” act (assertion concept). The reason that emails with the “Deliver” act (assertion concept) are being tagged here is that, as was mentioned previously, a dependency closure email might be an email containing the “Deliver” act if the declaration is implicit.

- d. Relate the dependency cycle start to the dependency cycle closure (in this step the closure email in the emails, which have been tagged by the declaration concept, are being searched for). For instance, the second email in step 2b can be a good closure for the dependency cycle that had been started by the email that was mentioned in 2a. If the request emails have no matching explicit closure emails found in the declaration emails, search the emails containing the “Deliver” act to see if the declaration has been implicit. One email might have a combination of different speech acts. It means one email can start two new dependency cycles while it is closing an old one.
- e. Find nested dependency cycles. As discussed earlier each new dependency usually creates other nested dependencies. For instance, when Mr. X depends on Mr. Y to provide him with a quote for developing a piece of software, then Mr. Y will depend on Mr. H to list the tasks for implementing the software and estimating the needed time efforts for each of them. After following the previous steps each of these dependency cycles will come up as a separate entity but in fact the second dependency cycle would not exist without the first dependency cycle, so the second dependency cycle should be nested under the first one. At this stage the business analyst should look for these interdependencies between different dependency cycles and identify if they exist independently or if they have been created as a result of another more high-level dependency.



3. *Combine viewpoints and translate the findings to the BPMN 2.0 choreography diagram as was explained in the framework.* As was mentioned earlier, a task in BPMN 2.0 choreography diagrams has been defined as “an interaction representing a set of one or more message exchanges between two or more participants” (Briol, 2010), and sub-choreography has been defined as “a compound choreography activity involving two or more participants” (Briol, 2010). According to these two definitions, compound dependency cycles (dependency cycles that have nested dependency cycles) can be translated to sub-choreographies, and simple dependency cycles to tasks in a choreography diagram. Dependency cycles that have got overlapped durations can be considered parallel. In this step a number of fragments of the business process model (according to the new definition of the business process model) get created. The result of this step will be similar to the result of the simple example that was given in the previous section.
4. *Drawing the incomplete picture of the business process model.* As was mentioned earlier, at each moment of time an incomplete picture of the business process model (business process fragment model) can be drawn by compiling the current extracted dependency cycles and created choreographies. At this stage the findings of this method can be compared with the findings of other conventional tools and techniques to reveal even more information about the realities of the current situation of the organisation. At this stage, repetitive patterns can also be recognised in some parts of the process. Unified models can be created for these parts of the process and it can be deduced that these parts are in the unitary problem context. This point will be elaborated on later in Chapter 5: and Chapter 7:.

#### **4.4.3 Tool support**

The framework’s method for analysing email messages as conversation logs can be supported by a few tools to facilitate and speed up the process for business analysts. These tools can be categorised into two main classes:

1. Simple, isolated tools that can be used to accelerate each of the steps solely by reliance on the business analyst's expertise, and simply facilitating the decision-making process, without any artificial intelligence.
2. More complex, integrated tools based on machine-learning and data-mining techniques, guiding the business analyst through applying the method by automating some of the steps and making suggestions about some of the decisions.

As the focus of this research has not been artificial intelligence and the research does not want to enter this realm, a few simple tools and techniques will be introduced from the first category, and show how they can be used to accelerate the process of applying the method to even a large email corpora. For the second category, we are going to introduce concepts that can be used for the design and development of an integrated intelligent tool, but the development of such a tool using those high-level concepts will be left for future research, specifically in the domain of artificial intelligence.

#### ***4.4.3.1 Simple stand-alone tools to facilitate the process of applying the method***

As was mentioned earlier in this subsection a set of tools will be introduced that simply facilitate the process of applying the method. These tools don't help the business analyst in decision-making, nor do they fully automate the process, but they help to carry out the steps more quickly.

##### ***4.4.3.1.1 Tools for the pre-processing steps***

The very first step that can make bulk analysis of emails faster is to transfer them into a relational database. Depending on the email corpus repository file, different tools can be used for this purpose. For instance Microsoft Access can extract emails from Outlook files and transfer them to a Microsoft Access relational database. They may then be converted to any other type of database such as MySQL or Microsoft SQL Server using a number of available tools.

The main benefit of transferring the emails to a relational database is that they enable the business analyst to use SQL statements to analyse them. SQL statements can be used to filter out emails based on heuristics. For instance, if the business process under investigation has started from a certain date in the past, then older emails can be filtered out; or if the main people involved in that business process are

known, all emails that have been sent and received by these people can be fetched and analysed in the first instance. SQL statements may be used to delete all emails that are not relevant to the business process under investigation, including emails such as group notifications, software patch announcements and many more that flood every person's inbox.

Relatively complex SELECT statements can be used to find relevant emails to the business process under investigation. Having background information about the business process that is being explored can be a great help here; information such as main participants of the process or a simple ontology of keywords and concepts. Other information that can help is the frequency of repetition of the process, and the unit of work that this process happens in; for instance, does this specific business process run once in every project, or every month during the life of the project, or is it event based. Having this information at hand the business analyst can create a SQL SELECT statement to prepare a collection of relevant emails to the business process under investigation which then can be used in the next steps of the framework's method.

For performing the case study that will be introduced in the next chapter, a simple PHP CRUD application has been developed to be used in the final clean-up section. It means that after filtering out a large number of emails using SQL, this application helps the process of going through the remaining emails one by one and deleting what is not relevant.

As it can be seen, this tool does not help the business analyst in making intellectual decisions but it certainly speeds up the process.

#### *4.4.3.1.2 Tools for extracting dependency cycles*

An application has been developed to guide the business analyst through the dependency cycle extraction steps. This application guides the business analyst through the necessary steps to extract dependency cycles and facilitate this process. Screenshots of this application can be found in the appendices.

#### ***4.4.3.2 An integrated tool that automates most steps of the framework's method***

In this section we are trying to show how several components, that have been built using machine-learning and data-mining algorithms and techniques, can automate most steps of the framework method. This section is not trying to review

artificial-intelligence and machine-learning literature, nor is it trying to comprehensively define how these components should be implemented. It is only trying to show the possibility of developing semi-automatic integrated tools and basic concepts behind it. This integrated tool should have all the components mentioned in the following diagram. Each of these components will be elaborated on further.

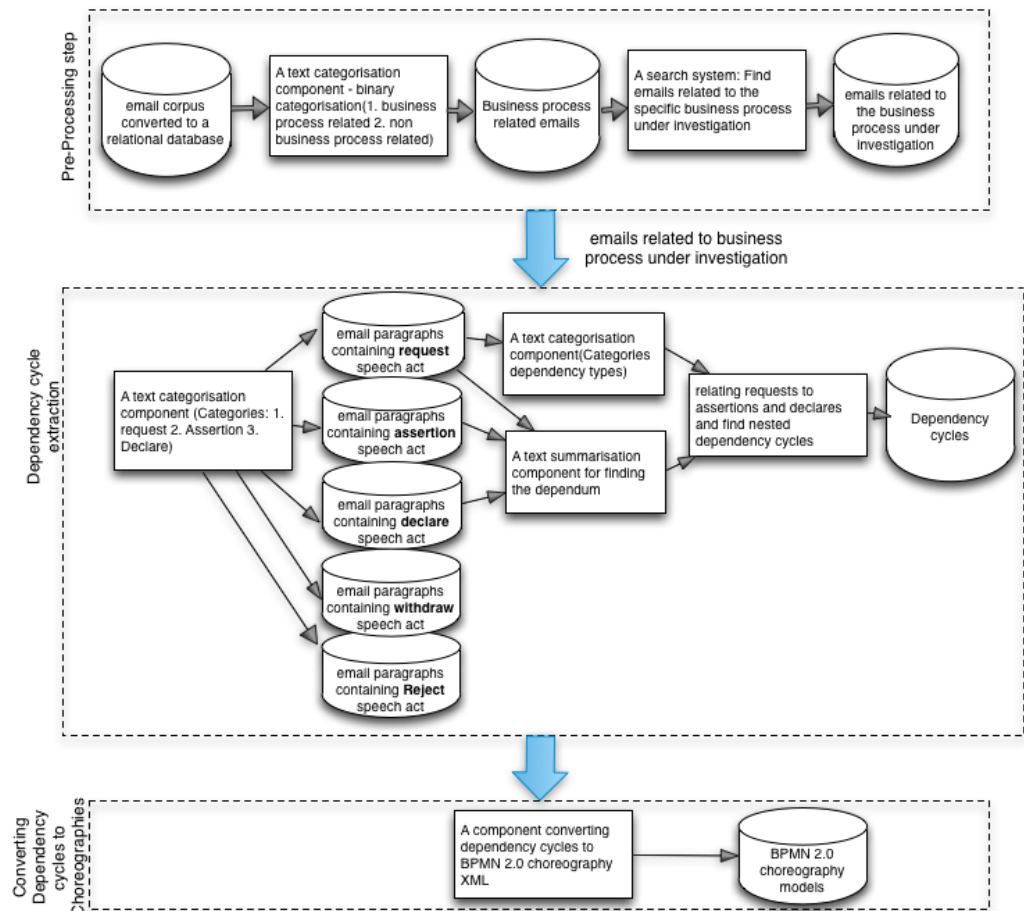


Figure 16. Components for automation

#### 4.4.3.2.1 Text categorisation

In Figure 16 several text categorisation components can be seen. Three steps of the frameworks method can be automated using text-categorisation techniques. The first categorisation happens when the non-business process emails are filtered out. The problem to be solved by this component is classifying the emails into two different categories or classes:

1. Business process related
2. Non-business process related emails.

The next component, trying to solve the same kind of problem, classifies the emails according to their intent:

1. Request
2. Reject
3. Withdraw
4. Assertion
5. Declare.

And the last component in this category tries to classify the emails that have been tagged (classified) as “Request” emails, according to their dependency types:

1. Goal dependency
2. Task dependency
3. Resource dependency
4. Soft-goal dependency.

Many different text categorisation techniques have been introduced in the literature which can be customised, optimised and used in the above components; techniques such as Naïve bays, Support Vector Machines (SVM) and Clustering (Manning, 2008).

Discussing these techniques in more detail is outside the scope of this thesis. Using a configuration of these techniques to generate the best result can be a topic of further research. For instance, as was mentioned in the previous section Carvalho (2011) has introduced a taxonomy of email acts and a method to classify emails based on these email acts (email intention) automatically which appears to be appropriate for the purpose of the second component. Mavaddat, Beeson, Green, *et al.*, (2011) have also proposed a high-level approach to conversation network extraction from email messages that can be enhanced and used in the second component.

#### 4.4.3.2.2 *Search systems (Information retrieval)*

Finding relevant emails based on the business process under investigation can be categorised as a specific search problem. The query is based on the name of the business process under investigation or subject matter, and the documents to be

searched for are email messages. In other words we are trying to find all the relevant emails to a specific business process. Recall (the fraction of relevant emails that are retrieved) is more important than Precision (the fraction of retrieved emails that are relevant) in this search problem. A good search system will return all documents (in this specific problem emails) relevant to the search query, in the order of relevance (Manning, 2008). Although many different search algorithms and techniques have been introduced in the literature, none of them have been optimised for this purpose and this can be a good research area for interested researchers in the field of artificial intelligence and machine learning.

#### 4.4.3.2.3 *Text summarisation*

Finding the dependum of a dependency cycle automatically, doesn't seem like a trivial task but using techniques in text summarisation and more specifically email summarisation can be a good start. Two different categories of techniques exist for email summarization (Carenini, Murray & Ng, 2011):

1. Techniques that focus on one email message
2. Techniques that use the email threads to summarise the whole email thread

The first group of techniques can be used to summarise email messages and then find semantically similar emails that belong to the same dependency cycle. These techniques can be used for relating the request emails (or paragraph depending on the granularity of analysis) to their relevant reject, withdraw, assertion and declare emails (or paragraph).

When all the related emails in a specific dependency cycle have been defined the second group of techniques can be used. The email summarisation technique, which is based on finding the conceptual commonalities in an email thread for summarising the whole email thread, can be used for finding the dependum of the dependency by analysing the emails in a dependency cycle.

## 4.5 CHAPTER SUMMARY

This chapter covered the design and development step of the DSR methodology. The following topics were discussed:

- In section 4.2, the theoretical foundations of the proposed solution were introduced. It deliberated on the fact that a people-oriented business

process definition should move from a sequence of tasks to a sequence of interactions and collaborations using VSM (Espejo & Reyes, 2011) and i\* framework (Yu, 2011) and BPMN choreography diagram notations and definitions. Then, using the conversation for action theory (Winograd & Flores, 1987) and the previously discussed theories, a definition for business processes based on the people's collaboration and interaction was introduced in the unitary problem context, and then, based on this definition and in reference to SOSM (Jackson & Keys, 1984), a new definition for business processes and business process models in pluralist and coercive problem contexts was proposed. Eventually a suitable data source that was created from people's collaboration and interactions and doesn't suffer from most of human memory and cognition limitations was introduced.

- In section 4.3, using the discussed theories and introduced definitions for activities, business processes and business process models, a conceptual framework for business process discovery from conversation logs was suggested.
- Eventually, in section 4.4 a method based on the conceptual framework was introduced for business process discovery using email messages as the conversation logs, and a tool set was suggested to facilitate the process and some artificial intelligence concepts were put forward that could help with developing an integrated semi-automatic tool for the proposed method.

In the next chapter, using two case studies, the application of the proposed conceptual framework's method will be demonstrated. One case study from a synthesised email corpus in the unitary problem context is demonstrated in order to clarify the application of the method and to show that it can work in the unitary problem context as well as pluralist and coercive problem contexts, and the second case study is a demonstration that uses a real email corpus including more than 10,000 emails and shows how instances of a specific business process can be discovered from these emails by applying the framework's method in real-life situations.

## Chapter 5: Case Studies

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### 5.1 INTRODUCTION

This chapter covers the demonstration step of the Peffers, Tuunanen & Gengler (2006) process model for DSR methodology. Using two case studies the application and value of the framework's method will be demonstrated. In the first case study, a synthesised email corpus will be used, and it will be shown that the method can be applied in the unitary problem context that can be considered a special case of the pluralist problem context (Jackson, 2003). In this synthesised corpus, as all the email messages from different mailboxes have been accessible, the processes can be analysed from every participant's point of view; and because the process is in the unitary problem context, a process model according to the conventional definition will be created. In the second case study a real email corpus containing more than 10,000 emails has been analysed and two instances of a supplier selection process has been extracted. It will be shown that the second case study is in the coercive problem context.

### 5.2 KNOWN LIMITATIONS

The main limitation of the email corpus for case study I is that it has been reverse engineered from a business process in the unitary problem context. It means that the business process has been explained to a group of people and they have started sending and receiving emails having that business process in mind. The first case study's main purpose is to demonstrate how the framework's method can be applied and also to show that the proposed concepts and definitions are compatible with the conventional ones and can be used in the unitary problem context.

The main limitation of the email corpus for case study II is that, due to access rights, all 10,000 emails have been taken from one inbox. This limitation has two main impacts on the outcomes:

- The extracted business processes are mainly from one participant's point of view. (It is worth mentioning that as this participant has been the manager of the project under investigation, most of other communications



have been CC'd to him as well, but we cannot make sure that everything has been covered, specifically the communications that have intentionally been not shared with the project manager.)

- Fragmentation can be a problem as well. As all participants' inboxes have not been accessible, the outcome of the method might be more fragmented than expected.

### 5.3 CASE STUDY I (SYNTHESISED EMAIL CORPUS)

As was mentioned earlier, the email corpus for this case study has been created by reverse engineering a business process in the unitary problem context. This business process has been adopted from a business process that has been introduced in the book *Fundamentals of Business Process Management* by Dumas, La Rosa, Mendling, *et al.* (2013).

This case study demonstrates the following points:

- The method can successfully be applied to email messages and can create correct, conventional business process models in unitary problem contexts. (We can compare the outcome of this case study with the business process that has inspired the email communications.)
- The method can analyse the process from different participants' perspectives. It can show the analyst what part of the process the participants have been taking part in and what part has been hidden from each participant.

#### 5.3.1 Email corpus

This process was used as a basis for creating the case study's email corpus:

“BuildIT is a construction company specialised in public works (road, bridges, pipelines, tunnels, railroads, etc.). Within BuildIT, it often happens that engineers working at a construction site (called site engineers) need a piece of equipment, such as a truck, an excavator, a bulldozer, a water pump, etc. BuildIT owns very little equipment and instead it rents most of its equipment from specialised suppliers.

The existing business process for renting equipment goes as follows. When site engineers need to rent a piece of equipment, they fill in a form called “equipment rental request” and send this request by email to one of the

clerks at the company's depot. The clerk at the depot receives the request and, after consulting the catalogues of the equipment suppliers, selects the most cost effective equipment that complies with the request. Next, the clerk checks the availability of the selected equipment with the supplier via phone or e-mail. Sometimes the selected option is not available and the clerk has to select an alternative piece of equipment and check its availability with the corresponding supplier.

Once the clerk has found a suitable piece of equipment available for rental, the clerk adds the details of the selected equipment to the rental request. Every rental request has to be approved by a work engineer, who also works at the depot. In some cases, the works engineer rejects the equipment rental request. Some rejections lead to the cancellation of the request (no equipment is rented at all). Other rejections are resolved by replacing the selected equipment with another equipment – such as a cheaper piece of equipment or a more appropriate piece of equipment for the job. In the latter case, the clerk needs to perform another availability enquiry.

When a work engineer approves a rental request, the clerk sends a confirmation to the supplier. This confirmation includes, a Purchase Order (PO) for renting the equipment. The PO is produced by BuildIT's financial information system using information entered by the clerk. The clerk also records the engagement of the equipment in a spread sheet that is maintained for the purpose of tracking all equipment rentals.

In due time, the supplier delivers the rented equipment to the construction site. The site engineer then inspects the equipment. If everything is in order, the engineer accepts the engagement and the equipment is put into use. In some cases, the equipment is sent back because it does not comply with the requirements of the site engineer. In this case, the site engineer has to start the rental process all over again.”

The above business process has inspired the communications via the email messages that have been captured in appendix B and will be used as the source of data for the discovery of the business process using the proposed framework's method.

Ashley, Kevin and Martin play the role of “Site engineer”, Merry, Maribel and Claire play the role of “Clerk”, Robert, Alan and Patrick play the role of “Works

engineer” and finally James, Jane and Jeffery play the role of “Supplier” in this scenario.

These are the names of inboxes (for process participants) and the number of relevant emails in them:

Mailbox	Number of relevant emails	Email IDs
Ashley@buildIT.com	2	879, 886
Merry@buildIT.com	8	879, 880, 881, 882, 883, 884, 885, 886
James@supplier1.com	4	880, 881, 884, 885
Robert@buildIT.com	2	882, 883
Kevin@buildIT.com	2	887, 896
Maribel@buildIT.com	6	888, 890, 892, 893, 894, 896
Jane@supplier2.com	8	888, 889, 898, 899, 902, 903, 904, 905
Jeffery@supplier3.com	4	890, 891, 894, 895
Alan@buildIT.com	2	892, 893
Martin@buildIT.com	2	897, 906
Claire@buildIT.com	10	897, 898, 899, 900, 901, 902, 903, 904, 905, 906
Patrick@buildIT.com	2	900, 901

Table 2. Inbox names and number of emails in each inbox

To simplify dependency cycle extraction each email only contains one email act.

### 5.3.2 Applying the framework's method to the email corpus

#### 5.3.2.1 Step 1. Pre-processing

As the data source of this case study was a mock email corpus, pre-processing was not needed and all emails in the inboxes were relevant to the business process under investigation.

#### 5.3.2.2 Step 2. Extracting dependency cycles

In this step the dependency cycles will be extracted. Please refer to appendix B to see how each of the sub-steps has been applied to the email corpus to eventually extract all the dependency cycles.

Table 1 shows the outcomes of the second step, which are the extracted dependency cycles.

DCID	Dependum	Type	Start	End	ParentID	Mailbox
4	CP2 rental	Resource dependency	2013-05-13 08:13:05	2013-05-14 09:30:20		Ashley, Merry
6	CP2 availability	Task dependency	2013-05-13 10:20:20	2013-05-13 12:33:24	4	Merry, James
8	Equipment rental approval	Task dependency	2013-05-13 14:01:04	2013-05-13 15:30:20	4	Merry, Robert
9	CP2	Resource dependency	2013-05-13 16:20:20	2013-05-14 08:30:20	4	Merry, James
1	PQT rental	Resource dependency	2013-05-12 11:13:25	2013-05-13 13:45:12		Martin, Claire
2	Check availability of PQT	Task dependency	2013-05-12 14:10:15	2013-05-12 16:14:12	1	Claire, Jane

3	PQT rent approval	Task dependency	2013-05-12 17:00:24	2013-05-13 09:00:44	1	Claire, Patrick
3a	Change PQT to TTM	Task dependency	2013-05-13 09:00:44	2013-05-13 10:04:44	1	Claire, Patrick
5	Check availability of TTM	Task dependency	2013-05-13 10:04:44	2013-05-13 10:24:38	1	Claire, Jane
7	TTM	Resource dependency	2013-05-13 11:13:36	2013-05-13 12:23:22	1	Claire, Jane
10	X3 rental	Resource dependency	2013-05-14 09:13:05	2013-05-15 11:00:22		Kevin, Maribel
11	Check X3 availability	Task dependency	2013-05-14 10:00:05	2013-05-14 10:30:45	10	Maribel, Jane
12	Check X3 availability	Task dependency	2013-05-14 11:13:23	2013-05-14 14:15:20	10	Maribel, Jeffery
13	X3 rent approval	Task dependency	2013-05-14 15:00:12	2013-05-14 16:08:12	10	Maribel, Alan
14	X3	Resource dependency	2013-05-15 09:10:16	2013-05-15 10:43:26	10	Maribel, Jeffery

Table 3. Case Study I extracted dependency cycles

As the process under investigation is the process of renting equipment for the site engineers, it can be deduced from the above table that three instances of the same

process have been executed. These instances have started by three requests in DCIDs 1, 4 and 10. All of these requests start a resource dependency whose dependum in a generalised form is “renting equipment”.

### 5.3.2.3 Step3. Creating choreography diagrams from dependency cycles and combining the viewpoints

#### 5.3.2.3.1 Process instance one from Ashley’s view point:

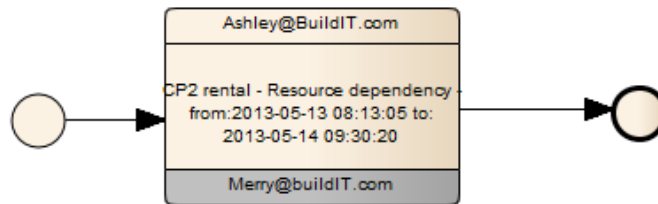


Figure 17. Process instance from Ashley’s viewpoint

Figure 17 shows, as far as Ashley is concerned, the process starts when Ashley depends on Merry to provide him with the equipment he needs and the process ends when Merry closes the dependency by delivering the equipment via the supplier to him.

#### 5.3.2.3.2 Process instance one from Merry’s viewpoint

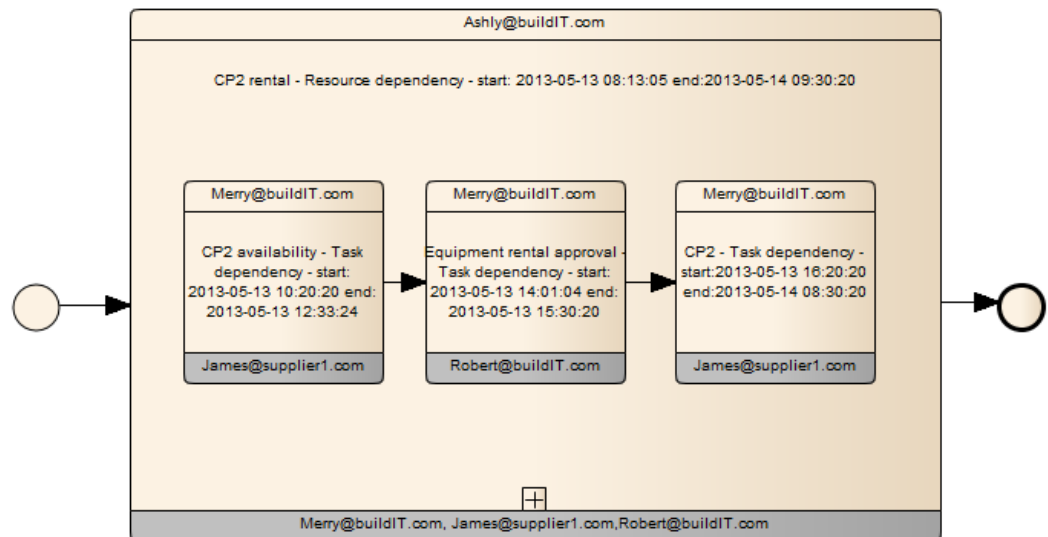


Figure 18. Process instance from Merry’s viewpoint

Figure 18 shows how the previous choreography diagram turns into a sub-choreography diagram as it has triggered other dependencies. It means for Merry, the

process starts when Ashley requests equipment and finishes when she delivers, but Merry, in order to fulfil this dependency, should create other dependencies that can be seen in the above diagram.

