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ON THE IMPACT OF IT ON VALUE GENERATING ACTIVITIES IN ORGANISATIONS: AN ONTOLOGY BASED APPROACH

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Introduction and Motivation

An Information Technology (IT) resource can be defined in many ways but, for the needs of this Ph.D. dissertation, an IT resource is intended as described by Orlikowski & Jacono (2001): a set of technological artifacts (like IT components), and IT personnel (human resources). Orlikowski and Jacono provide four different definitions of IT resource, on the basis of four different views of the IT. The one adopted in this Ph.D. dissertation is the one they call the "Tool" view.

IT infrastructures group all IT resources that an organisation might use to support its business processes, or activities, execution. An IT infrastructure is therefore composed by several IT resources. Due to their importance and their complexity, nowadays IT infrastructures can easily affect more than one business process (Scheepers & Scheepers, 2008; Tallon, 2007).

As already mentioned, IT infrastructures support an organisation's business processes and activities execution. By doing so, IT infrastructures, and thence IT resources, support the value generation process of the entire organisation. Anyhow, due to the aforementioned complexity, knowing exactly which IT resource affects which activity can be not easy. Sometimes these relationships are obvious, sometimes they are unknown, other times they are difficult to discover.

To fully understand how IT resources supports value production in organisations, literature on Information Systems (IS) suggests to clarify how IT resources relate to value generating activities (Tillquist & Rodgers, 2005). To do so, IT resources should be viewed in a perspective that allows to identify their contribution to business processes execution. With such perspective the identification of which IT resource influences which activity can be much more easy, offering organisations the possibility to take decisions regarding IT infrastructures on the basis of their actual contribution to value generating activities.

The study of how IT resources impact organisational performance is the focus of that body of research that goes under the name of "IT Business Value" (Melville et al., 2004). IT Business Value research aims at discovering the relationships between the profitability of an organisation and its IT investments (Seddon et al., 2002). This research has a long tradition that is testified by more than 25 years of studies. These studies are mainly concerned with the solution of the so called "Productivity Paradox", described