#### 5.3.2.3.3 Process instance one from James's viewpoint

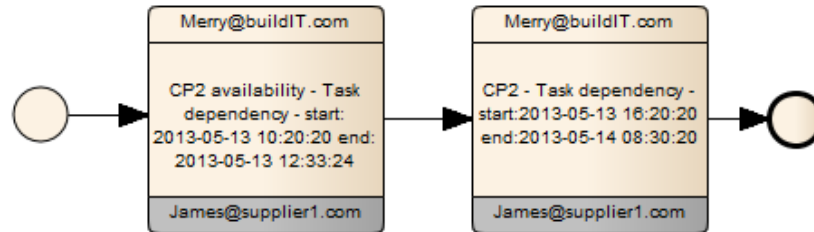


Figure 19. Process instance from James' viewpoint

From the number of emails that have been created for Merry's and James's interactions, Figure 19 can be drawn as James's view of the process instance. The process starts for him when Merry asks about the availability of an item of equipment and it ends when he receives the purchase order and accepts to deliver the equipment to the site. This is definitely a fragment of what should happen and if more emails were available, a more detailed process diagram could be created for that part of the process.

#### 5.3.2.3.4 Process instance one from Robert's viewpoint

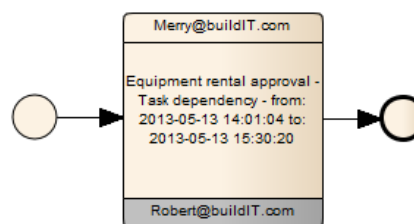


Figure 20. Process instance from Robert's viewpoint

For Robert the process (instance) starts when Merry asks him to approve the equipment rental request and he accepts/rejects the request or gives a counter offer. See Figure 20.

### 5.3.2.3.5 Combined viewpoint for the first instance

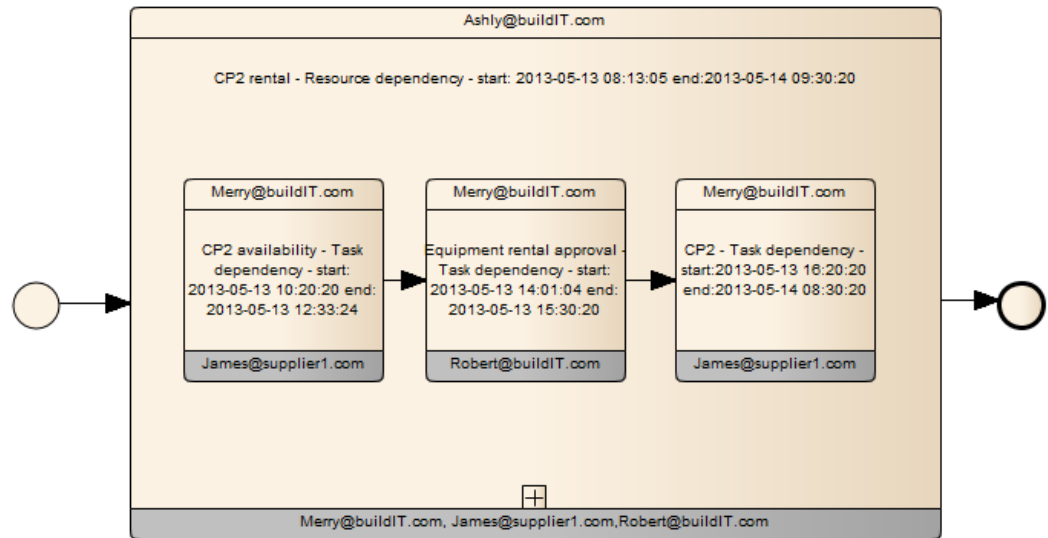


Figure 21. Combining the viewpoints

After combining the viewpoints Figure 21 has been created that covers all other viewpoints. It is worth mentioning that the similarity of the combined viewpoints and Merry's viewpoint is due to the fact that Merry has been involved as a mediator in all the different interactions and also the limited number of emails in the email corpus.

The following diagrams in Figure 22 to Figure 26 are related to the second instance of the same process. Each diagram shows the process from one process participant's perspective.

### 5.3.2.3.6 Process instance two from Martin's viewpoint



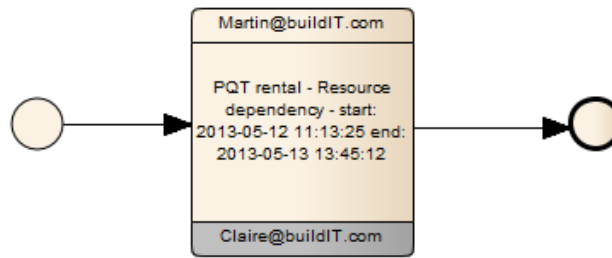


Figure 22. Process instance from Martin's viewpoint

5.3.2.3.7 Process instance two from Claire's viewpoint

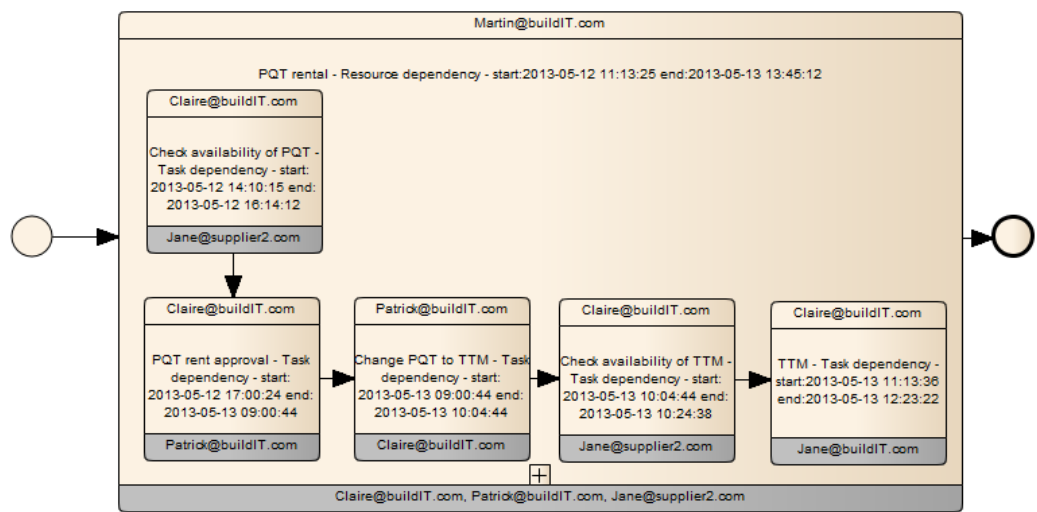


Figure 23. Process instance from Claire's viewpoint

5.3.2.3.8 Process instance two from Jane's viewpoint

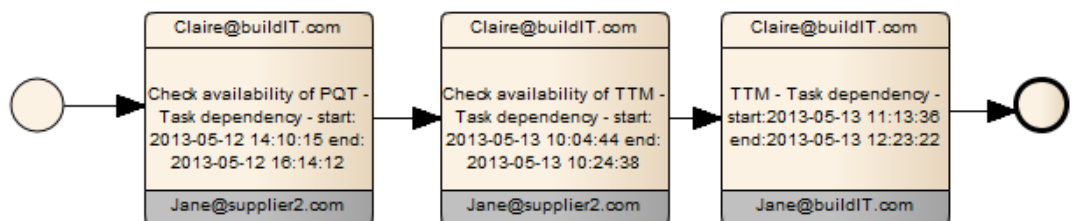


Figure 24. Process instance from Jane's viewpoint

5.3.2.3.9 Process instance two from Patrick's viewpoint

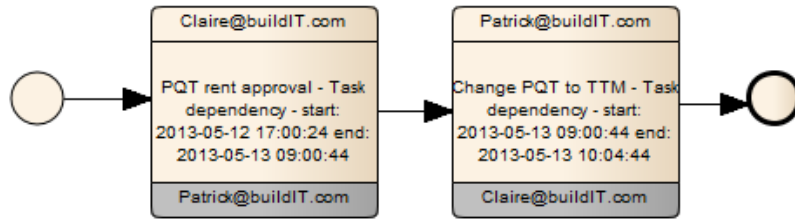


Figure 25. Process instance from Patrick's viewpoint

5.3.2.3.10 Combined viewpoints for the second instance

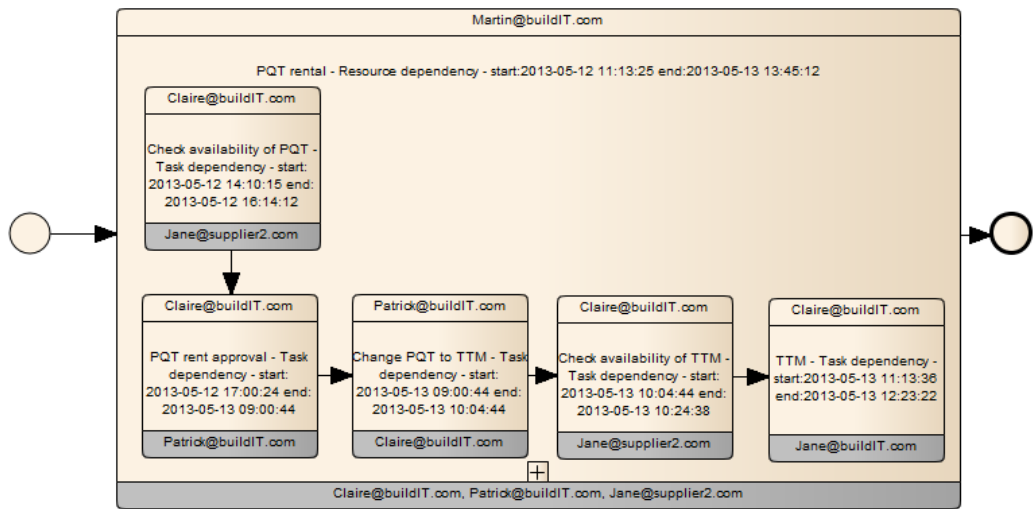


Figure 26. Combining the viewpoints

The following diagrams in Figure 27 to Figure 31 are related to the third instance of the process.

5.3.2.3.11 Process instance three from Kevin's viewpoint

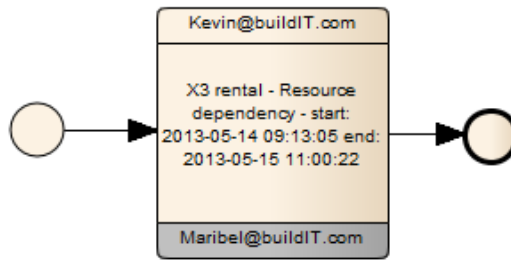


Figure 27. Process instance from Kevin's viewpoint

5.3.2.3.12 Process instance three from Maribel's viewpoint

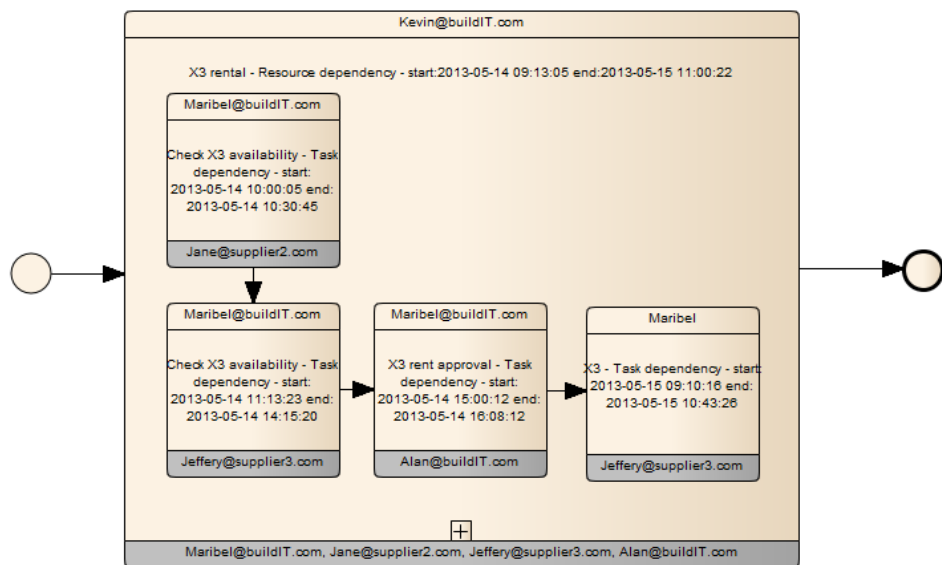


Figure 28. Process instance from Maribel's viewpoint

5.3.2.3.13 Process instance three from Jeffery's viewpoint

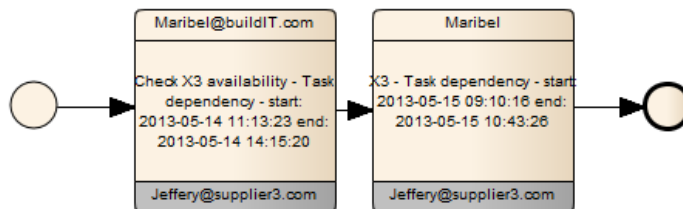


Figure 29. Process instance from Jeffery's viewpoint

5.3.2.3.14 Process instance three from Alan's viewpoint

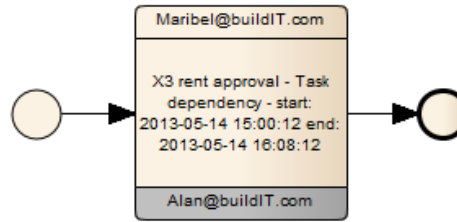


Figure 30. Process instance from Alan’s viewpoint

5.3.2.3.15 Combined viewpoints for the third instance

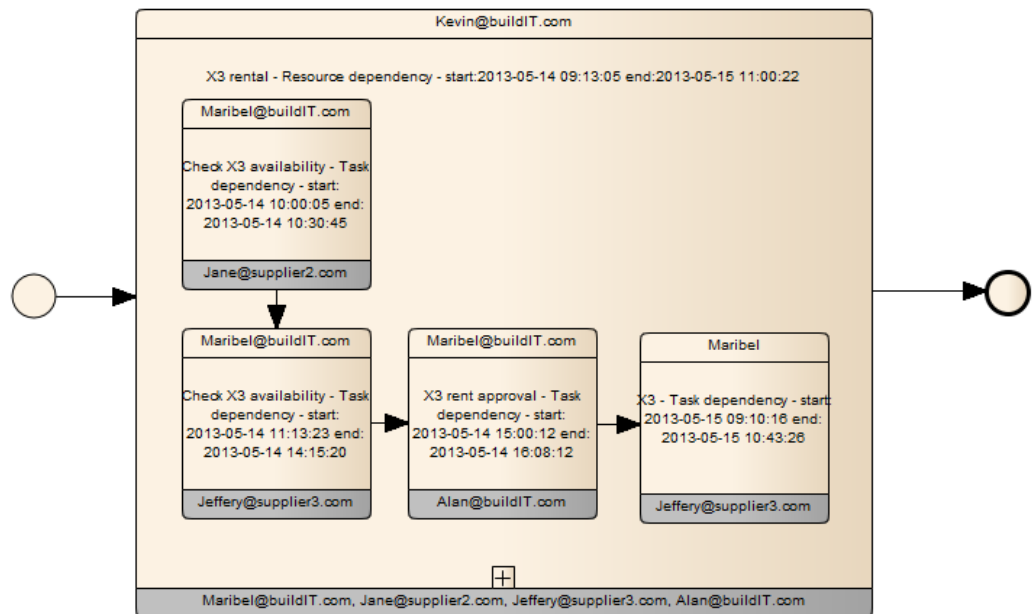


Figure 31. Combining the viewpoints

In the next two subsections, the last step of the method (step 4), that is, creating the models from the combined viewpoints, will be illustrated.

**5.3.3 Business process fragment model according to the proposed new definition**

According to the new definition of the business process model in the pluralist and coercive problem contexts, the process instances should not be reduced to a unified model, due to the importance of each process instance and the dynamic nature of the processes. Therefore, the following diagram (Figure 32) is the incomplete business process model (business process fragment model) that has been extracted from the email messages. As this business process has the characteristics of

processes in the unitary problem context, in the next section it will be explained how the conventional business process model can be created from the extracted instances as well.

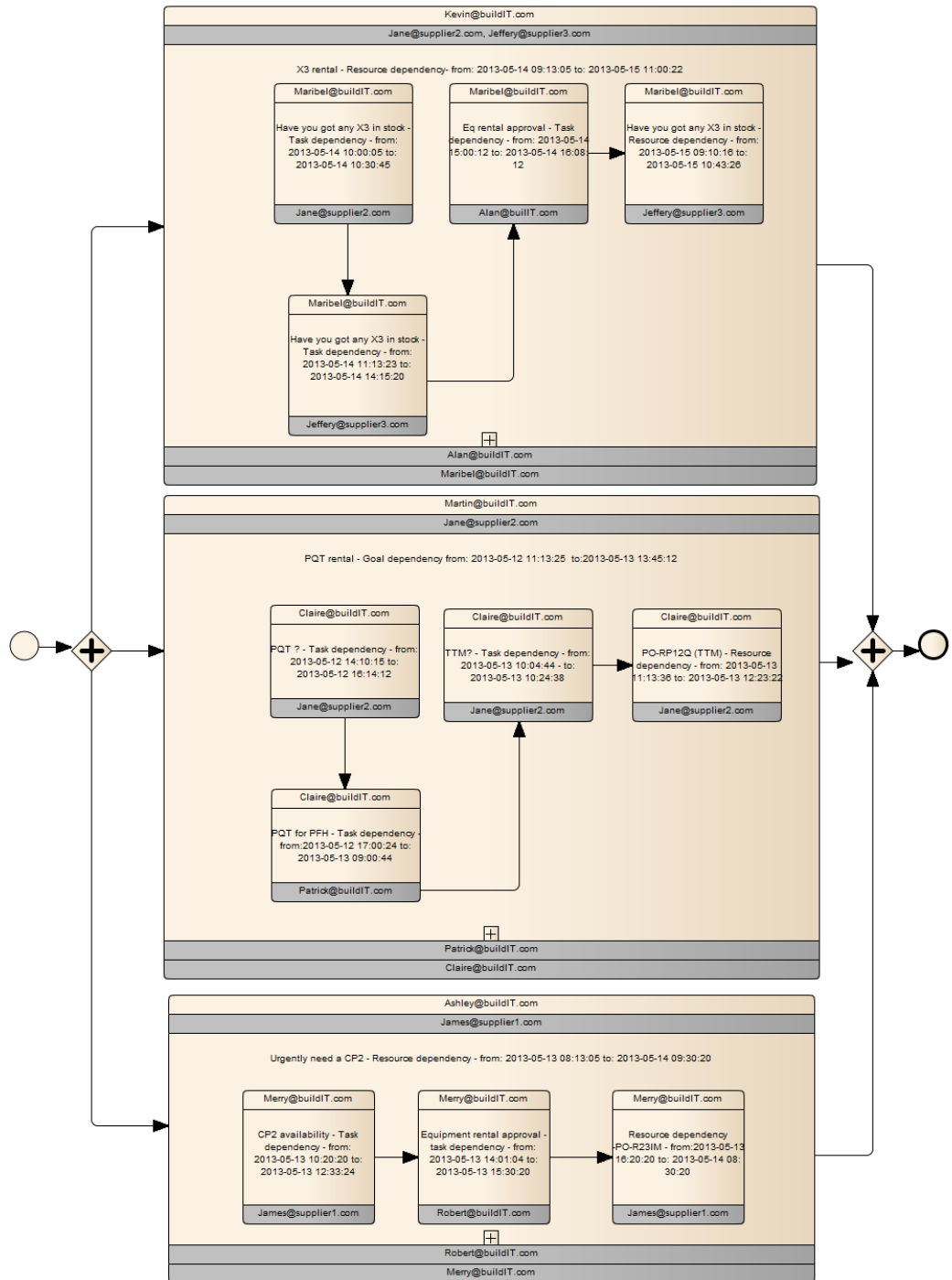


Figure 32. Case study I discovered business process model based on the proposed new definition of the business process models

The process model in Figure 32 has been formed by the compilation of three instances of the process. As the instances have had time overlaps, they have been drawn as three parallel instances (the cross in the diamond notation illustrates parallel instances).

#### **5.3.4 Conventional business process model**

The obvious similarities and patterns between different instances of the business model can suggest that this process has got the unitary problem context's characteristics, so by finding these patterns we can turn the business process model that has been created according to the proposed new definition to a conventional business process model. The following model in Figure 33 is the previous business process model (see section 5.3.3) that has been turned into a conventional business process model. It is worth mentioning here that not all process models can be reduced to conventional business process models. To create the diagram in Figure 33 we first substitute the role instances with the roles in each instance of the process. It means Ashley, Kevin and Martin turn into "Site engineers", Merry, Jane and Maribel turn into "Clerks", Robert, Alan and Patrick turn into "Works engineers" and finally James, Jane and Jeffery turn into "Suppliers". By doing this the pattern can be seen much more easily. Site engineers always ask the clerk for a new equipment rental; the clerk checks the availability of the equipment with one of the suppliers and continues this until she finds a supplier; then she seeks the works engineer's approval for renting that equipment; if the works engineer approves she goes ahead and rents the equipment from the supplier. It should be mentioned here that in the real world to be able to turn the patterns of a process in a unitary problem context into a conventional model more instances are needed than just three instances of the process.

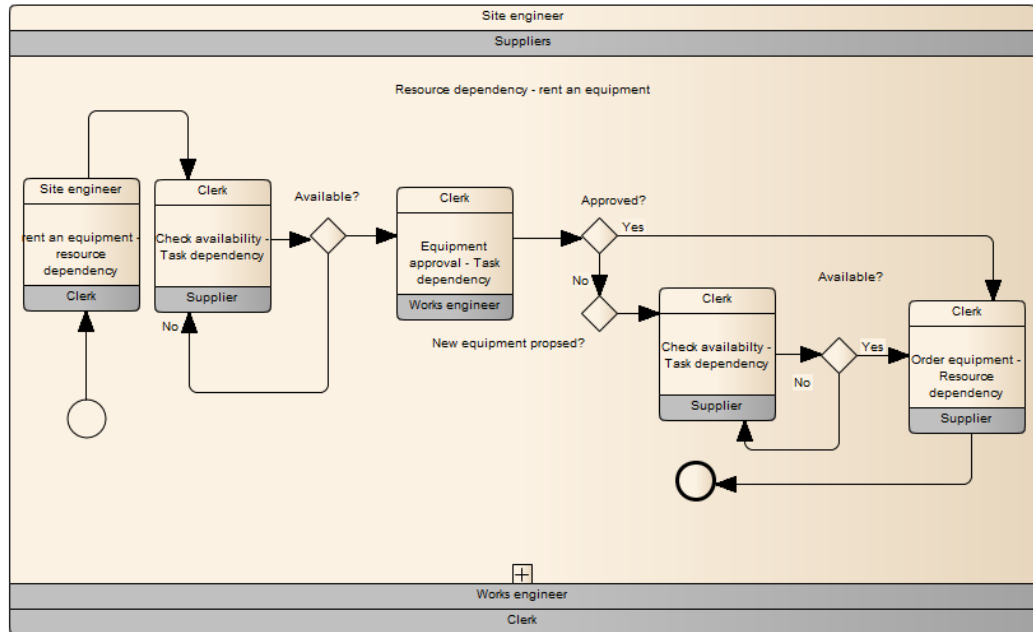


Figure 33. Case study I discovered business process model turned into a conventional business process model

### 5.3.5 Analysis of the results

By restating the final process model in words, the outcome of the method can be compared with the business process model that had inspired the email communication and was discussed in sub section 5.3.1.

The process model that the above model illustrates can be translated to:

“The process starts when the site engineers depend on clerks, works engineers and suppliers to provide them with a piece of equipment they need. The clerks then depend on one of the suppliers to provide them with the availability of that piece of equipment. If the equipment is not available the clerks select another supplier and repeat the process. If the equipment is available the clerks ask the work engineers to approve the rental. If the works engineers approve the rental the clerks fill in a purchase order and send it to the suppliers and the suppliers deliver the equipment to the site. If the works engineers don’t approve the rental they need to recommend new equipment for which the clerks need to repeat the process of checking the availability with the supplier and if available sending them the purchase order.”

The following points can be noted by comparing the original narrative of the business process and the discovered one using the framework’s method:

- The discovered process is conceptually quite close to the original one.
- The focus of the discovered process is on people and their interactions rather than the tasks they carry out. For instance the discovered process does not suggest any supplier selection method to the clerk, or how the clerk should keep a record of the orders made while the original business process description talks about “Clerk selects the most *cost-effective* equipment that complies with the request” or “Clerk records the engagement of the equipment in a spread sheet that is maintained for the purpose of tracking all equipment rentals.”
- As was expected, as some of the routes have not been traversed by the email communications, the discovered process is not complete. For instance, it does not tell what happens if the equipment rental is rejected by the works engineer completely, or what happens if none of the suppliers have got the equipment available. This shows that the completeness of the discovered diagram is directly related to two factors:
  - The number of interactions that have happened using the selected medium (email messages here)
  - The traversed routes by the extracted instances of the process.

#### **5.4 CASE STUDY II (REAL EMAIL CORPUS)**

In the second case study about 10,000 emails relevant to two big software development projects have been analysed. The business process under investigation was the supplier selection process. These two processes are no longer in a unitary problem context and this fact will be discussed in the analysis of the results section. Due to the privacy policy issues, the analysed emails cannot be shared, but the discovery process will be explained and the final extracted business process fragments can be found in section 5.4.2.

This case study demonstrates the following points:

- The framework’s method can successfully be applied to real email corpora and meaningful process models can result from this exercise.



- The outcome of this exercise can reveal interesting information about how people carry out their jobs and how power has an impact on the path that the process follows (coercive problem context).

#### **5.4.1 Email corpus**

The email corpus under investigation for case study II consists of about 10,000 email messages about two big software development projects. The main limitation of this email corpus is that it has been exported from the mailbox of one person who has been the project manager of the software development project. Therefore, it can be argued that the extracted models show the process instances from the project manager's point of view. On the other hand, due to the role of the project manager as the mediator of most of the collaborations, interactions and communications, it can be assumed that he has had a good visibility of the main parts of the process.

#### **5.4.2 Applying the framework's method to the email corpus**

In this subsection it will be explained how the method has been applied to the email corpus.

##### ***5.4.2.1 Pre-processing (step 1 of the method proposed in section 4.4.2)***

This step has been done manually using the software tools that were mentioned in section 4.4.2, and some heuristics, in order to facilitate and speed up the process that will be discussed later.

The following information was already available:

- The email corpus contains relevant emails about two software projects.
- The start and end date of each project was already known.
- The start of the implementation phase in each project was known.
- The business process under investigation was the supplier selection process
- The email addresses of the main project stakeholders were known.
- The working titles of the products of the projects were known.

The pre-processing was done in the following steps:

1. The newsletter, announcements and other group messaging email addresses were identified and all the emails that had been sent by them were deleted as they were just noise.
2. All the emails from email addresses that were obviously outside the scope of the process under investigation such as emails from facilities were deleted for the same reason.
3. According to the start date and end date of each project, the email corpus was divided into two sub-corpora (the second project had started after the first project had finished). Within each sub-corpus, one instance of the supplier selection process has been found.
4. All the emails dated after the start of the implementation date in each project were deleted as it could easily be established that the supplier selection process should be finished before the implementation could be started.

After these first steps of pre-processing, the number of the emails to be analysed was reduced to 1200 emails. 300 emails were related to the first project and 900 to the second project. Then each of the emails was analysed manually for direct relevance to the supplier selection process. Ultimately, 96 emails in the first corpus and 373 emails in the second corpus were directly related to the supplier selection process.

#### ***5.4.2.2 Extracting dependency cycles (step 2 of the method proposed in section 4.4.2)***

In this phase a simple application called Dependency Cycle Extractor (DCE) that was implemented specifically for this purpose was used. This application reads the emails from the pre-processed email database and leads the analyst through the sub-steps of the dependency cycle extraction. The analyst can tag emails with different speech acts and then create the dependency cycles by connecting relevant emails as was described in section 4.4.2. The analyst can also define nested choreographies or sub-processes in this application and use the result for the further steps of the analysis. The results of applying this step to both email corpora can be found in appendix C, and which contain a number of dependency cycles and whether

they are a task or a sub-process (nested choreography) according to the BPMN 2.0 (Omg.org, 2011) choreography diagram definition.

#### ***5.4.2.3 Translating the dependency cycles to BPMN2.0 choreography diagrams (step 3 of the method proposed in section 4.4.2)***

Figure 34 and Figure 35 illustrate the extracted choreography diagrams. Each of them shows an instance of the supplier selection process. As the diagrams might not be legible, the BPMN2.0 XMLs are available in appendix F and G which can be converted to BPMN 2.0 choreography diagrams using any tool that supports this modelling notation. It is worth mentioning here again that the emails have been extracted from the project manager's inbox so the models describe the fragment of the process that has been visible to him – or, in other words, the models represent the business process from the project manager's perspective.

#### ***5.4.2.4 Case study II, Project I brief high-level supplier selection process narrative***

Here a very high-level explanation of the discovered business process fragment for Project I will be narrated. The details of the process have been abstracted as they can be found in the model (Figure 34) and the BPMN2.0 XML file (appendix F).

The process instance fragment has started from requesting an initial quote from a company named MMT and in parallel working on the details of the requirement specification document. Then the quote has been discussed and in parallel a number of supplier selection process update requests have been answered. Then a consultation about requesting more companies to quote for the work has happened and then a permission to involve other companies have been requested and granted. After that, two more companies, UNO and GI, have been requested to quote for the job and MMT has been asked to revise its quote based on the more detailed requirement specification document. Meanwhile a request for progress updates has been made and replied to. Finally UNO, submits a proposal and MMT revises its proposal. The team consults with the head of department about UNO's proposal, and in parallel, background checks UNO. UNO gets selected and informed. MMT requests an update on the progress of the selection process and gets informed that it has not been selected for the job and other team members request an update on the progress of the selection process and are informed about the selected supplier. The process instance fragment ends after the project gets kicked off.

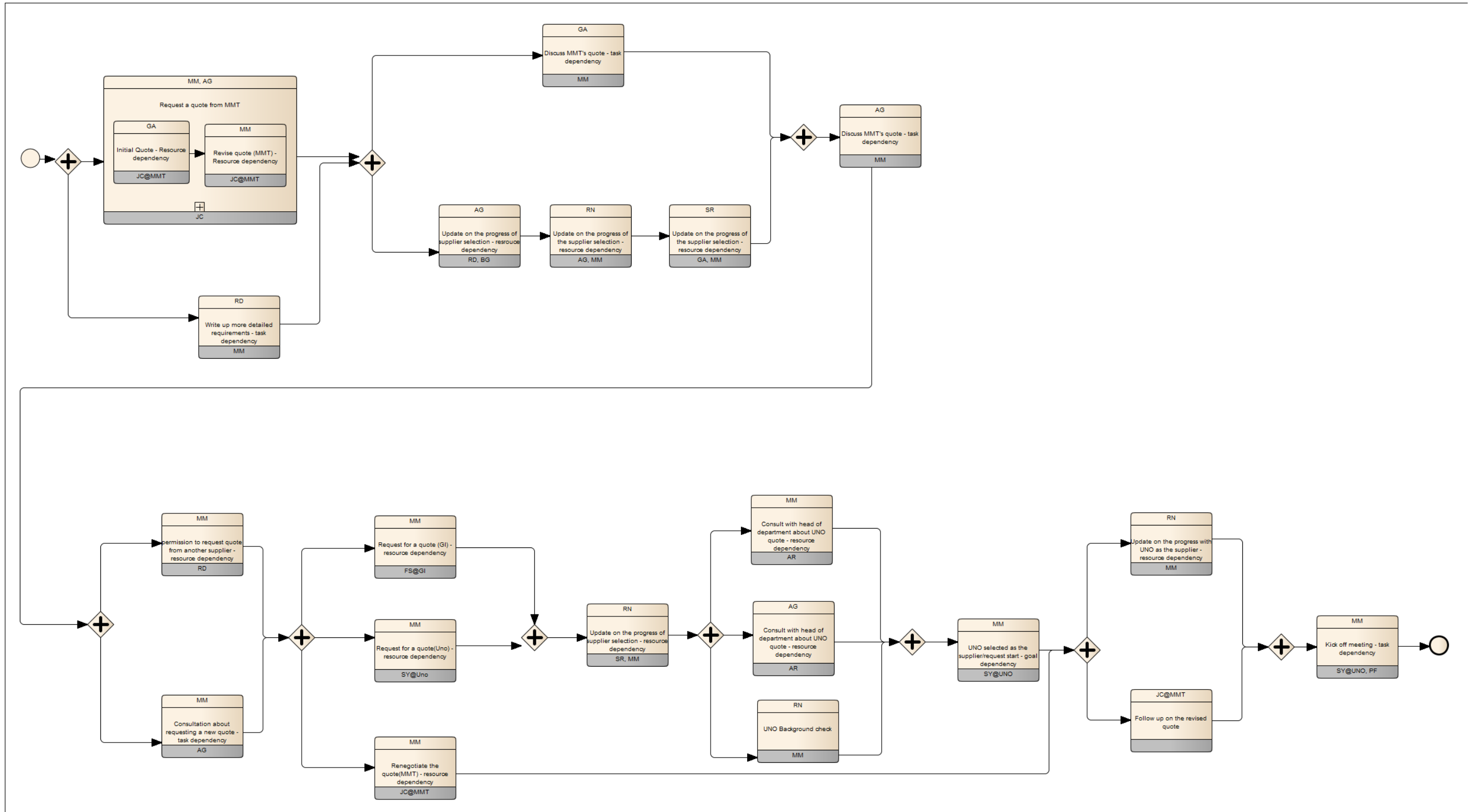


Figure 34. Discovered business process instance from project I

#### 5.4.2.5 *Case study II Project II brief supplier selection process narrative*

Here a very high-level explanation of the discovered business process fragment for Project II will be narrated. The details of the process have been abstracted as they can be found in the model (Figure 35) and the BPMN2.0 XML file (appendix G).

This process instance fragment can be divided into four main sections:

1. *Pre-negotiations and prototype creations*: In this section of the process instance fragment three suppliers (MMT, EDCO and Codgent) and their products have been evaluated, they have been asked to provide initial proposals and they have been asked to develop prototypes while more work on the requirements have been taking place.
2. *Request for proposal and quotes and assessing one of the currently available internal products*: In this section, a number of other suppliers (Orange bus, Learning mate, Unovision, Headlondon) in addition to the previously mentioned ones have been asked to put forward a proposal. In parallel an internal product named eText has been analysed.
3. *Selection of the supplier report generation and discussions*: In this section, the received proposals in the previous section have been compared and contrasted and a report has been generated that suggests the preferred combination of suppliers for different components of the product.
4. *Sudden change of direction from previously assessed supplier to a new supplier and then its selection as the project supplier*: In this section, after five months of investigation and analysis the results of the previous analysis gets ignored, a new supplier gets introduced to the team, gets analysed and selected for all the different components of the product in around two weeks.



### 5.4.3 Analysis of the results

To verify the meaningfulness and partial correctness of the extracted diagrams they were shared with two of the project participants (the project manager and the platform manager of the projects) and they confirmed that the models are a good representation of the reality “as far as they remember”. The second instance of the process was shared with the project manager’s line manager, who was not directly involved in the project but was aware of the progress of the project. For him the change of direction at the end of the supplier selection was interesting. This will be discussed later. The first process instance from the first project emails was shared with the product owner as well. The number of progress update requests made by the project manager and the product owner, to the people who were responsible for finding a supplier for the project development, was interesting to him. Out of 23 extracted main dependency cycles, six of them were somehow related to update requests from other team members such as publishers and the project manager. It was pointed out that this shows that there has been some kind of communication problem between the people responsible for supplier selection and the rest of the team. It would have been better if the diagrams from the second project could have been verified by some participants who had different roles (other than project management and platform management and line management) to verify it from different perspectives, but due to some organisational barriers that was not possible.

An interesting point that confirms the importance of power and power distribution and its impact on business processes can be shown on the second process instance (Figure 35). Looking at the progress of the supplier selection, as was mentioned in the process instance fragment narrative, four main sections can be recognised in the above diagram:

- Pre-negotiations and prototype creations (marked by blue dashed lines on the diagram)
- Requests for proposal and quotes and assessing one of the currently available internal products (marked by green dashed lines)
- Selection of the supplier report generation and discussions (marked by yellow dashed lines)

- Sudden change of direction from previously assessed supplier to a new supplier and then its selection as the project supplier (marked by red dashed lines)

In other words, a lot of people spend a noticeable amount of time assessing different suppliers (from the start of the first dependency cycle 14/09/2011 to the end of the last dependency cycle in the supplier selection phase before change of direction 17/01/2012, about five months and about 19 different people) and then a report get generated that reflects the result of the assessments and the preferred suppliers based on five months of investigation. Before the compilation of the report on 19/12/2011 another system gets presented to one of the influential people and after the report generation the project managers are asked to investigate that system and its supplier as a potential supplier and after two weeks that supplier gets selected. One might think that this newly found supplier has actually been a better supplier but from the email contents the pressure that has been put on the project managers and their unhappiness with the process can easily be felt.

This is the part of the process that does not usually get documented or could not be discovered by a business analyst by interviewing people or having workshops with them unless he has closely and directly been involved with the project. This part of the process emphasises the importance of power and power distribution in the realisation of business processes, and that is what has been called the coercive problem context.

The analysis of the results even for the models that have been created out of a limited number of emails and from one person's mailbox clearly shows the usefulness and applicability of the proposed method. Discovered business process instances not only made some valuable information known to the team about the process problems (for instance, too many update request resource dependencies) but also revealed some interesting information about the role of coercion in the process flow. The author's experience shows that due to organisational politics, it is very difficult for business analysts to get hold of this kind of information.

Although according to the above paragraph the process as a whole can be classified as a process in the coercive problem context, the request for proposal phase (marked by green dashed lines) has similarities with the extracted process from the



previous project. Although two instances are definitely not enough for making such a conclusion but this similarity demonstrates to some extent that a subset of the fragments of the business process might still have characteristics of the process in the unitary problem context and might follow a unified pattern of activities but it is safer (for not losing any information) for processes in pluralist and coercive problem contexts not to reduce the accuracy of the model by unifying them and keeping the final model as a compilation of instances.

#### **5.4.4 Business process model according to the proposed new definition**

Due to the dynamic nature of the supplier selection process and its characteristics that can classify it as being in the coercive problem context (because of its direct relation to organisational politics, power distribution, personal interests and objectives of higher-ranking people in the organisation) the actual business process model can only form in infinity (when no new instances are being added) when all the different business process instances have been extracted. But a business process fragment model that is the compilation of two process instances can be found in Figure 36. The important point is that as there has been no time overlaps between the two instances and they have happened sequentially and as execution of one instance might have had an impact on power distribution and many other factors, these two instances should be modelled sequentially and they have not been modelled as parallel instances.

#### **5.4.5 Ethical considerations**

It can easily be realised from the process of application of the conceptual framework's method to email messages (or more generally conversation logs), that ethical considerations should be addressed from two different points of view:

1. Sensitivity (from the business point of view) and personal nature of the source of information (email messages or more generally conversation logs)
2. The generated models from applying the framework's method that reveal information about power distribution, politics and even process participants' personalities which can all be sensitive and important information for the organisation

In Subsection 6.5.1 the first point and more specifically email messages and their relevant ethical considerations will be discussed further but it should be mentioned here that as email and conversation log corpora might contain sensitive personal and business information, great care and vigilance should be exercised in handling and using the information. Usually the data should be anonymised and further legal considerations should also be taken into account when dealing with this type of information.

Regarding the second point, as the generated models might reveal information about people, their authority, distribution of power, their organisational characteristics and personalities (this point will be further discussed in subsection 7.2.2) and this information might have an impact on the personal, social and organisational lives of the business process participants, it is extremely important to handle the revealed information, and the drawn conclusions from the models with utmost care. People whose data is being processed should announce their consent beforehand and legal advice or formal consent from the process participants should be sought before revealing the findings of the method, in particular if any controversial results have been found.

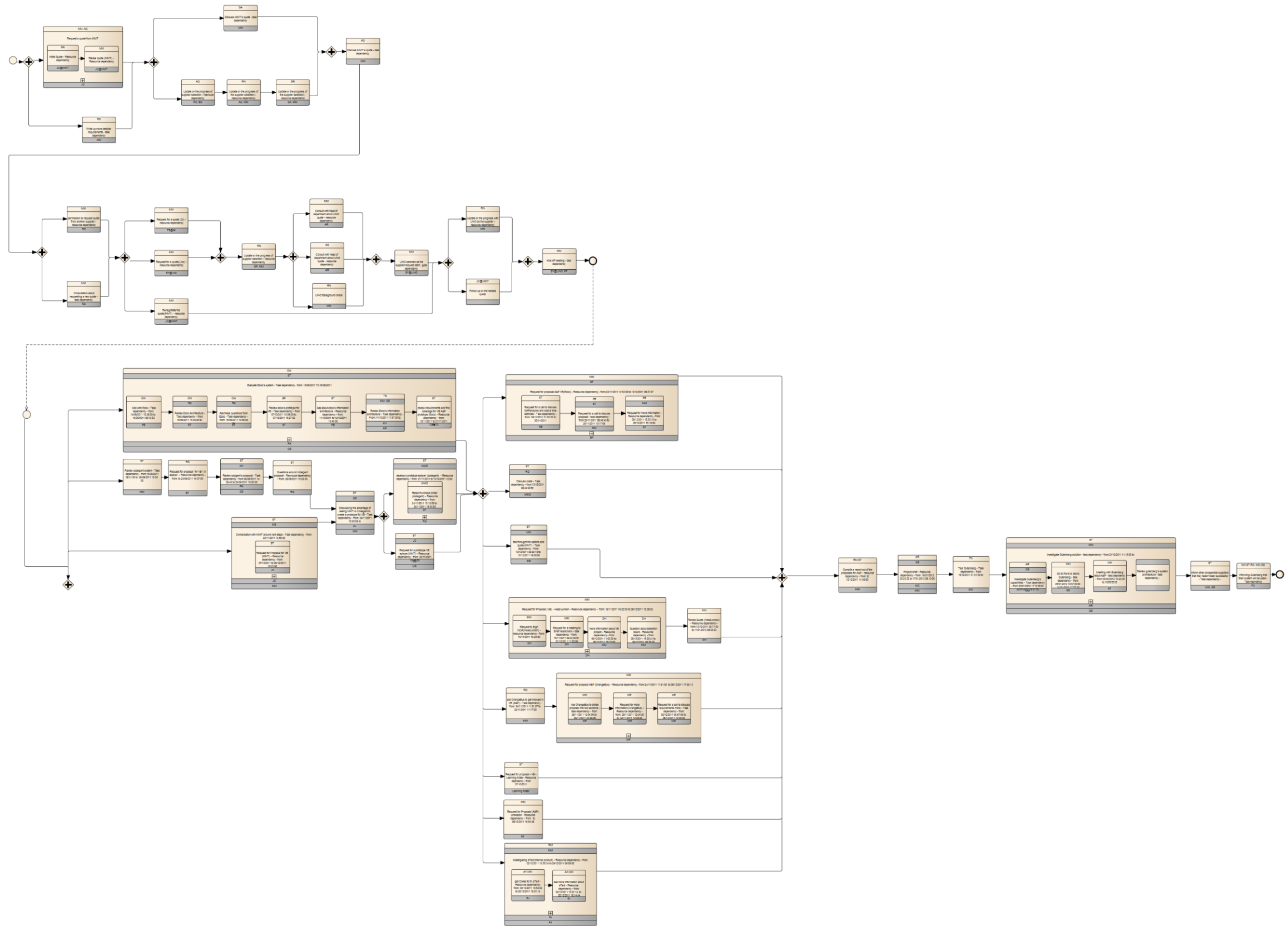


Figure 36. Fragment of the business process model

## 5.5 CHAPTER SUMMARY

This chapter covered the demonstration step of the DSR methodology. In this chapter, using two case studies the following points about the proposed framework and its technique for business process discovery through email analysis were demonstrated:

- The method can successfully be applied to email messages and can create correct, conventional business process models in unitary problem contexts.
- The method can analyse the process from different participants' perspectives. It can show the analyst what part of the process the participants have been taking part in and what part has been hidden from each participant.
- If we find similar patterns between a comparatively large number of extracted process instances, it is likely that the business process under investigation is in the unitary problem context, and a conventional business process model can be created for it from the extracted instances, and we do not need to keep analysing all the emails.
- Using the framework and its method a comparatively complete picture of the process can be created that includes different participants' viewpoints.
- The completeness of the process model created has a direct relation to the number of mailboxes of the participants, their emails that are accessible to the business analyst and the part of the interactions that have happened using email messages. The fragmentation of the business process is also related to the accessible emails and the parts of the collaboration and interaction that has happened using this medium.
- The framework's method can successfully be applied to real email corpora and meaningful and useful process models can result from this exercise.
- The outcome of this exercise can reveal interesting information about how people carry out their jobs and the great impact power has on the direction of the process flow (in the coercive problem context).

These case studies demonstrated that the research's artefact, the conceptual framework, and more specifically the method that has been developed based on the

conceptual framework, are capable of creating conventional business process models in the unitary problem context. They also demonstrated that they can create business process models based on the new definition of the business process, in pluralist and coercive problem contexts. They also show that the discovered business processes, according to the new definition, are closer to the reality of the ways people work in the organisation. They do not reduce the business processes to a unified model and they better represent the dynamism of the business processes and the impact of power distribution and autonomy of the process participants. Another interesting point demonstrated was that different parts of a single business process can be in different problem contexts. This point can be used in the next stages of BPM, for instance, different tools and techniques can be used for process design and enactment of different parts of the process in different problem contexts.

Using email messages, it was demonstrated that the conversation logs suffer to a lesser extent from human memory and cognition limitations than conventional sources of information. From the emails, business process details, which would otherwise have been forgotten, have been extracted and the impacts of the power distribution and political matters have also been exposed.

The case studies, also revealed some limitations of using just one source of data as the conversation log (incompleteness in case study I and incompleteness and fragmentation in case study II) and made clear that to have a more complete picture, taking advantage of different data sources (such as meeting minutes, social network chat logs, transcribed telephone conferences) and non-transcribed conversation logs (such as recorded telephone calls, meetings or telephone conferences) and even conventional sources of information (such as interviews and workshops) can be of great value.

The second case study also clarified the importance of ethical considerations and more specifically careful and vigilant handling of the data as well as careful interpretation of the resulting models.

# Chapter 6: Evaluation

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## 6.1 INTRODUCTION

This chapter covers the fifth step of the Peffers, Tuunanen & Gengler (2006) process model for DSR methodology, which is evaluation. At this stage the suitability of the applied research methodology will be discussed and the results of the demonstrated solution will be evaluated to see how well the artefact supports a solution to the research problem. In section 6.2 suitability of the selected research methodology (DSR) will be assessed. In section 6.3 the research problem will be restated and the extent to which the case studies have demonstrated the applicability of the proposed conceptual framework and its method for business process discovery through email analysis will be evaluated. In section 6.4 the applicability of the proposed conceptual framework to different process types will be discussed and finally in section 6.5 the limitations and shortcomings of the framework's method will be discussed and some mitigation strategies will be suggested for each of them.

## 6.2 EVALUATION OF THE SUITABILITY OF DSR AS THE SELECTED RESEARCH METHODOLOGY

In order to evaluate the suitability of the DSR as the selected research methodology for this research the distinction between natural science and science of the artificial (design science) should be revisited:

“A natural science is a body of knowledge about some class of things – objects or phenomena – in the world (nature or society) that describes and explains how they behave and interact with each other. A science of the artificial, on the other hand, is a body of knowledge about artificial (man made) objects and phenomena designed to meet certain desired goals.”(Simon, 1996)

As Vaishnavi & Kuechler Jr. (2007) also believe, justification of the use of DSR in Information and Communications Technology (ICT) is easy, as artefact construction is an important part of the community paradigm. However, it would be more difficult to justify the use of DSR in IS due to its socio-technical nature.

As was mentioned in Chapter 3: Research Method, IS is a multi-paradigm discipline, situated in both natural science (more specifically behavioural science) and design science (science of the artificial) paradigms (Hevner & Chatterjee, 2010). The paradigm in which the research is situated, and as a consequence, a suitable research methodology necessarily result from the formulation of the research.

To clarify this matter, the problem that this research attempts to address and its aims and objectives will be restated here and its characteristics that make it a good candidate for DSR will be discussed.

As was mentioned in the “Statement of the research problem” subsection, this research started by identifying a paradigmatic limitation in current BPM objectives and definitions that has caused the outcomes of its practices to be far from the reality of many organisations. As a result of this, information systems built based on the findings of these practices are found not to be completely functional and satisfactory for the process participants. The aim of this research has been developing a conceptual framework that does not suffer from that paradigmatic limitation. So the objective has been to develop an artefact to solve an identified problem which clearly situates the research in the design science paradigm.

Vaishnavi & Kuechler Jr. (2007) define the outputs of DSR as: (1) constructs, (2) models, (3) methods, (4) instantiations and (5) better theories.

Considering the outputs of this research that are (1) suggested new definitions for business processes and business process models (conceptual framework construct), (2) a new construct called dependency cycle (conceptual framework construct) and, (3) a proposed new method based on conversation log analysis for business process discovery (model) and (4) a method based on the conceptual framework for business process discovery through email analysis (instantiation), it can be clearly concluded that the outcomes are certainly in line with the expected outputs of design science based research. They vividly show that the application of this research methodology has been successful in creating the required and expected outcomes.

### **6.3 THE EXTENT TO WHICH A SOLUTION TO THE RESEARCH PROBLEM HAS SUCCESSFULLY BEEN DEMONSTRATED USING THE CASE STUDIES**

As was discussed in section 1.2, the problem that this research is trying to address is the fact that the discovered business processes in the process discovery phase of the BPM are not close to the reality of the organisational business processes. This problem causes a great number of BPM projects to fail and the business process support systems that are created for these processes to have great alignment problems. (Dumas, La Rosa, Mendling, *et al.*, 2013; Aalst, 2003; Attaran, 2004)

In chapter 2 the main shortcomings of the conventional business process analysis definitions and techniques were discussed and they were categorised as follows:

1. Conventional business process analysis definitions and techniques are bound to the unitary problem context.
2. Conventional business process analysis techniques suffer from two knowledge-acquisition shortcomings: human memory and cognition limitations.

The objective of this research has been to find a solution that addresses the shortcomings of the conventional business process analysis definitions and techniques.

In Chapter 4: a conceptual framework based on creative holism and leveraging sound theories was introduced with new definitions for activities (business tasks), business processes and business process models that were not bound to the unitary problem context. Then a new data source (conversation logs) for business process discovery was introduced to reduce human cognition and memory limitation impacts on the outcomes. A method for this conceptual framework was developed in section 4.4 that uses email messages as the conversation logs and in Chapter 5: the method was used in two case studies.

To show that the conceptual framework and its method address the first mentioned shortcoming (the paradigmatic issue – being bound to the unitary problem context), in the case studies the method was applied in two different problem contexts to show that although the conceptual framework's definitions and



techniques are still valid in the unitary problem context, they are not bound to it and can be applied to other problem contexts. Case study I was in the unitary problem context and therefore both conventional process models and process models based on the new definitions were created for it; and case study II was in the coercive problem context and the impact of the coercion was illustrated in the discovered business process instances and the business process fragment model was created for it based on the new proposed definitions.

The second case study also demonstrated how the human memory and cognition limitations can to some extent be addressed by using the proposed technique:

- The extracted details of the process could hardly be remembered by process participants when they were interviewed afterwards.
- The fourth part of the discovered business process instance in the second case study, project II (Figure 35 – red dashed box) that shows the sudden change of direction from the previously assessed supplier to a new supplier also demonstrates that the new data source does not suffer from representativeness or bias and does not omit information due to political reasons.

All these points illustrate that the case studies have successfully provided strong support that the conceptual framework and its method can address the aforementioned shortcomings of the conventional business process analysis techniques to a great extent.

#### **6.4 THE APPLICABILITY OF THE CONCEPTUAL FRAMEWORK TO DIFFERENT PROCESS TYPES**

In the previous two subsections, it was discussed that the aim of this research has been to develop a conceptual framework for business process discovery that does not have the inherent paradigmatic limitation of the conventional business process discovery techniques and also suffers to a lesser extent from human memory and cognition limitations. This conceptual framework has been developed using the DSR methodology and it was demonstrated through two case studies that the aims and objectives of the research have been achieved.

In this subsection, the environments and the type of business processes that the conceptual framework would be most effective will be discussed.

In the “Context of the Study” subsection, it was indicated that one of the main points that inspired initiation of this research has been alignment problems of Business Process Support Systems with the reality of the organisational business processes.

Dumas, Aalst & Hofstede (2005) categorise these business process support systems or as they call them Process Aware Information Systems (PAIS) into three classes that each enact one of the following process types:

1. Person to Person (P2P) processes: processes in which the tasks primarily require human intervention.
2. Person to Application (P2A) processes: processes in which the tasks require a combination of human intervention and those that can be completed by applications.
3. Application to Application (A2A) processes: processes in which the tasks do not require human intervention.

Processes can be categorised based on their structure and predictability (Dumas, Aalst & Hofstede, 2005; Weske, 2007) into the following classes:

1. Unframed: no explicit process model associated with it
2. Ad-hoc framed: process models get neglected or change dynamically
3. Loosely framed: process models only define normal way of doing things but deviations are allowed
4. Tightly framed: a process that tightly follows a predefined process model.

Now we will consider applying the conceptual framework and its method to problem domains that have the characteristics of each of the above categories:

**Application to Application processes:** these processes are always tightly framed. If application to application communications are considered a specific type of conversation, dependency models can be extracted that show how different applications depend on each other to fulfil a specific objective. It should be mentioned that, probably, by looking at architectural models, this can be achieved

more easily and applying the framework's method does not add any real value. It should also be mentioned that A2A processes are obviously always in the unitary problem context.

**Person to Application processes:** These processes are either loosely framed or tightly framed. Processes enacted by workflow management systems are one example of P2A processes. Tightly framed P2A processes are also in the unitary problem context due to the fact that it is the machine that usually dictates the process which should be followed, and machines are not strategic, autonomous agents. Also, applying the conceptual framework to these processes does not add any real value, as the process models can easily be extracted from workflow management systems. The conceptual framework can be applied to loosely framed P2A processes but other process discovery techniques such as process mining usually create more precise results due to the fact that work flow management systems usually log the happening events and the deviations from the defined process can easily be extracted from these event logs.

**Person to Person processes:** these are the type of processes for which the conceptual framework has been designed. These processes are usually unframed or ad-hoc framed. Most of these processes are not in the unitary problem context and, as discussed throughout the thesis, no business process discovery techniques exist for processes in pluralist or coercive problem contexts.

## 6.5 LIMITATIONS AND SHORTCOMINGS

In this section, the limitations and shortcomings of the proposed solution will be discussed and some remediation strategies will be suggested.

### 6.5.1 Having access to an organisation's conversation logs and the privacy issue

One of the main non-technical issues with the proposed approach is having access to an organisation's conversation logs or, more specifically, its email corpora. There are still a lot of ambiguities in the email usage policies of many organisations. This prevents them from being able to freely allow access to their email corpora. For instance, although NHS West Sussex in its email policy mentions that "PCT (Primary Care Trust) retains the right of access and ownership of all emails sent from and received by its systems" in another clause it permits the staff to limited personal use of the emails:

“Although personal use of e-mail facilities is discouraged, limited personal use is permitted provided it is consistent with the PCT’s code of conduct and does not interfere with the performance of your duties.”

This clause makes them automatically aware of their obligations under article 8 of the Human Rights Act that states, “Everyone has the right to respect for his private and family life, his home and his correspondence.”

This shows that although most of the organisations mention in their email policy that they own the email contents being sent and received via their email systems, there are still some sensitivities around personal emails that end up in organisational email corpora. This shows that further legal analysis and investigation should be carried out around this matter in organisations that wish to adopt the proposed framework and technique for business process analysis.

### **6.5.2 The framework and the framework’s method’s reliance on the business analyst’s expertise**

One of the issues that has been raised about the framework and its technique has been its over-reliance on the business analyst’s expertise in the last step, which is combining the detected business process fragments for creating the bigger picture, and also finding similar patterns between different extracted business process fragment instances (in the unitary problem context). The framework, or its technique, does not suggest any automatic method for fulfilling the above objectives, and relies on the human expert to carry out those tasks.

The researcher believes that this characteristic of the framework by itself cannot be considered a negative point or a deficiency. As was discussed in section 4.2.6 almost all other business process analysis techniques, that are being adopted today, rely not only on the expertise of the business analyst but also, as was discussed earlier, to some extent on the familiarity of all other business process participants with business process analysis concepts.

One of the objectives that this framework is trying to achieve is the migration of all the expertise and requirements of business analysis to the business analyst, which is more practical and achievable, specifically in large organisations.

### **6.5.3 Fragmentation degree of the extracted models**

As was mentioned earlier, the completeness of the extracted models using the proposed framework is directly affected by the completeness of the conversation

corpora under analysis, and the percentage of the dependencies that manifest themselves in that selected conversation medium. For instance, if emails have been chosen as conversation logs, the completeness of the resulting model is related to the:

- Number of relevant emails that have been successfully captured
- Percentage of the conversations that have happened using email messages rather than other mediums such as meetings or telephone.

Both of these limitations can be mitigated to a large extent by not limiting the analysis to only one type of conversation log. It means that the business process fragment instances could be extracted from different sources such as emails, transcribed telephone conversations, transcribed meeting conversations and social networking tools. Then the last step of the framework, which is combining the fragments and creating the bigger picture, will be applied to more comprehensive findings.

It is worth mentioning here again that the value of business process fragments has been more recognised recently. It has been understood that although these fragments might not be as complete or consistent as needed for automatic business process execution they do reveal valuable information (Schumm, Karastoyanova, Kopp, *et al.*, 2011).

#### **6.5.4 Not being familiar with the context of the conversation and the organisational culture**

Being familiar with the culture within which the conversation is happening or, knowing the context of the conversation, is very important in correct interpretation of the conversation. Lack of this understanding can lead to incorrect or incomplete interpretation of the words and phrases. This problem can be mitigated by the business analyst's familiarisation with the problem context through experience, consultation and collaboration with process participants.

## **6.6 CHAPTER SUMMARY**

This chapter covered the fifth step of the DSR methodology. The chapter was started by the evaluation of the suitability of DSR as the selected methodology for this research. Then, the extent to which the solution has demonstrated the achievement of its objectives by using the case studies was evaluated. It was

discussed how the case studies demonstrated that the conceptual framework and its method which are the artefacts of this solution address the research problem. In other words the extent to which the artefacts of the research managed to solve the following points was discussed:

- Conventional business analysis techniques are bound to the unitary problem context.
- Conventional business analysis techniques suffer from the knowledge acquisition problems that are related to human memory and cognition limitations.

It was discussed that the case studies strongly support the fact that the conceptual framework and the proposed method that has been derived from it, have been effective.

This fact was also deliberated that for what types of processes the proposed framework is most effective and finally the limitations and shortcomings of the proposed framework and its method were also discussed and some remediation strategies were suggested.

# Chapter 7: Conclusion and future work

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## 7.1 CONCLUSION

As was mentioned in Chapter 6:, this research was started from this research problem: the discovered business processes in the process discovery phase of the BPM are not close to the reality of the organisational business processes. This problem causes a great number of BPM projects to fail and the business process support systems that are created for these processes to have great alignment problems (Dumas, La Rosa, Mendling, *et al.*, 2013; Aalst, 2003; Attaran, 2004). This research problem was then divided into two perceived causes of the problem as follows:

- Conventional business analysis definitions and techniques are bound to the unitary problem context.
- Conventional techniques suffer from knowledge acquisition problems, mainly human memory and cognition limitations.

Therefore the research aimed to:

1. Find a definition for business processes that is not bound to the unitary problem context.
2. Find a reliable source of information that does not suffer from knowledge acquisition shortcomings and also is not tightly coupled with information systems.
5. And finally, develop a framework for business process discovery based on the new business process definition and the new source of information that creates models closer to the reality of the organisations.

Applying the DSR methodology (Peffer, Tuunanen & Gengler, 2006), and using the creative holism systems approach (Jackson, 2003), which leads the thinking towards analysing the organisation as a social system from different social paradigms, and leveraging sound theories such as the VSM definition for organisations (Espejo & Reyes, 2011), the *i\** framework (Yu, 2011), the speech act theory (Searle, 1969), the conversation for action diagram (Winograd & Flores, 1987) and episodic memory (Hasselmo, 2011), a conceptual framework was

developed that proposed new definitions for activity (business task), the business process and the business process model. It also proposed a new source of information for business process discovery that was conversation logs and put forward some heuristics to extract instances of business process fragments from this new source of information and selected BPMN 2.0 choreography diagrams (Briol, 2010) as its modelling notation. A method was also developed based on the conceptual framework for business process discovery from “email messages” as conversation logs.

Eventually, using two case studies it was demonstrated that the conceptual framework and its method have managed to address the research problems to a great extent. The conceptual framework has proposed new definitions that are not bound to the unitary problem context and it has introduced a source of information that is created by process participants whilst interacting and communicating, but suffers to a lesser extent from human memory and cognition shortcomings.

As it was mentioned in the previous chapter application of the proposed conceptual framework and its method can add the most value in discovery of unframed and ad-hoc framed P2P processes. These are the processes that are usually not in the unitary problem context and, as was discussed earlier, the current BPM definitions and techniques do not cover them. Dumas, Aalst & Hofstede (2005) specifically mention that their book does not cover this type of processes and no other literature could be found to address modelling of this type of processes without reducing them to problems in the unitary problem context.

The dynamic nature of these processes and the autonomy of their participants make them impossible to be reduced to a unified model and, as a result, the proposed conceptual framework and its modelling techniques, which are not bound to the unitary problem context, seem like a great choice for modelling them.

It is worth mentioning here again that as the purpose of the process discovery phase is understanding the current situation of the organisation or AS-IS business processes, conversation logs are an invaluable source of information, specifically for P2P processes, as the history log of process related data.

The models created from applying the conceptual framework’s definitions and techniques, help the BA to understand the reality of the organisational processes



better through several means by: (1) revealing interesting information about the role of power and power distribution in different process cases, (2) identifying the key people in the organisation, (3) clarifying the alteration of power distribution based on the outcomes of each process case, (4) showing the amount of dynamism of the process under investigation by comparing different cases, (5) illustrating the amount of autonomy of process participants and so on. As was briefly mentioned in the case study section and will be elaborated a little bit further in the Future Work subsection, the BA can even find some interesting information about process participants personalities and capabilities that should definitely be used carefully and responsibly.

Finally, it is important to mention that as the proposed conceptual framework and its methods and techniques do not necessarily directly involve the process participants and are concerned only with logged data, the generated models should be shared and verified with process participants before moving to the next steps in BPM.

In the next section some research areas will be introduced that are based on this research and can both address some of the current approach's shortcomings and also make it more complete.

## **7.2 FUTURE WORK**

In this section some interesting research areas based on the findings from this research will be introduced.

### **7.2.1 From business process discovery to business process design**

The focus of this research was on the process discovery stage of the BPM lifecycle (Dumas, La Rosa, Mendling, *et al.*, 2013). As was discussed before, all other phases of BPM rely on the results of the process discovery phase, therefore its closeness to the reality of the ways people carry out their day-to-day jobs within the organisation, has a great impact on all other following phases (Dumas, La Rosa, Mendling, *et al.*, 2013).

It was discussed in the body of the research that there is an intrinsic incompleteness inherent in the conventional BPM concepts and definitions, and this incompleteness is due to their attachment to the functionalist sociological paradigm and, as a result, the restriction of their application to the unitary problem context.

Using the creative holism systems approach (Jackson, 2003), it was discussed that organisations do not solely have the characteristics of a machine or a brain or an organism and they are not just cultural or political systems or psychic prisons or carnivals, but are very complex and dynamic systems that show the characteristics of all those aforementioned metaphors and in order to have a good understanding of them, organisations should be analysed from all different sociological paradigms. Therefore the concepts, definitions and techniques that are being used for discovery of the ways people carry out their day-to-day jobs should not be bound to one problem context and should not be attached to one sociological paradigm, so that, they can convey a closer picture to the reality of the organisations.

The new conceptual framework and its concepts, definitions and techniques are not bound to any specific problem context and the two case studies greatly supported this claim. It was shown that not only are they compatible with the conventional concepts and definitions, but they are also applicable in mixed problem contexts, where a part of the process shows the characteristics of the unitary problem context and a part of it shows the characteristics of the pluralist or coercive problem contexts. This important feature of the new conceptual framework can help the business analysts and other stakeholders greatly in the process design phase of the BPM, as they can make more informed decisions about which parts of the business process need to be changed, which parts need to be optimised and which parts should be automated and, finally, which parts should be left untouched and unrestricted to keep the autonomy and innovativeness of the business process participants.

Taking advantage of the findings of the proposed conceptual framework definitions and techniques in other phases of the BPM lifecycle can be the subject of further research. For instance, the techniques that can optimise the parts of the business processes that are in pluralist or coercive problem contexts should be studied, the best business process support systems (IT systems) that can support the business processes in pluralist or coercive problem contexts should be investigated and so on.

### **7.2.2 Extracting dependency cycle patterns**

Another interesting job for the future is the analysis of dependency cycles' dependency types and their sequences. For instance, one could aim to find out what are the best configurations of the dependency cycles, according to their dependency types. As an example, in organisations with a top-down structure where the work is delegated down the organisational structure, often too many task dependencies, in dependency cycles between the senior management and the layer below, show some sort of problem. Problems such as trust, old-fashioned management styles, incompetent technical staff, etc. By analysing the dependency cycle patterns the best configurations for different team structures can be found which would help the business analyst to find the problem and suggest the best solution (Mavaddat, Green & Sa, 2013).

### **7.2.3 Developing methods for the framework to analyse other forms of transcribed or non-transcribed conversation logs**

As was mentioned in the limitations and shortcomings, the framework completeness can be greatly improved by developing more methods that use other conversation mediums as a source of analysis. It means that these methods can analyse other types of transcribed conversation data such as meeting minutes, social networks chat logs, transcribed telephone conferences and even non-transcribed conversation logs such as recorded telephone calls, meetings or telephone conferences.

By using different conversation mediums for analysis, we can capture more aspects of the business processes, and the resulting models will be more comprehensive and probably less fragmented, as the parts that have not been covered by one medium will be fulfilled by others.

### **7.2.4 Complexity theory, strange attractors and business process models**

Complexity theory propounds six theoretical concepts that are (Jackson, 2003):

- Sensitive dependency on initial conditions
- Strange attractors
- Self-similarity
- Self-organisation

- Edge of chaos
- Fitness landscape

From which one of them is of interest for future work: strange attractors.

Strange attractor theory states that although a system's behaviour does not repeat itself it does stay within the bounds of certain limits or patterns. It means that although systems are unpredictable, they are still attracted to a particular pattern.

Although critiques like Rosenhead (1998) believe that applying complex theory to social systems is not a good idea, because they are fundamentally different from physical systems which are run by a limited number of deterministic laws, unlike the great number of probabilistic values and elements in social systems which are caused by people's free will and self-consciousness, it can be argued that people's reactions within organisations, in spite of free will, are still limited to some extent by the organisational culture, peer pressures, rules and regulations, etc. And this may create some sort of strange attractors, at least for the ways they carry out their day-to-day tasks through communication and collaboration.

In the proposed framework chapter, it was discussed that the business process models should not be reduced to the limited patterns found in the currently extracted collaboration instances, as the next experience can totally negate the pattern, and that the business process model is the compilation of those instances at infinity.

By applying the complexity theory to the proposed framework, one may manage to find the strange attractor diagram that illustrates the limits or boundaries, inside of which the interactions and collaborations are happening. This diagram may be a good representative for a business process model, since, although it is not limited to a repetitive pattern of collaborations, it still governs them not to fall out of the bounds and limitations.

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# Appendices

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## Appendix A Case study I – email messages

Subject: Urgently need a CP2 Received: 2013-05-13 08:13:05

From: Ashley@buildIT.com  
To: Merry@buildIT.com  
CC: Emma@buildIT.com

mid: 879

Contents:

Hi Merry,

I have been asked by Emma to sort out the PQ2 machine so I am urgently in need of a CP2. Could you please sort it out for me ASAP. The "Rental Request Form" is attached.

Many thanks,

Ashley

Subject: CP2 availability - from 15th of May for a month Received: 2013-05-13 10:20:20

From: Merry@buildIT.com  
To: James@supplier1.com  
CC:

mid: 880

Contents:

Hi James,

Our records show that you have got 10 CP2s for rental. I was wondering if any of them are available from 15th of May for about a month. I would really appreciate it if you could let me know AS.

Many thanks,

Merry

**Subject:** RE:CP2 availability - from 15th of May for a month **Received:** 2013-05-13 12:33:24

**From:** James@supplier1.com mid: 881

**To:** Merry@buildIT.com

**CC:**

**Contents:**

---

Hi Merry,

We have got two CP2s ready to be delivered by the 15th. Please send over the PO and I will sort it out for you ASAP.

Many thanks,

James

**Subject:** Equipment rental approval **Received:** 2013-05-13 14:01:04

**From:** Merry@buildIT.com mid: 882

**To:** Robert@buildIT.com

**CC:**

**Contents:**

---

Hi Robert,

I have received a CP2 rental request from Ashley (the form is attached) - I have contacted James at supplier1 and they are happy to supply the requested equipment for the 15th of May delivery. The price we have got at our records for a CP2 rental is Â£200/day. Could you please have a look at the attached rental form and approve it if you are happy with the equipment and the rental rate?

Many thanks,

Merry

Subject: RE:Equipment rental approval Received: 2013-05-13 15:30:20

From Robert@buildIT.com mid: 883

To: Merry@buildIT.com

CC:

Contents:

---

Hi Merry,

I had a look at the form. everything seems ok. I am happy for you to proceed and send the PO to the supplier.

Rob

Subject: PO-R23IM Received: 2013-05-13 16:20:20

From Merry@buildIT.com mid: 884

To: James@supplier1.com

CC:

Contents:

---

Hi James,

Please find attached the purchase order for the rental of 1 CP2. As stated in the PO the equipment is definitely needed by the 15th of May.

Many thanks,

Merry

Subject: RE:PO-R23IM Received: 2013-05-14 08:30:20

From James@supplier1.com mid: 885

To: Merry@buildIT.com

CC:

Contents:

---

Hi Merry,

No problem at all. The requested equipment will be shipped to the site tomorrow (the 15th of May). you can track the shipment using your PO reference number on our website as usual.

James

Subject: RE:Urgently need a CP2 Received: 2013-05-14 09:30:20

From Merry@buildIT.com mid: 886

To: Ashley@buildIT.com

CC:

Contents:

---

Hi Ashley,

A CP2 will be delivered to the site tomorrow by supplier1. you can track the shipment using this tracking number: PO-R23IM on supplier1 website. Please inspect the equipment and make sure everything is in order before signing the delivery receipt when it arrives tomorrow and let me know. If there was any problem with the shipment please reject it and email me ASAP.

Thanks,

Merry

Subject: X3 rental Received: 2013-05-14 09:13:05

From Kevin@buildIT.com mid: 887

To: Maribel@buildIT

CC:

Contents:

---

Hi Maribel,

In order to complete the EM2 I need an X3 (it would be great if I could have it by 21st of May but I can actually wait till 26th).Please find attached the rental requ.

Thanks,

Kevin

Subject: Have you got any X3 in stock? Received: 2013-05-14 10:00:05

From Maribel@buildIT.com mid: 888

To: Jane@supplier2.com

CC:

Contents:

---

Hi Jane,

we need an X3 for the 26th of May the latest. Do you think you can provide us with that?

Maribel

Subject: RE:Have you got any X3 in stock? Received: 2013-05-14 10:30:45

From Jane@supplier2.com  
To: Maribel@buildIT  
CC:

mid: 889

Contents:

---

Hi Maribel,

Unfortunately there are no X3 available in our stock for rental until 1st of June.Please let me know if you can wait until then.

Thanks,

Jane

Subject: Have you got any X3 in stock? Received: 2013-05-14 11:13:23

From Maribel@buildIT.com  
To: Jeffery@supplier3.com  
CC:

mid: 890

Contents:

---

Hi Jeffery

I would like to know if you have got any X3 in stock for the 26th of May the latest?

Thanks,

Maribel



Subject: RE:Have you got any X3 in stock? Received: 2013-05-14 14:15:20

From Jeffery@supplier3.com mid: 891

To: Maribel@buildIT

CC:

Contents:

---

Hi Maribel,

Yes. No problem at all. We can deliver an X3 to your site from 20th on wards.

Jeffery

Subject: Eq rental approval Received: 2013-05-14 15:00:12

From Maribel@buildIT.com mid: 892

To: Alan@buillT.com

CC:

Contents:

---

Hi Al,

Could you please have a look at the attached equipment rental approval and let me know if you are happy for me to put forward a PO to the supplier?It has been requested by Kevin for completing EM2 and he thinks he needs an.

Many thanks,

Maribel

Subject: RE:Eq rental approval Received: 2013-05-14 16:08:12

From Alan@buildIT.com mid: 893

To: Maribel@buildIT

CC:

Contents:

---

Hi Maribel,

Everything seems fine. Please go ahead with the rental.

Thanks,

Al

Subject: RE:Have you got any X3 in stock? Received: 2013-05-15 09:10:16

From Maribel@buildIT.com mid: 894

To: Jeffery@supplier3.com

CC:

Contents:

---

Hi Jeffery,

Many thanks. Please find attached the PO for the X3 rental. Please ship the equipment in a way that it arrives the site by the 21st.

Thanks,

Maribel

Subject: RE:Have you got any X3 in stock? Received: 2013-05-15 10:43:26

From Jeffery@supplier3.com mid: 895

To: Maribel@buildIT

CC:

Contents:

---

Hi Maribel,

Sure. I will make sure that the the shipment will be delivered to your site on the 21st ofay.

Best,

Jeff

Subject: RE:X3 rental Received: 2013-05-15 11:00:22

From Maribel@buildIT.com mid: 896

To: Kevin@buildIT.com

CC:

Contents:

---

Hi Kevin,

X3 will be delivered to the site on the 21st by supplier3. Please make sure everything is in order about the equipment before signing the delivery receipt. You should contact me as usual if you had any concerns about the equipment.

Maribel

Subject: Could you rent a PQT Received: 2013-05-12 11:13:25

From Martin@buildIT.com  
To: Claire@buildIT.com  
CC:

mid: 897

Contents:

---

Hi Claire,

I work for Andrew in B department (I am quite new here so I am still learning!). To assemble the PFH I think I need to have a PQT. I have been told I can ask you to sort it out for me. I have filled in the rental request form and it is attached to this email. Please let me know if you need anything else.(I have mentioned int rental request form that I need this equipment for the 18th of May)

Many thanks,

Martin

Subject: PQT ? Received: 2013-05-12 14:10:15

From Claire@buildIT.com  
To: Jane@supplier2.com  
CC:

mid: 898

Contents:

---

Hi Jane,

Could you please let me know asap if you have got any PQT in stock for the 18th of May?

Many thanks,

Claire

Subject: Re:PQT ? Received: 2013-05-12 16:14:12

From Jane@supplier2.com  
To: Claire@buildIT.com  
CC:

mid: 899

Contents:

---

Hi Claire,

Yes. We do. Please send me the PO and I will send it over to your site.

Thanks,

Jane

Subject: PQT for PFH Received: 2013-05-12 17:00:24

From Claire@buildIT.com  
To: Patrick@buildIT.com  
CC:

mid: 900

Contents:

---

Hi Patrick,

Could you please have a look at the attached ERR and let me know if you are happy for me to proceed?

Thanks,

Claire

Subject: RE:PQT for PFH Received: 2013-05-13 09:00:44

From Patrick@buildIT.com  
To: Claire@buildIT.com  
CC:

mid: 901

Contents:

---

Hi Claire,

I had a look at the ERR. Actually there is a cheaper equipment than PQT for PFH assembling called TTM. I think Martin should use that instead of PQT. it is as good as PQT for this job but much cheaper.

Thanks,

Patrick

Subject: TTM? Received: 2013-05-13 10:04:44

From Claire@buildIT.com  
To: Jane@supplier2.com  
CC:

mid: 902

Contents:

---

Hi Jane,

There has been a change in the previous equipment request. Have you got any TTM in stock for 18th of May delivery?

Thanks,

Claire

Subject: RE:TTM? Received: 2013-05-13 10:24:38

From Jane@supplier2.com mid: 903

To: Claire@buildIT.com

CC:

Contents:

---

Hi Claire,

No problem. Fortunately we do have a TTM in stock for 18th of May delivery. Send over the PO and I will sort it out for you.

Thanks,

Jane

Subject: PO-RP12Q (TTM) Received: 2013-05-13 11:13:36

From Claire@buildIT.com mid: 904

To: Jane@supplier2.com

CC:

Contents:

---

Hi Jane,

Please find attached the PO.

Many thanks,

Claire

Subject: RE:PO-RP12Q (TTM) Received: 2013-05-13 12:23:22

From Jane@supplier2.com  
To: Claire@buildIT.com  
CC:

**mid: 905**

---

Contents:

Hi Claire,

Great. We will deliver the TTM on the 18th of May to your site.

Thanks,

Jane

Subject: RE:Could you rent a PQT Received: 2013-05-13 13:45:12

From Claire@buildIT.com  
To: Martin@buildIT.com  
CC:

**mid: 906**

---

Contents:

Hi Martin,

We were advised by Patrick that the PFH assembly can be done by a cheaper but as good equipment called TTM. We have rented one for you and it will delivered to the site on the 18th as requested. The order number is PO-RP12Q (TTM)

Thanks,

Claire



**Appendix B**  
**Email analysis tables for Case study I**

*7.2.4.1.1 Ashley’s mailbox (Works engineer):*

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
879	Resource dependency	CP2 rental

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
886

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
4	CP2 rental	from: 2013-05-13 08:13:05 to: 2013-05-14 09:30:20	Resource dependency	Ashley@buildIT.com & Merry@buildIT.com	879,886

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.2 *Merry's mailbox (Clerk):*

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
879	Resource dependency	CP2 rental
880	Task dependency	Check availability of CP2 in stock for 15th of May
882	Task dependency	CP2 rental request approval
884	Resource dependency	CP2

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
881,883,885,886

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
4	CP2 rental	from:	Resource	Ashley@buildIT.com	879,886

		2013-05-13 08:13:05 to: 2013-05-14 09:30:20	dependency	& Merry@buildIT.com	
6	CP2 availability	from: 2013-05-13 10:20:20 to: 2013-05-13 12:33:24	Task dependency	Merry@buildIT.com & James@supplier1.com	880,881
8	Equipment rental approval	from: 2013-05-13 14:01:04 to: 2013-05-13 15:30:20	Task dependency	Merry@buildIT.com & Robert@buildIT.com	882,883
9	PO- R23IM	from:2013-05-13 16:20:20 to: 2013-05-14 08:30:20	Resource dependency	Merry@buildIT.com & James@supplier1.com	884,885

- Step 2.e Find nested dependency cycles: Dependency cycles 6,8 and 9 are nested within dependency cycle 4 because dependency cycle 4’s initiation has caused them to be created. In other words, Merry in order to deliver the dependum of the dependency cycle 4, has to create dependency cycles 6, 8 and 9.

7.2.4.1.3 James' mailbox (Supplier):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
880	Task dependency	Check availability of CP2 in stock for 15th of May
884	Resource dependency	CP2

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
881,885

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
6	CP2 availability	from: 2013-05-13 10:20:20 to: 2013-05-13 12:33:24	Task dependency	Merry@buildIT.com & James@supplier1.com	880,881

9	PO-R23IM	from:2013-05-13 16:20:20 to: 2013-05-14 08:30:20	Resource dependency	Merry@buildIT.com & James@supplier1.com	884,885
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- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.4 Robert’s mailbox (Works engineer):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
882	Task dependency	CP2 rental request approval

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
883

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start & end

		<b>mids</b>			
8	CP2 rental request approval	from: 2013-05- 13 14:01:04 to: 2013- 05-13 15:30:20	Task dependency	Merry@buildIT.com & Robert@buildIT.com	882,883

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.5 *Martin’s mailbox (Works engineer):*

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

<b>mid</b>	<b>dependency cycle type</b>	<b>dependum</b>
897	Resource dependency	PQT rental

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

<b>mid</b>	<b>Email act</b>
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

<b>mid</b>
906

- Step 2.d relate each request email to one dependency cycle closure email

<b>DCID</b>	<b>Title</b>	<b>Duration</b>	<b>Type</b>	<b>Participants</b>	<b>Start and end</b>
-------------	--------------	-----------------	-------------	---------------------	--------------------------

					mids
1	PQT rental	from: 2013-05-12 11:13:25 to: 2013-05-13 13:45:12	Resource dependency	Martin@buildIT.com& Claire@buildIT.com	897,906

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.6 *Claire’s mailbox (Clerk):*

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
897	Resource dependency	PQT rental
898	Task dependency	Check availability of PQT
900	Task dependency	PQT rent approval
901	Task dependency	Change PQT to TTM
902	Task dependency	Check availability of TTM
904	Resource dependency	TTM

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
901	refuse

- Step 2.c find all emails that contain assert (deliver) email act

<b>mid</b>
899,903,905,906

- Step 2.d relate each request email to one dependency cycle closure email

<b>DCID</b>	<b>Title</b>	<b>Duration</b>	<b>Type</b>	<b>Participants</b>	<b>Start and end mids</b>
1	PQT rental	from: 2013-05-12 11:13:25 to: 2013-05-13 13:45:12	Resource dependency	Martin@buildIT.com & Claire@buildIT.com	897,906
2	Check availability of PQT	from: 2013-05-12 14:10:15 to: 2013-05-12 16:14:12	Task dependency	Claire@buildIT.com & Jane@supplier2.com	898,899
3	PQT rent approval	from: 2013-05-12 17:00:24 to: 2013-05-13 09:00:44	Task dependency	Claire@buildIT.com & Patrick@buildIT.com	900,901
3a	Change PQT to TTM	From: 2013-05-13	Task dependency	Patrick@buildIT.com & Claire@buildIT.com	901, implicit



		09:00:44 To: 2013-05-13 10:04:44			
5	Check availability of TTM	2013-05-13 10:04:44 - to: 2013-05-13 10:24:38	Task dependency	Claire@buildIT.com & Jane@supplier2.com	902,903
7	TTM	2013-05-13 11:13:36 to: 2013-05-13 12:23:22	Resource dependency	Claire@buildIT.com & Jane@supplier2.com	904,905

Step 2.e Find nested dependency cycles: Dependency cycles 2, 3, 3a, 5, 7 are nested within dependency cycle 1 as they have been created to fulfil the dependum of the dependency cycle 1.

There is an important point about email with mid=901. As it can be seen in the tables, it has got two email acts “refuse” and “request”. It means it ends one dependency cycle and creates a new one. The reason is in this email the “sender” refuses what has been requested from and but proposes something else. The other important point is that the closure email of dependency cycle 3a is implicit. It means the recipient of the request (new proposal) has never responded. It can mean two things 1. Commit & Assert 2. Refuse that needs to be decided based on the context of the future emails. Here Patrick asks Clair to rent TTM instead of PQT, She doesn’t respond but she rents TTM. So the implicit email act is “commit” and eventually “assert”.

7.2.4.1.7 Jane’s mailbox (Supplier):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
898	Task dependency	Check availability of PQT
902	Task dependency	Check availability of TTM
904	Resource dependency	TTM
888	Task dependency	Check availability of X3

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
899,903,905,889

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
2	Check availability of PQT	from:2013-05-12 14:10:15 to: 2013-05-12 16:14:12	Task dependency	Claire@buildIT.com & Jane@supplier2.com	898,899
5	Check	from:	Task	Claire@buildIT.com	902,903

	availability of TTM	2013-05-13 10:04:44 - to: 2013-05-13 10:24:38	dependency	& Jane@supplier2.com	
7	TTM	from: 2013-05-13 11:13:36 to: 2013-05-13 12:23:22	Resource dependency	Claire@buildIT.com & Jane@supplier2.com	904,905
11	Check availability of X3	from: 2013-05-14 10:00:05 to: 2013-05-14 10:30:45	Task dependency	Maribel@buildIT.com & Jane@supplier2.com	888,889

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.8 Patrick's mailbox (Works engineer):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
900	Task dependency	PQT rent approval
901	Task dependency	Change PQT to TTM

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
901	Refuse

- Step 2.c find all emails that contain assert (deliver) email act

mid

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
3	PQT rent approval	from:2013-05-12 17:00:24 to: 2013-05-13 09:00:44	Task dependency	Claire@buildIT.com & Patrick@buildIT.com	900,901
3a	Change PQT to TTM	From: 2013-05-13 09:00:44 To: 2013-05-13 10:04:44	Task dependency	Patrick@buildIT.com& Claire@buildIT.com	901, implicit

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.9 Kevin’s mailbox (Works engineer):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
887	Resource dependency	X3 rental

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
896

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
10	X3 rental	from: 2013-05-14 09:13:05 to: 2013-05-15 11:00:22	Resource dependency	Kevin@buildIT.com & Maribel@buildIT.com	887,896

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.10 Maribel's mailbox (Clerk):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
887	Resource dependency	X3 rental
888	Task dependency	Check availability of X3
890	Task dependency	Check availability of X3
892	Task dependency	X3 rent approval
894	Resource dependency	X3

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
889,891,893,895,896

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
10	X3 rental	from: 2013-05-14 09:13:05	Resource dependency	Kevin@buildIT.com & Maribel@buildIT.com	887,896

		to: 2013-05-15 11:00:22			
11	Check X3 availability	from:2013-05-14 10:00:05 to: 2013-05-14 10:30:45	Task dependency	Maribel@buildIT.com & Jane@supplier2.com	888,889
12	Check X3 availability	from: 2013-05-14 11:13:23 to: 2013-05-14 14:15:20	Task dependency	Maribel@buildIT.com & Jeffery@supplier3.com	890,891
13	X3 rent approval	2013-05-14 15:00:12 to: 2013-05-14 16:08:12	Task dependency	Maribel@buildIT.com & Alan@buildIT.com	892,893
14	X3	from: 2013-05-15 09:10:16 to:2013-05-15 10:43:26	Resource dependency	Maribel@buildIT.com & Jeffery@supplier3.com	894,895

- Step 2.e Find nested dependency cycles: Dependency cycles 11, 12, 13, 14 are nested within dependency cycle 10 as they have been created to fulfil the dependum of dependency cycle 10.

7.2.4.1.11 Jeffery’s mailbox (Supplier):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
890	Task dependency	Check availability of X3
894	Resource dependency	X3

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
891,895

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end mids
12	Check X3 availability	from: 2013-05-14 11:13:23 to: 2013-05-14	Task dependency	Maribel@buildIT.com & Jeffery@supplier3.com	890,891



		14:15:20			
14	X3	from: 2013-05-15 09:10:16 to:2013-05-15 10:43:26	Resource dependency	Maribel@buildIT.com & Jeffery@supplier3.com	894,895

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

7.2.4.1.12 Alan’s mailbox (Works engineer):

- Step 2.a finding emails that contain request email acts and define dependency cycle type and dependum:

mid	dependency cycle type	dependum
892	Task dependency	X3 rent approval

- Step 2.b find all emails that contain declare, refuse, withdraw email acts

mid	Email act
Not found	N/A

- Step 2.c find all emails that contain assert (deliver) email act

mid
893

- Step 2.d relate each request email to one dependency cycle closure email

DCID	Title	Duration	Type	Participants	Start and end
------	-------	----------	------	--------------	---------------

<b>mids</b>					
13	X3 rent approval	2013-05-14 15:00:12 to: 2013-05-14 16:08:12	Task dependency	Maribel@buildIT.com & Alan@buildIT.com	892,893

- Step 2.e Find nested dependency cycles: No nested dependency cycle was found.

### Appendix C Extracted dependency cycles for Case study II

ID	Dependency cycle type	Dependency(Dependency cycle name)	Start email id	Closure email id	Closure type	Start timestamp	End timestamp	Parent
1	Resource dependency	Initial quote	19953	24	Implicit	09/06/2011 20:40	14/06/2011 20:49	-
2	Task dependency	Initial requirements	1995622	199557	Implicit	15/06/2011 07:43	17/06/2011 14:45	-
3	Resource dependency	Revised quote	6627	6667	Explicit	17/06/2011 16:33	24/06/2011 16:30	
4	Resource dependency	Update on the progress of supplier selection	199558	58	Implicit	17/06/2011 15:44	17/06/2011 16:33	
5	Resource dependency	Update on the progress of supplier selection	63	64	Explicit	20/06/2011 12:31	20/06/2011 12:41	
6	Task dependency	Take new provided information into consideration	6633			20/06/2011		3
7	Resource dependency	Update on the progress of supplier selection	70	77	Explicit	20/06/2011 14:50	21/06/2011 09:25	
8	Resource dependency	More information	97	99	Explicit	22/06/2011 11:52	22/06/2011 12:28	3
9	Task dependency	Discuss MMT's quote	104			23/06/2011 11:33		
10	Resource dependency	Permission to request quote from another supplier	6656	108	Implicit	23/06/2011 11:54	23/06/2011 13:18	
11	Task dependency	Consultation about requesting a new quote	6657	107	Implicit	23/06/2011 12:23	23/06/2011 12:23	
12	Task dependency	Consult with the publisher	111	242	Implicit	23/06/2011 21:22	28/06/2011 14:03	
13	Resource dependency	Quote (G1)	6665		Implicit	24/06/2011 13:27	-	
14	Resource dependency	Re negotiate quote (MMT)	6667			24/06/2011 16:30		
15	Resource dependency	Define project risk factors	6675	6683	Explicit	27/06/2011 10:40	28/06/2011 09:37	14
16	Resource dependency	Quote (UNO)	6677	231	Implicit	27/06/2011 11:31	28/06/2011 09:27	
17	Resource dependency	Update on the progress of the supplier selection	146	6681	Implicit	27/06/2011 16:48	27/06/2011 16:48	
18	Resource dependency	Update on the progress of the supplier selection	153	6668	Implicit	28/06/2011 09:10	28/06/2011 10:14	
19	Resource dependency	Opinion (UNO Quote)	1995238	238	Implicit	28/06/2011	28/06/2011 11:54	
20	Task dependency	UNO Background check	242	247	Implicit	28/06/2011 14:03	29/06/2011 09:26	
21	Task dependency	Consult with head of department		250	Explicit		29/06/2011 10:23	
22	Goal dependency	Announce selection and start implementation	1995275	275	Implicit	29/06/2011	30/06/2011 09:56	
23	Resource dependency	Quote follow up (MMT)	276	293	Explicit	30/06/2011 10:11	01/07/2011 12:19	
24	Resource dependency	Update progress with UNO	277	6717	Implicit	30/06/2011 13:02	30/06/2011 15:40	
25	Task dependency	Kick off meeting	6719			01/07/2011 08:59		
26	Task dependency	Kick off meeting	6725			01/07/2011 09:58		

Figure 37. Extracted dependency cycles case study II – Project I

DCID	Dependency cycle type	Dependency(Dependency cycle name)	start email ID	implicit end email id - asset	explicit end email id - declare start	end
27	Task_dependency	Visit next week & log details for reviewing the prototype	903	902	0 14/09/2011 15:28	15/09/2011 08:13
28	Task_dependency	Team review the Edo product using the provided login details	901	0	0 15/09/2011 09:51	15/09/2011 09:51
29	Task_dependency	attend the meeting with Edo	9	545	0 15/09/2011 11:14	15/09/2011 11:25
30	Task_dependency	Peoples opinion about the demonstrated product by edo	900	0	0 15/09/2011 17:21	15/09/2011 17:21
31	Goal_dependency	Engage in vbook project & Engage in supplier selection for the project"	13	547	0 15/09/2011 18:14	16/09/2011 05:48
32	Task_dependency	Take part in product demo Edo	12	551	0 15/09/2011 17:24	16/09/2011 09:31
33	Task_dependency	Review Edo software architecture	904	0	0 16/09/2011 13:03	16/09/2011 13:03
34	Task_dependency	Take part in product demo (EDCO)	15	0	0 16/09/2011 14:17	16/09/2011 14:17
35	Task_dependency	Review the questions to be asked from Edo and add more and send back	905	19	0 16/09/2011 14:56	18/09/2011 09:01
36	Task_dependency	Call with Edo to answer questions about their proposal	30	0	0 21/09/2011 15:55	21/09/2011 15:55
37	Task_dependency	a meeting to review codegnet's documents	31	0	0 22/09/2011 10:52	22/09/2011 10:52
38	Task_dependency	review the submitted proposal for vbook by codegent	39	0	0 26/09/2011 14:09	26/09/2011 14:09
39	Task_dependency	review the next version of the prototype	916	915	0 07/10/2011 15:59	07/10/2011 16:27
40	Task_dependency	more information about how to improve the demo - EDCO	912	0	0 10/10/2011 12:16	10/10/2011 12:16
41	Goal_dependency	to consider Suntedigital as a supplier	910	0	0 10/10/2011 15:51	10/10/2011 15:51
42	Resource_dependency	Information architecture of the Edo system	908	909	0 11/10/2011 06:44	14/10/2011 10:45
43	Task_dependency	ask to be a part of the conversation with EDCO about their system	50	0	0 14/10/2011 11:57	14/10/2011 11:57
44	Task_dependency	login details for Edo prototype	543	0	0 18/10/2011 13:53	18/10/2011 13:53
45	Task_dependency	Considers Suntec as a prospective supplier for vbook	57	58	0 18/10/2011 16:24	18/10/2011 16:53
46	Task_dependency	a meeting to plan what needs to be done next for vbooks	94	0	0 03/11/2011 09:19	03/11/2011 09:19
47	Task_dependency	Think about what needs to be achieved by Poc	95	0	98 03/11/2011 17:01	03/11/2011 17:01
48	Resource_dependency	Explore EDCO access model	107	111	0 10/11/2011 11:13	11/11/2011 16:05
49	Resource_dependency	NDA For Head London	638	0	642 14/11/2011 16:10	14/11/2011 16:10
50	Resource_dependency	NDA for 3rd parties	118	119	0 15/11/2011 11:29	15/11/2011 11:47
51	Resource_dependency	NDA for Head London	643	123	0 15/11/2011 12:42	15/11/2011 15:54
52	Task_dependency	A meeting with Head London in Oxford	649	659	0 16/11/2011 09:23	22/11/2011 16:46

Figure 38. Case study II Project II extracted dependency cycles - 1

53 Task_dependency	Review EdCo Gap analysis of their system and the projects requirements	148	930	0	21/11/2011 12:54	21/11/2011 16:54
54 Task_dependency	Meeting about player	160	163	0	22/11/2011 14:56	22/11/2011 15:59
55 Task_dependency	Talk to OB about Wbook - new supplier	182	666	0	24/11/2011 11:01	24/11/2011 11:17
56 Resource_dependency	Proposal for Wbook platform development	667	281	0	24/11/2011 11:41	08/12/2011 12:08
57 Task_dependency	Raising PO	929	928	0	24/11/2011 13:13	24/11/2011 15:26
58 Resource_dependency	Proposal for A&P of Wbooks	662	288	0	23/11/2011 12:53	08/12/2011 17:45
59 Task_dependency	arrange a call about A&P proposal	190	195	0	25/11/2011 08:45	25/11/2011 10:17
60 Resource_dependency	Proposal for A&P / GAP analysis of EDKO road map and project requirements	200	203	0	28/11/2011 21:42	29/11/2011 06:18
61 Resource_dependency	More description about project	202	692	0	28/11/2011 23:48	30/11/2011 10:28
62 Task_dependency	Call to chat through the Wbook project	224	0	0	02/12/2011 05:57	02/12/2011 05:57
63 Resource_dependency	Clarification / Document about eText as a prospective internal platform for Wbooks	233	234	0	02/12/2011 15:01	02/12/2011 16:14
64 Resource_dependency	Question about the Wbook project (HeadLondon)	247	532	0	05/12/2011 11:43	06/12/2011 09:26
65 Task_dependency	More questions around Wbook project- (EdCo)	250	528	0	05/12/2011 13:33	05/12/2011 15:19
66 Resource_dependency	More question about selection board (HeadLondon)	256	531	0	05/12/2011 15:20	06/12/2011 09:23
67 Resource_dependency	Question about SOA and Pearson IT Culture	258	533	0	05/12/2011 15:51	06/12/2011 09:33
68 Resource_dependency	Question about the system (EdCo)	262	716	0	06/12/2011 09:55	06/12/2011 12:03
69 Resource_dependency	More Question(HeadLondon)	266	0	0	06/12/2011 15:50	06/12/2011 15:50
70 Task_dependency	High level system architecture	722	279	0	07/12/2011 08:28	07/12/2011 15:10
71 Task_dependency	a call to answer more questions(EdCo)	271	277	0	07/12/2011 09:43	07/12/2011 10:46
72 Resource_dependency	Information about the call with Edco	170	726	0	07/12/2011 13:18	07/12/2011 13:26
73 Task_dependency	call about analysing(Cadegant costs)	171	0	0	07/12/2011 14:03	07/12/2011 14:03
74 Task_dependency	a call to revise proposal(HeadLondon)	283	0	0	08/12/2011 13:52	08/12/2011 13:52
75 Task_dependency	Call with WMMT in regards to the quote for Wbook	311	742	0	13/12/2011 09:19	13/12/2011 09:59
76 Task_dependency	Revise quote(HeadLondon)	741	312	0	13/12/2011 09:17	13/12/2011 10:19
77 Task_dependency	meeting to discuss the quote(HeadLondon)	321	0	0	331 15/12/2011 10:57	15/12/2011 10:57
78 Goal_dependency	Consider Gutenberg as a possible product delivery mechanism	338	339	0	21/12/2011 11:16	21/12/2011 11:48
79 Resource_dependency	Raising PO	929	0	0	24/11/2011 13:43	24/11/2011 13:43
80 Task_dependency	Consider Gutenberg as a possible product delivery mechanism	338	0	0	21/12/2011 11:16	21/12/2011 11:16
81 Task_dependency	Project brief	389	0	0	16/01/2012 20:23	16/01/2012 20:23

Figure 39. Case study II Project II extracted dependency cycles - 2

## Appendix D Dependency cycle extraction tool screenshot

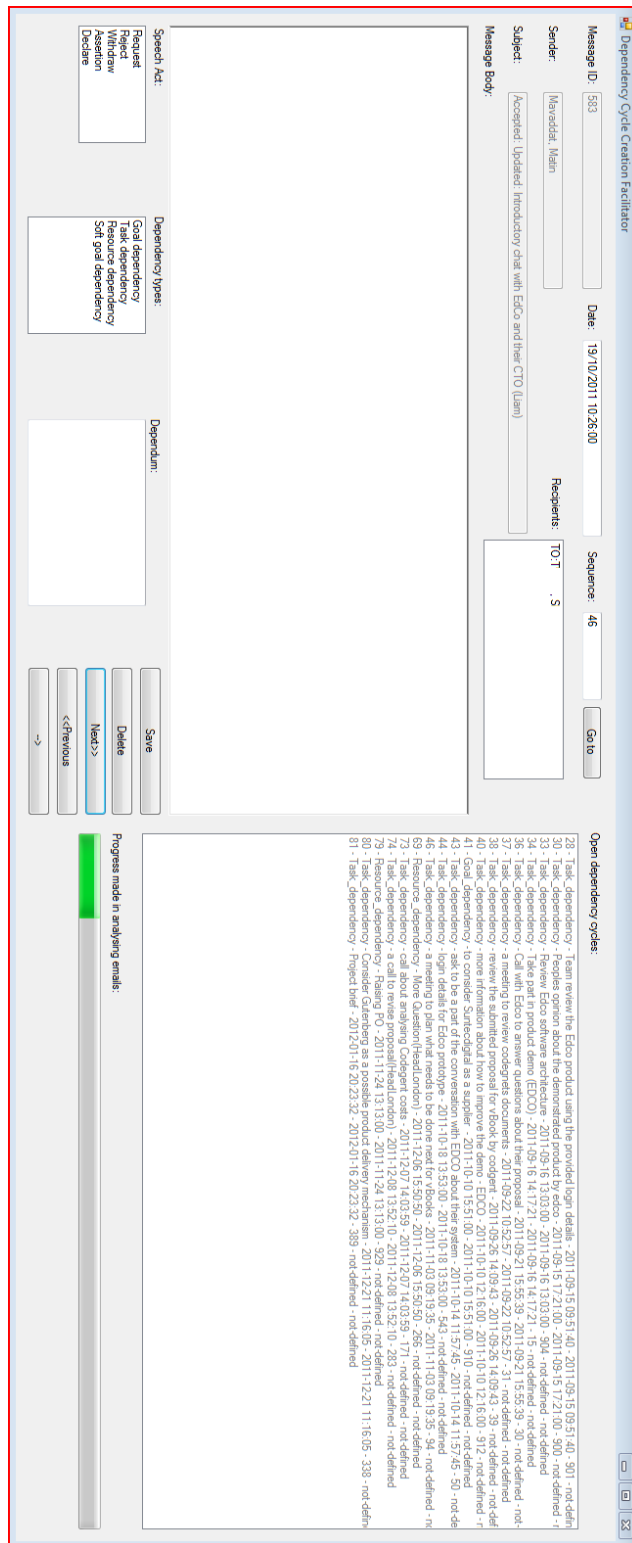


Figure 40. Dependency cycle extraction application

**Appendix E how to interpret choreographies and sub-choreographies for dependency cycles and nested-dependency cycles (a short tutorial)**

In this short tutorial it will be explained how choreography modelling notations should be interpreted for the dependency cycles.

The main construct of a choreography diagram is a choreography task or activity. Choreography tasks are “interactions representing a set of one or more message exchanges between two or more participants” (Briol P., 2010). In this research a dependency cycle has been modelled by a choreography task. Figure 41 shows a dependency cycle as a choreography task:

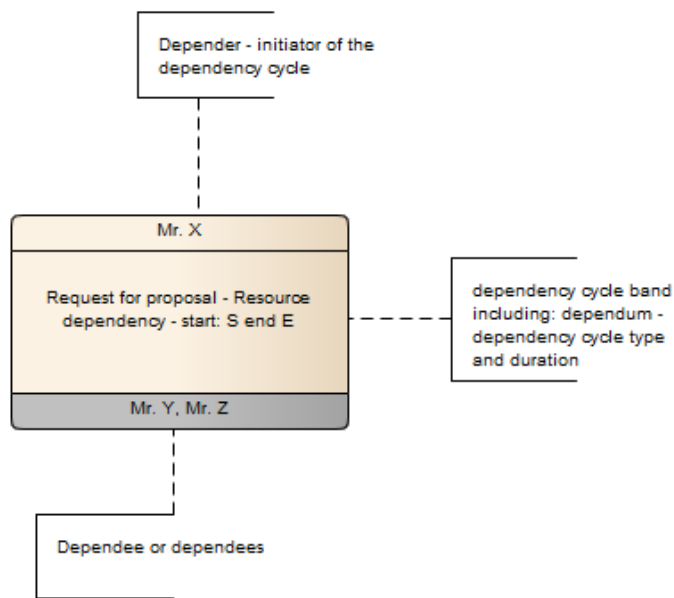


Figure 41. Choreography task as a dependency cycle

This notation illustrates that Mr. X (the initiator of the dependency cycle) has depended on Mr. Y and Mr. Z (the dependees) to provide him with a resource (a proposal). The dependency cycle has started at time S and has ended at time E, which means Mr. X has requested for a proposal on time S and Mr. Y and Mr. Z have either rejected it at time E or they have delivered the proposal and Mr. X has declared the receipt of the proposal on time E.

The other important notation in choreography diagrams is sub-choreography. Sub-choreographies are compound choreography activities that consist of two or more choreographies (Briol P., 2010). Sub-choreographies have been used to model nested dependency cycles. Figure 42 shows how nested dependency cycles are

modelled using sub-choreographies for this scenario: “Mr. X has asked Mr. Y to write up a report. In order to do this Mr. Y has requested Mr. Z to have a meeting with him to consult about the subject of the report. Mr. Y then writes up the report and asks Mr. T to type the report. Mr. T in order to write up the report requests a supplier to provide him with a word processor (He buys a word processor from a supplier).”

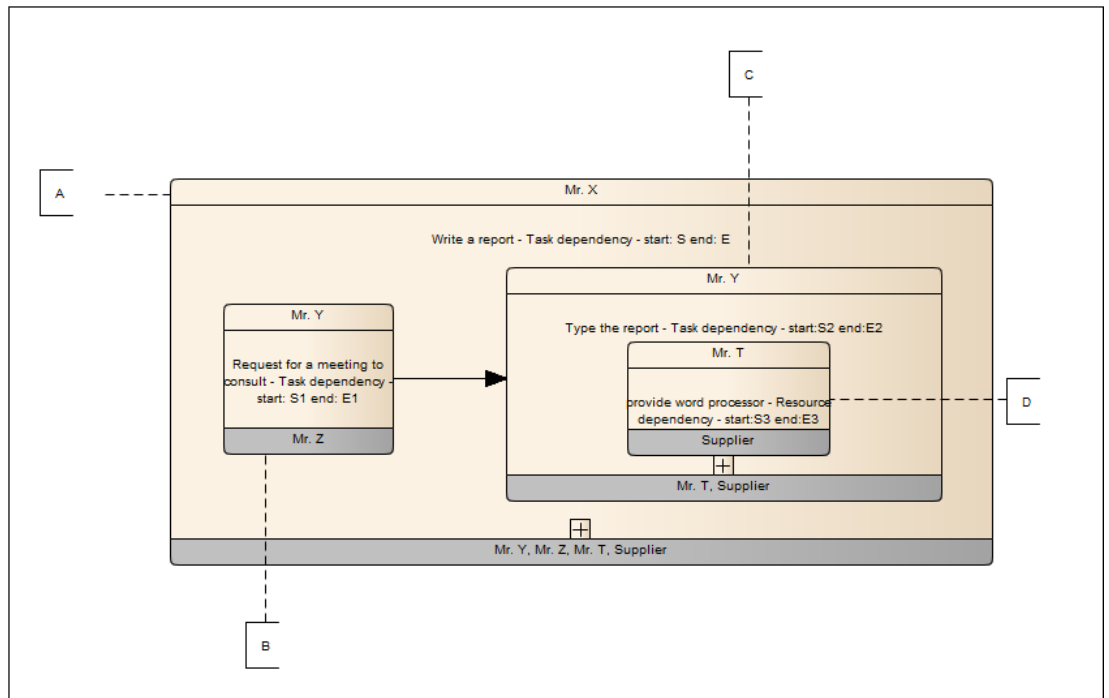


Figure 42. Sub-choreographies as nested dependency cycles

Figure 42 illustrates the above scenario in nested dependency cycles. The compound dependency cycle A, the outer sub-choreography, shows that there is a dependency cycle between Mr. X, Mr. Y, Mr. Z, Mr. T and the Supplier, initiated by Mr X. It is a task dependency cycle, its dependum is “writing a report” and its duration is from S to E. This part of the diagram shows that although Mr. X has only asked Mr. Y to write a report, he has a dependency with all the nested dependency cycles’ participants. This means that the main dependency cycle’s dependees are the direct dependees plus all the indirect nested dependency cycles’ dependees. The reason is if any of them cannot provide the dependum of its own dependency cycle, Mr. Y won’t be able to deliver the dependum of the compound dependency cycle A.

In order to deliver the dependum of the main dependency cycle, the compound dependency cycle A, Mr Y has created the dependency cycles B and C. Choreography task B shows that there is a dependency cycle between Mr. Y and Mr.



Z, initiated by Mr. Y. It is a Task dependency cycle, its dependum is “Request for a meeting to consult” and its duration is from S1 to E1. Sub-choreography C, the compound dependency cycle, shows there is a dependency cycle between Mr. Y and Mr. T and the supplier, initiated by Mr. Y. Here again, the direct dependency is between Mr. Y and Mr. T but because there is a nested dependency cycle, the dependee of that nested dependency cycle should be added to the dependees of the main compound dependency cycle. It is a task dependency cycle, its dependum is “type the report” and its duration is from S2 to E2. Mr T, in order to deliver the dependum of the dependency cycle C, has created the dependency cycle D. Choreography task D shows that there is a dependency cycle between Mr. T and the supplier; initiated by Mr. T. It is a resource dependency cycle and its dependum is a word processor and its duration is from S3 to E3.

## Appendix F BPMN2.0 XML of the Case study II Project I extracted choreography diagram

```

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xmlns:bpmndi="http://www.omg.org/spec/BPMN/20100524/DI" xmlns:dc="http://www.omg.org/spec/DD/20100524/DC"
exporter="Enterprise Architect" exporterVersion="10.0.1007">
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choreographyActivityShape="EAID_DO000021_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000021_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
  <dc:Bounds x="864" y="628" width="130" height="20"/>
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choreographyActivityShape="EAID_DO000024_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
  <dc:Bounds x="1055" y="548" width="130" height="20"/>
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choreographyActivityShape="EAID_DO000024_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000028_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000028_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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  <dc:Bounds x="123" y="1199" width="42" height="42"/>
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bpmnElement="EAID_E2AF2106_9B7B_4b1a_9E29_A3DB73674A78">
  <dc:Bounds x="242" y="1042" width="130" height="100"/>
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choreographyActivityShape="EAID_DO000032_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000032_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
  <dc:Bounds x="242" y="1122" width="130" height="20"/>
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bpmnElement="EAID_D3B63EAA_2F16_4596_B08E_6170BA974C9A">
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choreographyActivityShape="EAID_DO000035_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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</bpmndi:BPMNShape>
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choreographyActivityShape="EAID_DO000035_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000039_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000039_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
  <dc:Bounds x="583" y="1126" width="130" height="20"/>
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choreographyActivityShape="EAID_DO000042_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000042_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000045_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000045_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000049_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000053_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000056_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000056_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000059_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000059_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000063_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000067_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000067_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000070_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000070_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000074_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000074_58B3_4d23_8036_26C1ABC24DEC" participantBandKind="bottom_non_initiating">
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  <di:waypoint x="994" y="598"/>
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  <di:waypoint x="431" y="739"/>
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        <di:waypoint x="495" y="481"/>
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        <di:waypoint x="445" y="1241"/>
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        <di:waypoint x="372" y="1095"/>
        <di:waypoint x="404" y="1095"/>
        <di:waypoint x="404" y="1241"/>
        <di:waypoint x="445" y="1241"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000004_58B3_4d23_8036_26C1ABC24DEC"
bpmnElement="EAID_78DF1736_EFA0_4220_AE00_84318A85048D">
        <di:waypoint x="144" y="1241"/>
        <di:waypoint x="144" y="1409"/>
        <di:waypoint x="242" y="1409"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000005_58B3_4d23_8036_26C1ABC24DEC"
bpmnElement="EAID_5172B1D1_EE79_4a4d_A695_5C694D9658B7">
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        <di:waypoint x="144" y="1090"/>
        <di:waypoint x="242" y="1090"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000006_58B3_4d23_8036_26C1ABC24DEC"
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        <di:waypoint x="1379" y="488"/>
        <di:waypoint x="1379" y="841"/>
        <di:waypoint x="15" y="841"/>
        <di:waypoint x="15" y="1220"/>
        <di:waypoint x="123" y="1220"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000007_58B3_4d23_8036_26C1ABC24DEC"
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        <di:waypoint x="1291" y="440"/>
        <di:waypoint x="1328" y="440"/>
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    <bpmndi:BPMNEdge id="EAID_DL000008_58B3_4d23_8036_26C1ABC24DEC"
bpmnElement="EAID_BADB268C_AB93_4d63_9B9A_3C3CCEE90CE6">
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    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000009_58B3_4d23_8036_26C1ABC24DEC"
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        <di:waypoint x="982" y="303"/>
        <di:waypoint x="1216" y="303"/>
        <di:waypoint x="1216" y="440"/>
        <di:waypoint x="1249" y="440"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000010_58B3_4d23_8036_26C1ABC24DEC"
bpmnElement="EAID_98BCD2B4_451D_44c5_9A5C_706E67727D54">
        <di:waypoint x="466" y="1262"/>
        <di:waypoint x="466" y="1449"/>
        <di:waypoint x="583" y="1449"/>
    </bpmndi:BPMNEdge>
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        <di:waypoint x="816" y="598"/>
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        <di:waypoint x="579" y="309"/>
        <di:waypoint x="852" y="309"/>
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        <di:waypoint x="92" y="729"/>
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        <di:waypoint x="113" y="479"/>
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    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000017_58B3_4d23_8036_26C1ABC24DEC"
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        <di:waypoint x="47" y="475"/>

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        <di:waypoint x="71" y="475"/>
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        <di:waypoint x="1185" y="610"/>
        <di:waypoint x="1217" y="610"/>
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    </bpmndi:BPMNEdge>
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        <di:waypoint x="1924" y="1374"/>
        <di:waypoint x="1972" y="1374"/>
        <di:waypoint x="1972" y="1256"/>
        <di:waypoint x="2014" y="1256"/>
    </bpmndi:BPMNEdge>
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        <di:waypoint x="1924" y="1083"/>
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        <di:waypoint x="1703" y="1261"/>
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        <di:waypoint x="1423" y="1248"/>
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        <di:waypoint x="1316" y="1066"/>
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        <di:waypoint x="1423" y="1248"/>
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        <di:waypoint x="1196" y="1433"/>
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    <bpmndi:BPMNEdge id="EAID_DL000033_58B3_4d23_8036_26C1ABC24DEC"
    bpmnElement="EAID_059DFB73_A039_4d62_8121_700370A432CC">
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        <di:waypoint x="1189" y="1237"/>
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        <di:waypoint x="1121" y="1216"/>
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bpmnElement="EAID_274F2175_710E_4352_BB32_266D82D2649E">
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</bpmndi:BPMNPlane>
</bpmndi:BPMNDiagram>
</bpmn:definitions>

```

## Appendix G BPMN2.0 XML of the Case study II Project II extracted choreography diagram

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xmlns:bpmn="http://www.omg.org/spec/BPMN/20100524/MODEL"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:di="http://www.omg.org/spec/DD/20100524/DI"
xmlns:bpmndi="http://www.omg.org/spec/BPMN/20100524/DI"
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exporterVersion="10.0.1007">
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    <bpmn:participant id="EAID_PR000000_F49A_42c1_826E_A58CAF2EED6" name="OW,ST,RG,MM,GS"/>
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targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
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targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
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sourceRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
targetRef="EAID_PR000000_DF88_48db_898A_C562BA9C50C3"/>
<bpmn:messageFlow id="EAID_MF000000_60BB_423f_90FF_DACCCDE7E4811"
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targetRef="EAID_PR000000_DF88_48db_898A_C562BA9C50C3"/>
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targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
<bpmn:messageFlow id="EAID_MF000000_3DAE_4ce6_A2E8_646664E9CCB5"
sourceRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
targetRef="EAID_PR000000_3DAE_4ce6_A2E8_646664E9CCB5"/>
<bpmn:messageFlow id="EAID_MF000000_E61C_412b_84E4_B03C7E9D14DE"
sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000001_5409_4d73_A90D_9A076E5EFB19"/>
<bpmn:messageFlow id="EAID_MF000000_D255_41ce_A5CB_4813629078BD"
sourceRef="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
<bpmn:messageFlow id="EAID_MF000000_B272_4fa7_A15F_FE468BD19F5C"
sourceRef="EAID_PR000000_F66E_4771_B5E7_5F59042C28DB"
targetRef="EAID_PR000002_2876_43eb_967F_EB7FA9574B44"/>
<bpmn:messageFlow id="EAID_MF000000_F66E_4771_B5E7_5F59042C28DB"
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targetRef="EAID_PR000001_F10F_4a0d_8F8A_DD3C23AFD743"/>
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sourceRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
targetRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"/>
<bpmn:messageFlow id="EAID_MF000000_5199_4350_AAB4_4EF34CBE5415"
sourceRef="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
<bpmn:messageFlow id="EAID_MF000000_71A5_4d77_A8E3_86EAA08F7438"
sourceRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
targetRef="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"/>
<bpmn:messageFlow id="EAID_MF000000_F49A_42c1_826E_A58CAFBE2EED6"
sourceRef="EAID_PR000000_F49A_42c1_826E_A58CAFBE2EED6"
targetRef="EAID_PR000001_F49A_42c1_826E_A58CAFBE2EED6"/>
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sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000002_7281_4956_AD6F_6FA35B504A10"/>
<bpmn:messageFlow id="EAID_MF000000_B7B6_48bc_BA6E_290FD5E7710F"
sourceRef="EAID_PR000000_B7B6_48bc_BA6E_290FD5E7710F"
targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
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sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000000_35DC_4258_9E30_A063D7EC59B2"/>
<bpmn:messageFlow id="EAID_MF000000_C067_4030_9D75_CDC130C113DD"
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targetRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"/>
<bpmn:messageFlow id="EAID_MF000000_7281_4956_AD6F_6FA35B504A10"
sourceRef="EAID_PR000000_7281_4956_AD6F_6FA35B504A10"
targetRef="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"/>
<bpmn:messageFlow id="EAID_MF000000_919C_4adc_A3CB_729280F32F38"
sourceRef="EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E"
targetRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"/>
<bpmn:messageFlow id="EAID_MF000000_60F0_4e28_BAFB_DD93B98CDB3A"
sourceRef="EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E"
targetRef="EAID_PR000000_35DC_4258_9E30_A063D7EC59B2"/>
<bpmn:messageFlow id="EAID_MF000000_F621_4f1f_9397_A38BE0F54221"
sourceRef="EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E"
targetRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"/>
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sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000000_35DC_4258_9E30_A063D7EC59B2"/>
<bpmn:messageFlow id="EAID_MF000000_12FE_42fa_BF07_0427AE42F226"
sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
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    <bpmn:messageFlow id="EAID_MF000000_5409_4d73_A90D_9A076E5EFB19"
sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000000_5409_4d73_A90D_9A076E5EFB19"/>
    <bpmn:messageFlow id="EAID_MF000000_01F6_4662_8665_F45E9AD53619"
sourceRef="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_PR000002_563A_429c_AD26_95C26D8A68C1"/>
    <bpmn:messageFlow id="EAID_MF000000_1AE6_4034_9A62_0B7B92294FA5"
sourceRef="EAID_PR000000_1AE6_4034_9A62_0B7B92294FA5"
targetRef="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"/>
    <bpmn:parallelGateway id="EAID_373CC4FE_47DE_4aba_9B35_61F76283B73F"
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    <bpmn:incoming>EAID_370B4F86_1787_4b5e_9543_8FE97B5D84B2</bpmn:incoming>
    <bpmn:incoming>EAID_AB6344CC_2D8F_4056_AE81_F4FB21041D77</bpmn:incoming>
    <bpmn:outgoing>EAID_F591E7C1_E39D_415d_BBE1_826EC31B7822</bpmn:outgoing>
    </bpmn:parallelGateway>
    <bpmn:parallelGateway id="EAID_F9422CB3_298B_4bef_BE37_15E7CC4D71E1"
gatewayDirection="Unspecified">
    <bpmn:incoming>EAID_7945356F_0F36_473e_B6F6_5BF87A3683C0</bpmn:incoming>
    <bpmn:outgoing>EAID_72619A3F_B837_42c1_AA5F_5696B7DBAF64</bpmn:outgoing>
    <bpmn:outgoing>EAID_4C7CFF80_7503_4216_B387_3BF187AAB36E</bpmn:outgoing>
    </bpmn:parallelGateway>
    <bpmn:parallelGateway id="EAID_A9260F9C_E6CF_46fa_B3F9_A5B6553C57D"
gatewayDirection="Unspecified">
    <bpmn:incoming>EAID_4685C223_356B_49b0_9BD9_8916ED5EEAC8</bpmn:incoming>
    <bpmn:outgoing>EAID_DE789081_4D95_4f9a_B1EF_E7CEE1426418</bpmn:outgoing>
    <bpmn:outgoing>EAID_6D140D5E_223A_4e17_A5B8_9838F2641DB9</bpmn:outgoing>
    <bpmn:outgoing>EAID_61A78444_4AE1_41e4_8143_23FE74FBCB0D</bpmn:outgoing>
    </bpmn:parallelGateway>
    <bpmn:parallelGateway id="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"
gatewayDirection="Unspecified">
    <bpmn:incoming>EAID_3184B4B2_DCC3_45ca_8E10_27B2BB90F4EB</bpmn:incoming>
    <bpmn:incoming>EAID_1B877CFA_3FBC_4cce_802A_414D2D276121</bpmn:incoming>
    <bpmn:incoming>EAID_8BC68D54_971D_4556_87E2_CB7C3D093375</bpmn:incoming>
    <bpmn:incoming>EAID_F44C16D4_541E_446f_A12E_E2A903B8B099</bpmn:incoming>
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    <bpmn:incoming>EAID_D3599D39_33BC_438b_83B5_081A8311A404</bpmn:incoming>
    <bpmn:incoming>EAID_E985C353_15D1_4401_A462_F6F5E31B4BA6</bpmn:incoming>
    <bpmn:incoming>EAID_3DCD369C_81F9_4fc6_935A_44D132C67F5A</bpmn:incoming>
    <bpmn:outgoing>EAID_A4C6ED2F_E0AB_4d8d_B509_2CADECFDF33B</bpmn:outgoing>
    </bpmn:parallelGateway>
    <bpmn:parallelGateway id="EAID_1C26B15C_C7B7_4171_B32C_7381D451E970"
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    <bpmn:incoming>EAID_F4A1B92D_4DB7_4e88_8801_7C45E73FA9F0</bpmn:incoming>
    <bpmn:incoming>EAID_33062A4B_EB7D_4fed_9F71_59F7E8DE286D</bpmn:incoming>
    <bpmn:incoming>EAID_7F318BFC_5842_405c_95CC_BD31980E3C9A</bpmn:incoming>
    <bpmn:outgoing>EAID_58C873F4_AE78_42a0_AD50_C89DDCC8BFFB8</bpmn:outgoing>
    <bpmn:outgoing>EAID_CF483E31_9FA6_436b_82C1_0F42CC82BE7A</bpmn:outgoing>
    <bpmn:outgoing>EAID_BD11F13B_8DE7_4a2c_95FC_9650094B274E</bpmn:outgoing>
    <bpmn:outgoing>EAID_54F0AE34_D16F_42cf_B20E_E3FFA7FDDDD1D</bpmn:outgoing>
    <bpmn:outgoing>EAID_BBC85AF5_3801_42b2_82E2_8788F6B9A13E</bpmn:outgoing>
    <bpmn:outgoing>EAID_33E8A6BD_B638_4fc9_92E8_C763E7D0393C</bpmn:outgoing>
    <bpmn:outgoing>EAID_260D0D4B_39EA_42b9_BD51_54E7D0FD8AD8</bpmn:outgoing>
    <bpmn:outgoing>EAID_A67DF170_5934_4942_920D_A0C307DA74D1</bpmn:outgoing>
    </bpmn:parallelGateway>
    <bpmn:startEvent id="EAID_286CC4B8_445E_4f6f_8544_768737A775D7" isInterrupting="true"
parallelMultiple="false">
    <bpmn:outgoing>EAID_4685C223_356B_49b0_9BD9_8916ED5EEAC8</bpmn:outgoing>
    </bpmn:startEvent>
    <bpmn:sequenceFlow id="EAID_4685C223_356B_49b0_9BD9_8916ED5EEAC8"
sourceRef="EAID_286CC4B8_445E_4f6f_8544_768737A775D7"
targetRef="EAID_A9260F9C_E6CF_46fa_B3F9_A5B6553C57D"/>
    <bpmn:endEvent id="EAID_8D1CED4A_C1C6_4a83_9673_F79D4E3C7433">
    <bpmn:incoming>EAID_5DF7D5ED_3600_466f_91AA_041B338B56D4</bpmn:incoming>
    </bpmn:endEvent>
    <bpmn:choreographyTask id="EAID_2A2D626B_7879_4b98_B2AA_04D0FFC0226C" name="talk through
the options and quote(MMT) - Task dependency - from: 13/12/2011 08:44:10 to: 13/12/2011 16:00:00"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_BD11F13B_8DE7_4a2c_95FC_9650094B274E</bpmn:incoming>
    <bpmn:outgoing>EAID_1B877CFA_3FBC_4cce_802A_414D2D276121</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000001_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_7879_4b98_B2AA_04D0FFC0226C</bpmn:messageFlowRef>
    </bpmn:choreographyTask>
    <bpmn:sequenceFlow id="EAID_1B877CFA_3FBC_4cce_802A_414D2D276121"
sourceRef="EAID_2A2D626B_7879_4b98_B2AA_04D0FFC0226C"
targetRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"/>
    <bpmn:sequenceFlow id="EAID_BD11F13B_8DE7_4a2c_95FC_9650094B274E"
sourceRef="EAID_1C26B15C_C7B7_4171_B32C_7381D451E970"
targetRef="EAID_2A2D626B_7879_4b98_B2AA_04D0FFC0226C"/>

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    <bpmn:choreographyTask id="EAID_138C3864_395C_4c53_9968_887310F8E5EE" name="expected traffic
level for VB - Resource dependency - from:06/12/2011 15:50:50 to:" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:participantRef>EAID_PR000000_F10F_4a0d_8F8A_DD3C23AFD743</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_F10F_4a0d_8F8A_DD3C23AFD743</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_395C_4c53_9968_887310F8E5EE</bpmn:messageFlowRef>
  </bpmn:choreographyTask>
  <bpmn:subChoreography id="EAID_FCA8C99F_D86E_474e_8876_80BE209128B0" name="develop a
prototype player (codegent) - Resource dependency - from: 21/11/2011 to:12/12/2011 12:00:00"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_72619A3F_B837_42c1_AA5F_5696B7DBAF64</bpmn:incoming>
    <bpmn:outgoing>EAID_33062A4B_EB7D_4fed_9F71_59F7E8DE286D</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_5409_4d73_A90D_9A076E5EFB19</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_5409_4d73_A90D_9A076E5EFB19</bpmn:participantRef>
    <bpmn:choreographyTask id="EAID_53562DE7_3C74_4017_97CA_DDEE8AE17E75" name="Raise
Purchase Order (codegent) - Resource dependency - from: 24/11/2011 13:13:00 to:24/11/2011 15:54:50"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:participantRef>EAID_PR000000_5409_4d73_A90D_9A076E5EFB19</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_3C74_4017_97CA_DDEE8AE17E75</bpmn:messageFlowRef>
  </bpmn:choreographyTask>
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  <bpmn:sequenceFlow id="EAID_33062A4B_EB7D_4fed_9F71_59F7E8DE286D"
sourceRef="EAID_FCA8C99F_D86E_474e_8876_80BE209128B0"
targetRef="EAID_1C26B15C_C7B7_4171_B32C_7381D451E970"/>
    <bpmn:sequenceFlow id="EAID_72619A3F_B837_42c1_AA5F_5696B7DBAF64"
sourceRef="EAID_F9422CB3_298B_4bef_BE37_15E7CC4D71E1"
targetRef="EAID_FCA8C99F_D86E_474e_8876_80BE209128B0"/>
    <bpmn:choreographyTask id="EAID_B3402AF2_C3EA_4651_9D9B_4C8009D17441" name="ask OrangeBus
to get involved in VB (A&P) - Task depdnency - from: 24/11/2011 11:01:07 to:24/11/2011 11:17:00"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_BBC85AF5_3801_42b2_82E2_8788F6B9A13E</bpmn:incoming>
    <bpmn:outgoing>EAID_6DA74DAB_B9CA_4a3c_B9C1_3F1C329B005C</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_B7B6_48bc_BA6E_290FD5E7710F</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_C3EA_4651_9D9B_4C8009D17441</bpmn:messageFlowRef>
  </bpmn:choreographyTask>
  <bpmn:sequenceFlow id="EAID_BBC85AF5_3801_42b2_82E2_8788F6B9A13E"
sourceRef="EAID_1C26B15C_C7B7_4171_B32C_7381D451E970"
targetRef="EAID_B3402AF2_C3EA_4651_9D9B_4C8009D17441"/>
    <bpmn:choreographyTask id="EAID_C3E5CFE0_A7E4_46b5_B195_9EBAF2758FAF" name="Test Gutenberg
- Task dependency - from: 19/12/2011 21:21:00 to:" loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_FE2CDCD8_24BC_4147_88EE_FB8E3286481D</bpmn:incoming>
    <bpmn:outgoing>EAID_CACC19F4_ED92_4c35_8B54_3DE8A6E8E53A</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_F49A_42c1_826E_A58CAF2EED6</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E</bpmn:participantRef>
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  </bpmn:choreographyTask>
  <bpmn:choreographyTask id="EAID_25D6E576_8910_438e_AB4D_E9CFBBE35A17" name="Revise Quote
(HeadLondon) - Resource dependency - from:13/12/2011 09:17:00 to:11/01/2012 08:53:23" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_8D93332D_1EF5_45d9_A9EC_6DC66189A271</bpmn:incoming>
    <bpmn:outgoing>EAID_3184B4B2_DCC3_45ca_8E10_27B2BB90F4EB</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_DF88_48db_898A_C562BA9C50C3</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_8910_438e_AB4D_E9CFBBE35A17</bpmn:messageFlowRef>
  </bpmn:choreographyTask>
  <bpmn:sequenceFlow id="EAID_3184B4B2_DCC3_45ca_8E10_27B2BB90F4EB"
sourceRef="EAID_25D6E576_8910_438e_AB4D_E9CFBBE35A17"
targetRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"/>
    <bpmn:choreographyTask id="EAID_ADD0A282_7D53_4fa1_8960_2D5AAB037601" name="Review
codgent's proposal - Task dependency - from:26/09/2011 14:09:43 to:26/09/2011 16:00:00" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_EECE591B_FBBB_4b4d_B225_C443983C2621</bpmn:incoming>
    <bpmn:outgoing>EAID_6423FA51_006C_4619_A722_56839FDF3F3A</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_12FE_42fa_BF07_0427AE42F226</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_7281_4956_AD6F_6FA35B504A10</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E</bpmn:participantRef>
    <bpmn:messageFlowRef>EAID_MF000000_7D53_4fa1_8960_2D5AAB037601</bpmn:messageFlowRef>
  </bpmn:choreographyTask>
  <bpmn:choreographyTask id="EAID_AD61F9F5_F17C_4456_B784_5B3EE9D93059" name="Review
codegent system - Taks dependency - from:16/09/2011 09:31:00 to: 26/09/2011 15:30:00" loopType="None"
initiatingParticipantRef="unspecified">
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    <bpmn:participantRef>EAID_PR000000_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
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initiatingParticipantRef="unspecified">
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    <bpmn:participantRef>EAID_PR000002_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
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    <bpmn:messageFlowRef>EAID_MF000000_784A_4339_BF76_12699ADA88A3</bpmn:messageFlowRef>
    </bpmn:choreographyTask>
    <bpmn:subChoreography id="EAID_D1FD85B4_3998_4793_9169_837D56F44558" name="Request for
proposal A&P VB(Edco) - Resource dependency - from:23/11/2011 12:53:00 to:12/12/2011 09:37:27"
loopType="None" initiatingParticipantRef="unspecified">
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    <bpmn:outgoing>EAID_F44C16D4_541E_446f_A12E_E2A903B8B099</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_C067_4030_9D75_CDC130C113DD</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:choreographyTask id="EAID_C680C28A_401E_47af_ABAF_642C40513350" name="Request for
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    <bpmn:participantRef>EAID_PR000000_35DC_4258_9E30_A063D7EC59B2</bpmn:participantRef>
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    <bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
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targetRef="EAID_C680C28A_401E_47af_ABAF_642C40513350"/>
    <bpmn:choreographyTask id="EAID_253A2D31_16E7_4597_86C7_0C811065F618" name="Request for
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to:30/11/2011 " loopType="None" initiatingParticipantRef="unspecified">
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    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
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targetRef="EAID_64BE355C_A8DD_40d8_886A_9AA9BA115937"/>
    </bpmn:subChoreography>
    <bpmn:sequenceFlow id="EAID_F44C16D4_541E_446f_A12E_E2A903B8B099"
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targetRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"/>
    <bpmn:sequenceFlow id="EAID_58C873F4_AE78_42a0_AD50_C89DDCB8FFB8"
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targetRef="EAID_D1FD85B4_3998_4793_9169_837D56F44558"/>
    <bpmn:subChoreography id="EAID_E8C791B4_BA30_428d_8DF8_AFA52F6BDCD9" name="Request for
proposal A&P (OrangeBus) - Resource dependency - from:24/11/2011 11:41:00 to:08/12/2011 17:45:13"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_6DA74DAB_B9CA_4a3c_B9C1_3F1C329B005C</bpmn:incoming>
    <bpmn:outgoing>EAID_15830553_E2BE_4a74_9B54_657EAE6CE0CA</bpmn:outgoing>
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    <bpmn:choreographyTask id="EAID_477FD82E_65B4_49d6_B4FD_D88C81B42E25" name="Request
for more information(OrangeBus) - Resource dependency - from: 28/11/2011 12:04:00 to: 30/11/2011 10:28:00"
loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_7317B4CB_439D_4290_B74C_948FE63B3C13</bpmn:incoming>
    <bpmn:outgoing>EAID_B98DD3A4_2F65_436f_AED9_21E482C17193</bpmn:outgoing>
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    <bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
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    </bpmn:choreographyTask>
    <bpmn:choreographyTask id="EAID_C03DFFD1_674C_4aa1_819F_B8A062DB7CDE" name="Request
for a call to discuss requirements more - Task dependency - from:02/12/2011 05:57:55 to: 06/12/2011 12:00:00"
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targetRef="EAID_C03DFFD1_674C_4aa1_819F_B8A062DB7CDE"/>
<bpmn:choreographyTask id="EAID_66B8949A_C8D9_4596_A5DE_DB5591132DB4" name="Ask
OrangeBus to divide proposal into two sections - task dependency - from: 28/11/2011 12:04:00 to: 28/11/2011
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targetRef="EAID_477FD82E_65B4_49d6_B4FD_D88C81B42E25"/>
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targetRef="EAID_E8C791B4_BA30_428d_8DF8_AFA52F6BD9"
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targetRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"/>
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targetRef="EAID_03659B7F_8F37_40c9_AE37_270A2923314C"/>
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Proposal (VB) - Head London - Resoruce dependency - from: 15/11/2011 16:22:00 to:08/12/2011 12:08:25"
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information about VB project - Resource dependency - from:05/12/2011 11:03:35 to:06/12/2011 09:23:00"
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targetRef="EAID_51CDDF71_DF88_48db_898A_C562BA9C50C3"/>
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to try eText - Resource dependency- from: 02/12/2011 13:55:34 to:02/12/2011 15:01:14" loopType="None"
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requirements and find coverage for VB A&P prototype (Edco) - Resource dependency - from:10/11/2011
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targetRef="EAID_31E2D2FA_919C_4adc_A3CB_729280F32F38"/>
<bpmn:choreographyTask id="EAID_6B5CC4AA_F621_4f1f_9397_A38BE0F54221" name="Ask these
questions from Edco - Task dependency - from: 16/09/2011 14:56:00 to:" loopType="None"
initiatingParticipantRef="unspecified">
<bpmn:incoming>EAID_45574C0D_292B_4875_8F86_CCF64C577A7</bpmn:incoming>
<bpmn:outgoing>EAID_3971619F_0021_4e55_8CEA_CC97C6BB1D05</bpmn:outgoing>
<bpmn:participantRef>EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E</bpmn:participantRef>
<bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
<bpmn:participantRef>EAID_PR000001_5B0B_4c4a_AAD0_F046A25A856E</bpmn:participantRef>
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targetRef="EAID_22A5B219_C067_4030_9D75_CDC130C113DD"/>
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targetRef="EAID_6B5CC4AA_F621_4f1f_9397_A38BE0F54221"/>
<bpmn:choreographyTask id="EAID_A3F8B983_35DC_4258_9E30_A063D7EC59B2" name="Ask about
edco's information architecture - Resource dependency - from: 11/10/2011 to:14/10/2011 10:45:00"
loopType="None" initiatingParticipantRef="unspecified">
<bpmn:incoming>EAID_3C87E287_38E1_40f2_9FB8_DC2CC05F3628</bpmn:incoming>
<bpmn:outgoing>EAID_A13E141F_C2D1_43a2_91A3_2DA64DEE1E66</bpmn:outgoing>
<bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
<bpmn:participantRef>EAID_PR000000_35DC_4258_9E30_A063D7EC59B2</bpmn:participantRef>
<bpmn:messageFlowRef>EAID_MF000000_35DC_4258_9E30_A063D7EC59B2</bpmn:messageFlowRef>
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targetRef="EAID_B30E7888_7281_4956_AD6F_6FA35B504A10"/>
<bpmn:sequenceFlow id="EAID_3C87E287_38E1_40f2_9FB8_DC2CC05F3628"
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targetRef="EAID_A3F8B983_35DC_4258_9E30_A063D7EC59B2"/>
</bpmn:subChoreography>
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sourceRef="EAID_2C525BA2_5B0B_4c4a_AAD0_F046A25A856E"
targetRef="EAID_1C26B15C_C7B7_4171_B32C_7381D451E970"/>
<bpmn:sequenceFlow id="EAID_DE789081_4D95_4f9a_B1EF_E7CEE1426418"
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targetRef="EAID_2C525BA2_5B0B_4c4a_AAD0_F046A25A856E"/>
<bpmn:choreographyTask id="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226" name="Discussing the
advantage of asking MMT & Codegent to create a prototype for VB - Task dependency - from: 04/11/2011
15:50:59 to" loopType="None" initiatingParticipantRef="unspecified">
<bpmn:incoming>EAID_F591E7C1_E39D_415d_BBE1_826EC31B7822</bpmn:incoming>
<bpmn:incoming>EAID_4B339756_02F3_4f31_BCC5_CCFA7DC067DA</bpmn:incoming>
<bpmn:incoming>EAID_11CCEE66_C41B_49b7_B4EA_F9687D4E7883</bpmn:incoming>
<bpmn:outgoing>EAID_7945356F_0F36_473e_B6F6_5BF87A3683C0</bpmn:outgoing>
<bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
<bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
<bpmn:participantRef>EAID_PR000000_12FE_42fa_BF07_0427AE42F226</bpmn:participantRef>
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    <bpmn:sequenceFlow id="EAID_7945356F_0F36_473e_B6F6_5BF87A3683C0"
sourceRef="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226"
targetRef="EAID_F9422CB3_298B_4bef_BE37_15E7CC4D71E1"/>
    <bpmn:sequenceFlow id="EAID_11CCEE66_C41B_49b7_B4EA_F9687D4E7883"
sourceRef="EAID_0D28B241_E61C_412b_84E4_B03C7E9D14DE"
targetRef="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226"/>
    <bpmn:sequenceFlow id="EAID_F591E7C1_E39D_415d_BBE1_826EC31B7822"
sourceRef="EAID_373CC4FE_47DE_4aba_9B35_61F76283B73F"
targetRef="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226"/>
    <bpmn:choreographyTask id="EAID_F80DF429_5409_4d73_A90D_9A076E5EFB19" name="Discuss costs -
Task dependency - from:13/12/2011 08:34:00 to:" loopType="None" initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_CF483E31_9FA6_436b_82C1_0F42CC82BE7A</bpmn:incoming>
    <bpmn:outgoing>EAID_8BC68D54_971D_4556_87E2_CB7C3D093375</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
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    <bpmn:participantRef>EAID_PR000001_5409_4d73_A90D_9A076E5EFB19</bpmn:participantRef>
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sourceRef="EAID_F80DF429_5409_4d73_A90D_9A076E5EFB19"
targetRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"/>
    <bpmn:sequenceFlow id="EAID_CF483E31_9FA6_436b_82C1_0F42CC82BE7A"
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targetRef="EAID_F80DF429_5409_4d73_A90D_9A076E5EFB19"/>
    <bpmn:subChoreography id="EAID_AAB550C2_563A_429c_AD26_95C26D8A68C1" name="Conversation
with MMT around next steps - Task dependency - from:22/11/2011 14:56:00" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_61A78444_4AE1_41e4_8143_23FE74FBCB0D</bpmn:incoming>
    <bpmn:outgoing>EAID_AB6344CC_2D8F_4056_AE81_F4FB21041D77</bpmn:outgoing>
    <bpmn:outgoing>EAID_4B339756_02F3_4f31_BCC5_CCF7DC067DA</bpmn:outgoing>
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000001_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000002_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:choreographyTask id="EAID_7A021132_01F6_4662_8665_F45E9AD53619" name="Request for
Proposal for VB (MMT) - Resource dependency - from: 07/10/2011 to:09/12/2011 18:23:00" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:participantRef>EAID_PR000000_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
    <bpmn:participantRef>EAID_PR000002_563A_429c_AD26_95C26D8A68C1</bpmn:participantRef>
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sourceRef="EAID_AAB550C2_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226"/>
    <bpmn:sequenceFlow id="EAID_AB6344CC_2D8F_4056_AE81_F4FB21041D77"
sourceRef="EAID_AAB550C2_563A_429c_AD26_95C26D8A68C1"
targetRef="EAID_373CC4FE_47DE_4aba_9B35_61F76283B73F"/>
    <bpmn:sequenceFlow id="EAID_61A78444_4AE1_41e4_8143_23FE74FBCB0D"
sourceRef="EAID_A9260F9C_E6CF_46fa_B3F9_A5B65553C57D"
targetRef="EAID_AAB550C2_563A_429c_AD26_95C26D8A68C1"/>
    <bpmn:choreographyTask id="EAID_BC0198B2_1AE6_4034_9A62_0B7B92294FA5" name="Compile a
report out of the proposals for A&P - resource dependency - from: to:12/12/2011 11:45:00" loopType="None"
initiatingParticipantRef="unspecified">
    <bpmn:incoming>EAID_A4C6ED2F_E0AB_4d8d_B509_2CADECDF33B</bpmn:incoming>
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    <bpmn:participantRef>EAID_PR000000_1AE6_4034_9A62_0B7B92294FA5</bpmn:participantRef>
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targetRef="EAID_13845F5D_D255_41ce_A5CB_4813629078BD"/>
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sourceRef="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6"
targetRef="EAID_BC0198B2_1AE6_4034_9A62_0B7B92294FA5"/>
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    <bpmn:collaboration id="EAID_DC000000_DD5F_4137_BA45_C0428DB7E320">
    <bpmn:participant id="EAID_PR000000_F66E_4771_B5E7_5F59042C28DB" name="AY,MM"/>
    <bpmn:participant id="EAID_PR000001_F10F_4a0d_8F8A_DD3C23AFD743" name="participantB"/>
    <bpmn:participant id="EAID_PR000000_F10F_4a0d_8F8A_DD3C23AFD743" name="participantA"/>
    <bpmn:participant id="EAID_PR000000_C067_4030_9D75_CDC130C113DD" name="BP"/>
    <bpmn:participant id="EAID_PR000003_7281_4956_AD6F_6FA35B504A10" name="KH"/>
    <bpmn:participant id="EAID_PR000002_7281_4956_AD6F_6FA35B504A10" name="MM, GS"/>
    <bpmn:participant id="EAID_PR000001_7281_4956_AD6F_6FA35B504A10" name="AR"/>
    <bpmn:participant id="EAID_PR000000_7281_4956_AD6F_6FA35B504A10" name="TS"/>
    <bpmn:participant id="EAID_PR000000_35DC_4258_9E30_A063D7EC59B2" name="PB"/>
    </bpmn:collaboration>
    <bpmn:choreography id="EAID_D87A8AD2_E4DC_49ee_AF52_D9BAD2818009" name="ChoreographyModel1"
isClosed="false"/>
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Choreography View">

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choreographyActivityShape="EAID_DO000000_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="404" y="25" width="1294" height="20"/>
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choreographyActivityShape="EAID_DO000000_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000000_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000000_C1CA_491d_9844_A8BB987CCFDB"
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    <dc:Bounds x="417" y="133" width="134" height="124"/>
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choreographyActivityShape="EAID_DO000005_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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participantBandKind="top_initiating">
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participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000011_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">

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      <dc:Bounds x="597" y="153" width="134" height="20"/>
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choreographyActivityShape="EAID_DO000015_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000015_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000019_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
      <dc:Bounds x="580" y="501" width="150" height="20"/>
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    <bpmndi:BPMNShape id="EAID_DO000022_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_ADD0A282_7D53_4fa1_8960_2D5AAB037601">
      <dc:Bounds x="782" y="376" width="167" height="140"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000023_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000022_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
      <dc:Bounds x="782" y="376" width="167" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000024_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000022_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
      <dc:Bounds x="782" y="496" width="167" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000025_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000003_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000022_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
      <dc:Bounds x="782" y="396" width="167" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000026_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_5B0B_4c4a_AAD0_F046A25A856E"
choreographyActivityShape="EAID_DO000022_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
      <dc:Bounds x="782" y="476" width="167" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000027_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_OD28B241_E61C_412b_84E4_B03C7E9D14DE">
      <dc:Bounds x="988" y="383" width="149" height="134"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000028_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000027_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
      <dc:Bounds x="988" y="383" width="149" height="20"/>
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    <bpmndi:BPMNShape id="EAID_DO000029_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_5409_4d73_A90D_9A076E5EFB19"
choreographyActivityShape="EAID_DO000027_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">

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    <dc:Bounds x="988" y="497" width="149" height="20"/>
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    <dc:Bounds x="964" y="133" width="134" height="124"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000031_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_C067_4030_9D75_CDC130C113DD"
choreographyActivityShape="EAID_DO000030_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="964" y="133" width="134" height="20"/>
  </bpmndi:BPMNShape>
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choreographyActivityShape="EAID_DO000030_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="964" y="237" width="134" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000033_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_A3F8B983_35DC_4258_9E30_A063D7EC59B2">
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  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000034_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000033_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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  </bpmndi:BPMNShape>
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choreographyActivityShape="EAID_DO000033_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1154" y="237" width="134" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000036_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_B30E7888_7281_4956_AD6F_6FA35B504A10">
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  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000037_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000036_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1349" y="124" width="149" height="20"/>
  </bpmndi:BPMNShape>
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bpmnElement="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000036_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1349" y="250" width="149" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000039_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000036_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="1349" y="144" width="149" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000040_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000003_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000036_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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  </bpmndi:BPMNShape>
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    <dc:Bounds x="1888" y="1558" width="130" height="123"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000042_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000041_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1888" y="1558" width="130" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000043_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_8F37_40c9_AE37_270A2923314C"
choreographyActivityShape="EAID_DO000041_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1888" y="1661" width="130" height="20"/>
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  <bpmndi:BPMNShape id="EAID_DO000044_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_A2B62FD5_12FE_42fa_BF07_0427AE42F226">
    <dc:Bounds x="1231" y="502" width="150" height="169"/>
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    <bpmndi:BPMNShape id="EAID_DO000045_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000044_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1231" y="502" width="150" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000046_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000044_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1231" y="651" width="150" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000047_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000044_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="1231" y="522" width="150" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000048_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000044_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000049_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_B0658EA8_E0F5_4577_9FF1_53AA4CD7E898">
    <dc:Bounds x="1546" y="133" width="134" height="124"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000050_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000049_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1546" y="133" width="134" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000051_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_35DC_4258_9E30_A063D7EC59B2"
choreographyActivityShape="EAID_DO000049_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1546" y="237" width="134" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000052_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000052_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000054_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000052_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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    <dc:Bounds x="1920" y="985" width="128" height="122"/>
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choreographyActivityShape="EAID_DO000055_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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bpmnElement="EAID_PR000000_DF88_48db_898A_C562BA9C50C3"
choreographyActivityShape="EAID_DO000055_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000058_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000058_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="2066" y="1091" width="128" height="20"/>
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bpmnElement="EAID_FCA8C99F_D86E_474e_8876_80BE209128B0">
    <dc:Bounds x="1456" y="376" width="244" height="256"/>
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bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000061_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1456" y="376" width="244" height="20"/>
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choreographyActivityShape="EAID_DO000061_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000061_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="1456" y="396" width="244" height="20"/>
</bpmndi:BPMNShape>
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choreographyActivityShape="EAID_DO000065_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="825" y="605" width="334" height="20"/>
</bpmndi:BPMNShape>
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choreographyActivityShape="EAID_DO000065_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000065_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="825" y="625" width="334" height="20"/>
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choreographyActivityShape="EAID_DO000065_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000070_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000070_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000073_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000073_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000073_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000073_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000078_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000078_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000082_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000082_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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    <dc:Bounds x="2090" y="1210" width="562" height="272"/>
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choreographyActivityShape="EAID_DO000085_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000088_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000091_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000091_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000091_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000095_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000095_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000098_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000098_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000101_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000101_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000107_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000107_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000107_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000107_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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choreographyActivityShape="EAID_DO000112_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000112_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000115_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000115_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000118_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000121_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000121_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
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  <dc:Bounds x="2365" y="991" width="128" height="122"/>
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choreographyActivityShape="EAID_DO000125_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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choreographyActivityShape="EAID_DO000125_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000128_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
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participantBandKind="bottom_non_initiating">
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participantBandKind="top_initiating">
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participantBandKind="bottom_non_initiating">
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choreographyActivityShape="EAID_DO000134_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">

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choreographyActivityShape="EAID_DO000134_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1907" y="508" width="142" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000137_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_5409_4d73_A90D_9A076E5EFB19"
choreographyActivityShape="EAID_DO000134_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="1907" y="418" width="142" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000138_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_25D6E576_8910_438e_AB4D_E9CFBBE35A17">
    <dc:Bounds x="2600" y="958" width="130" height="136"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000139_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000138_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="2600" y="958" width="130" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000140_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_DF88_48db_898A_C562BA9C50C3"
choreographyActivityShape="EAID_DO000138_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="2600" y="1074" width="130" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000141_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_2A2D626B_7879_4b98_B2AA_04D0FFC0226C">
    <dc:Bounds x="1912" y="634" width="140" height="152"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000142_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000141_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="1912" y="634" width="140" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000143_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000141_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="1912" y="766" width="140" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000144_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000141_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
    <dc:Bounds x="1912" y="654" width="140" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000145_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_C3E5CFE0_A7E4_46b5_B195_9EBAF2758FAF">
    <dc:Bounds x="3633" y="756" width="140" height="142"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000146_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_F49A_42c1_826E_A58CAF2EED6"
choreographyActivityShape="EAID_DO000145_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="3633" y="756" width="140" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000147_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_5B0B_4c4a_AAD0_F046A25A856E"
choreographyActivityShape="EAID_DO000145_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
    <dc:Bounds x="3633" y="878" width="140" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000148_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_29A32D0C_DB4F_4e79_8D5C_6164F591ED38">
    <dc:Bounds x="3840" y="684" width="659" height="296"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000149_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000148_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
    <dc:Bounds x="3840" y="684" width="659" height="20"/>
  </bpmndi:BPMNShape>
  <bpmndi:BPMNShape id="EAID_DO000150_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000148_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">

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        <dc:Bounds x="3840" y="960" width="659" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000151_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000148_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
        <dc:Bounds x="3840" y="704" width="659" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000152_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000148_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
        <dc:Bounds x="3840" y="940" width="659" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000153_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_13845F5D_D255_41ce_A5CB_4813629078BD">
        <dc:Bounds x="3419" y="751" width="150" height="151"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000154_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000153_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="3419" y="751" width="150" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000155_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000153_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="3419" y="882" width="150" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000156_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000153_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
        <dc:Bounds x="3419" y="771" width="150" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000157_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_D255_41ce_A5CB_4813629078BD"
choreographyActivityShape="EAID_DO000153_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
        <dc:Bounds x="3419" y="862" width="150" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000158_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_03243A74_5199_4350_AAB4_4EF34CBE5415">
        <dc:Bounds x="3852" y="779" width="143" height="122"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000159_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_7281_4956_AD6F_6FA35B504A10"
choreographyActivityShape="EAID_DO000158_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="3852" y="779" width="143" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000160_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000158_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="3852" y="881" width="143" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000161_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000158_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="middle_non_initiating">
        <dc:Bounds x="3852" y="799" width="143" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000162_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_B092D25D_71A5_4d77_A8E3_86EAA08F7438">
        <dc:Bounds x="4017" y="778" width="128" height="122"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000163_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000162_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="4017" y="778" width="128" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000164_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_12FE_42fa_BF07_0427AE42F226"
choreographyActivityShape="EAID_DO000162_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="4017" y="880" width="128" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000165_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_D6D5A3D3_B1D1_4577_B000_10253F910E6F">

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        <dc:Bounds x="4179" y="772" width="128" height="122"/>
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bpmnElement="EAID_PR000001_1AE6_4034_9A62_0B7B92294FA5"
choreographyActivityShape="EAID_DO000165_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="4179" y="772" width="128" height="20"/>
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    <bpmndi:BPMNShape id="EAID_DO000167_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000165_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="4179" y="874" width="128" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000168_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_C775DB3C_F10F_4a0d_8F8A_DD3C23AFD743">
        <dc:Bounds x="4345" y="768" width="128" height="122"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000169_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_F10F_4a0d_8F8A_DD3C23AFD743"
choreographyActivityShape="EAID_DO000168_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_non_initiating">
        <dc:Bounds x="4345" y="768" width="128" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000170_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000001_F10F_4a0d_8F8A_DD3C23AFD743"
choreographyActivityShape="EAID_DO000168_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="4345" y="870" width="128" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000171_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_F9422CB3_298B_4bef_BE37_15E7CC4D71E1">
        <dc:Bounds x="1397" y="580" width="42" height="42"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000172_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_286CC4B8_445E_4f6f_8544_768737A775D7">
        <dc:Bounds x="54" y="692" width="30" height="30"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000173_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_A9260F9C_E6CF_46fa_B3F9_A5B65553C57D">
        <dc:Bounds x="162" y="688" width="42" height="42"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000174_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_6EC189BE_7A15_497e_99F3_D36CA52D3BC4">
        <dc:Bounds x="4557" y="774" width="152" height="115"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000175_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_PR000000_563A_429c_AD26_95C26D8A68C1"
choreographyActivityShape="EAID_DO000174_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="4557" y="774" width="152" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000176_C1CA_491d_9844_A8BB987CCFDB"
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choreographyActivityShape="EAID_DO000174_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="4557" y="869" width="152" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000177_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_ED0CE9AB_F49A_42c1_826E_A58CAFB2EED6">
        <dc:Bounds x="4736" y="780" width="130" height="100"/>
    </bpmndi:BPMNShape>
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bpmnElement="EAID_PR000000_F49A_42c1_826E_A58CAFB2EED6"
choreographyActivityShape="EAID_DO000177_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="top_initiating">
        <dc:Bounds x="4736" y="780" width="130" height="20"/>
    </bpmndi:BPMNShape>
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bpmnElement="EAID_PR000001_F49A_42c1_826E_A58CAFB2EED6"
choreographyActivityShape="EAID_DO000177_C1CA_491d_9844_A8BB987CCFDB"
participantBandKind="bottom_non_initiating">
        <dc:Bounds x="4736" y="860" width="130" height="20"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000180_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_8D1CED4A_C1C6_4a83_9673_F79D4E3C7433">
        <dc:Bounds x="4890" y="810" width="30" height="30"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNShape id="EAID_DO000181_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_0E06DC16_3FBE_406d_93E4_A8C7BE8DC5F6">
        <dc:Bounds x="2946" y="818" width="42" height="42"/>
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    <bpmndi:BPMNShape id="EAID_DO000182_C1CA_491d_9844_A8BB987CCFDB"
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    <dc:Bounds x="1783" y="491" width="42" height="42"/>
    </bpmndi:BPMNShape>
    <bpmndi:BPMNEdge id="EAID_DL000000_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_87A257BA_259B_4abb_AC74_F9ABD43ABC2">
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    <di:waypoint x="4736" y="830"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000001_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_B98DD3A4_2F65_436f_AED9_21E482C17193">
    <di:waypoint x="2439" y="1348"/>
    <di:waypoint x="2483" y="1348"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000002_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_DE789081_4D95_4f9a_B1EF_E7CEE1426418">
    <di:waypoint x="183" y="688"/>
    <di:waypoint x="183" y="187"/>
    <di:waypoint x="404" y="187"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000003_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_11CCEE66_C41B_49b7_B4EA_F9687D4E7883">
    <di:waypoint x="1131" y="517"/>
    <di:waypoint x="1131" y="571"/>
    <di:waypoint x="1231" y="571"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000004_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_4B339756_02F3_4f31_BCC5_CCFA7DC067DA">
    <di:waypoint x="1159" y="659"/>
    <di:waypoint x="1231" y="659"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000005_C1CA_491d_9844_A8BB987CCFDB"
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    <di:waypoint x="2264" y="1348"/>
    <di:waypoint x="2311" y="1348"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000006_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_8D93332D_1EF5_45d9_A9EC_6DC66189A271">
    <di:waypoint x="2516" y="1028"/>
    <di:waypoint x="2600" y="1028"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000007_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_5DF7D5ED_3600_466f_91AA_041B338B56D4">
    <di:waypoint x="4866" y="826"/>
    <di:waypoint x="4890" y="826"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000008_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_4685C223_356B_49b0_9BD9_8916ED5EEAC8">
    <di:waypoint x="84" y="707"/>
    <di:waypoint x="162" y="707"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000009_C1CA_491d_9844_A8BB987CCFDB"
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    <di:waypoint x="2340" y="1052"/>
    <di:waypoint x="2365" y="1052"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000010_C1CA_491d_9844_A8BB987CCFDB"
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    <di:waypoint x="902" y="195"/>
    <di:waypoint x="964" y="195"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000011_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_45574C0D_292B_4875_8F86_CCFF64C577A7">
    <di:waypoint x="731" y="195"/>
    <di:waypoint x="768" y="195"/>
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    <bpmndi:BPMNEdge id="EAID_DL000012_C1CA_491d_9844_A8BB987CCFDB"
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    <di:waypoint x="2043" y="2036"/>
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    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000013_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_E5B09CD3_4772_4d2d_B88D_3FDF0521ECF8">
    <di:waypoint x="2194" y="1050"/>
    <di:waypoint x="2212" y="1050"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000014_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_DC25F48D_3555_4112_8199_F8497B30FDD9">
    <di:waypoint x="553" y="448"/>
    <di:waypoint x="580" y="448"/>
    </bpmndi:BPMNEdge>

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    <bpmndi:BPMNEdge id="EAID_DL000015_C1CA_491d_9844_A8BB987CCFDB"
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    <di:waypoint x="4499" y="831"/>
    <di:waypoint x="4557" y="831"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000016_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_4FF1EEF1_65C8_4297_8A16_E69EFD90B92A">
    <di:waypoint x="2312" y="200"/>
    <di:waypoint x="2358" y="200"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000017_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_60DB3ECC_E148_478f_90DF_4E56AEA47478">
    <di:waypoint x="2103" y="198"/>
    <di:waypoint x="2163" y="198"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000018_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_94066792_A659_4c02_9B4C_C020994659C5">
    <di:waypoint x="1498" y="196"/>
    <di:waypoint x="1546" y="196"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000019_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_A13E141F_C2D1_43a2_91A3_2DA64DEE1E66">
    <di:waypoint x="1288" y="195"/>
    <di:waypoint x="1349" y="195"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000020_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_3C87E287_38E1_40f2_9FB8_DC2CC05F3628">
    <di:waypoint x="1098" y="195"/>
    <di:waypoint x="1154" y="195"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000021_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_799ACC4C_A030_4bb3_A901_780135EAD2E2">
    <di:waypoint x="2048" y="1047"/>
    <di:waypoint x="2066" y="1047"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000022_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_6423FA51_006C_4619_A722_56839FDF3F3A">
    <di:waypoint x="949" y="447"/>
    <di:waypoint x="988" y="447"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000023_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_CACC19F4_ED92_4c35_8B54_3DE8A6E8E53A">
    <di:waypoint x="3773" y="827"/>
    <di:waypoint x="3840" y="827"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000024_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_CB2644CF_6B86_4796_BC24_102B8F43DF4E">
    <di:waypoint x="4307" y="831"/>
    <di:waypoint x="4345" y="831"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000025_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_733390D8_AAA5_4821_8016_D3C70C1D16BB">
    <di:waypoint x="4145" y="836"/>
    <di:waypoint x="4179" y="836"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000026_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_CC80BD0F_B757_479e_BC72_071920C5AE01">
    <di:waypoint x="3995" y="839"/>
    <di:waypoint x="4017" y="839"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000027_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_7CAB1C86_57F5_4971_B504_1AC9FBB26064">
    <di:waypoint x="551" y="195"/>
    <di:waypoint x="597" y="195"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000028_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_E985C353_15D1_4401_A462_F6F5E31B4BA6">
    <di:waypoint x="2035" y="1779"/>
    <di:waypoint x="2967" y="1779"/>
    <di:waypoint x="2967" y="860"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000029_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_260D0D4B_39EA_42b9_BD51_54E7D0FD8AD8">
    <di:waypoint x="1804" y="533"/>
    <di:waypoint x="1804" y="1775"/>
    <di:waypoint x="1885" y="1775"/>
    <di:waypoint x="1885" y="1775"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000030_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_33E8A6BD_B638_4fc9_92E8_C763E7D0393C">
    <di:waypoint x="1804" y="533"/>
    <di:waypoint x="1804" y="1612"/>

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        <di:waypoint x="1888" y="1612"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000031_C1CA_491d_9844_A8BB987CCFDB"
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        <di:waypoint x="1804" y="533"/>
        <di:waypoint x="1804" y="1350"/>
        <di:waypoint x="1894" y="1350"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000032_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_54F0AE34_D16F_42cf_B20E_E3FFA7FDDDD1D">
        <di:waypoint x="1804" y="533"/>
        <di:waypoint x="1804" y="1018"/>
        <di:waypoint x="1905" y="1018"/>
        <di:waypoint x="1905" y="1018"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000033_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_BD11F13B_8DE7_4a2c_95FC_9650094B274E">
        <di:waypoint x="1804" y="533"/>
        <di:waypoint x="1804" y="716"/>
        <di:waypoint x="1912" y="716"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000034_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_Cf483E31_9FA6_436b_82C1_0F42CC82BE7A">
        <di:waypoint x="1825" y="512"/>
        <di:waypoint x="1907" y="512"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000035_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_58C873F4_AE78_42a0_AD50_C89DDCB8FFB8">
        <di:waypoint x="1804" y="491"/>
        <di:waypoint x="1804" y="139"/>
        <di:waypoint x="1893" y="139"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000036_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_7F318BFC_5842_405c_95CC_BD31980E3C9A">
        <di:waypoint x="1613" y="740"/>
        <di:waypoint x="1717" y="740"/>
        <di:waypoint x="1717" y="516"/>
        <di:waypoint x="1783" y="512"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000037_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_33062A4B_EB7D_4fed_9F71_59F7E8DE286D">
        <di:waypoint x="1700" y="508"/>
        <di:waypoint x="1783" y="508"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000038_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_F4A1B92D_4DB7_4e88_8801_7C45E73FA9F0">
        <di:waypoint x="1698" y="305"/>
        <di:waypoint x="1738" y="305"/>
        <di:waypoint x="1738" y="500"/>
        <di:waypoint x="1783" y="512"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000039_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_61A78444_4AE1_41e4_8143_23FE74FBCB0D">
        <di:waypoint x="204" y="709"/>
        <di:waypoint x="825" y="709"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000040_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_A4C6ED2F_E0AB_4d8d_B509_2CADECDFD33B">
        <di:waypoint x="2988" y="839"/>
        <di:waypoint x="3187" y="839"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000041_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_7945356F_0F36_473e_B6F6_5BF87A3683C0">
        <di:waypoint x="1381" y="596"/>
        <di:waypoint x="1397" y="596"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000042_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_3DCD369C_81F9_4fc6_935A_44D132C67F5A">
        <di:waypoint x="2246" y="1981"/>
        <di:waypoint x="2967" y="1981"/>
        <di:waypoint x="2967" y="860"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000043_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_EECE591B_FB8B_4b4d_B225_C443983C2621">
        <di:waypoint x="730" y="449"/>
        <di:waypoint x="782" y="449"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000044_C1CA_491d_9844_A8BB987CCFDB"
bpmnElement="EAID_D3599D39_33BC_438b_83B5_081A8311A404">
        <di:waypoint x="2018" y="1618"/>
        <di:waypoint x="2967" y="1618"/>
        <di:waypoint x="2967" y="860"/>
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    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000045_C1CA_491d_9844_A8BB987CCFDB"
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      <di:waypoint x="2652" y="1349"/>
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      <di:waypoint x="2967" y="860"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000046_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_FE2CDCD8_24BC_4147_88EE_FB8E3286481D">
      <di:waypoint x="3569" y="826"/>
      <di:waypoint x="3633" y="826"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000047_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_F44C16D4_541E_446f_A12E_E2A903B8B099">
      <di:waypoint x="2562" y="54"/>
      <di:waypoint x="2967" y="54"/>
      <di:waypoint x="2967" y="818"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000048_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_8BC68D54_971D_4556_87E2_CB7C3D093375">
      <di:waypoint x="2049" y="418"/>
      <di:waypoint x="2967" y="418"/>
      <di:waypoint x="2967" y="818"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000049_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_1B877CFA_3FBC_4cce_802A_414D2D276121">
      <di:waypoint x="2052" y="728"/>
      <di:waypoint x="2259" y="728"/>
      <di:waypoint x="2259" y="839"/>
      <di:waypoint x="2946" y="839"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000050_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_3184B4B2_DCC3_45ca_8E10_27B2BB90F4EB">
      <di:waypoint x="2730" y="1070"/>
      <di:waypoint x="2967" y="1070"/>
      <di:waypoint x="2967" y="860"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000051_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_9C042659_DB58_4af5_AD45_521C5BD27DD5">
      <di:waypoint x="3336" y="828"/>
      <di:waypoint x="3419" y="828"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000052_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_4C7CFF80_7503_4216_B387_3BF187AAB36E">
      <di:waypoint x="1418" y="622"/>
      <di:waypoint x="1418" y="744"/>
      <di:waypoint x="1463" y="744"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000053_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_72619A3F_B837_42c1_AA5F_5696B7DBAF64">
      <di:waypoint x="1418" y="580"/>
      <di:waypoint x="1418" y="513"/>
      <di:waypoint x="1456" y="513"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000054_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_6DA74DAB_B9CA_4a3c_B9C1_3F1C329B005C">
      <di:waypoint x="2044" y="1339"/>
      <di:waypoint x="2090" y="1339"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000055_C1CA_491d_9844_A8BB987CCFDB"
    bpmnElement="EAID_A67DF170_5934_4942_920D_A0C307DA74D1">
      <di:waypoint x="1804" y="533"/>
      <di:waypoint x="1804" y="1948"/>
      <di:waypoint x="1888" y="1948"/>
    </bpmndi:BPMNEdge>
    <bpmndi:BPMNEdge id="EAID_DL000056_C1CA_491d_9844_A8BB987CCFDB"
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      <di:waypoint x="183" y="688"/>
      <di:waypoint x="183" y="461"/>
      <di:waypoint x="403" y="461"/>
    </bpmndi:BPMNEdge>
  </bpmndi:BPMNPlane>
</bpmndi:BPMNDiagram>
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name="ChoreographyModel1">
  <bpmndi:BPMNPlane id="EAID_PL000000_7151_4624_BF66_0B371D981503"
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</bpmn:definitions>

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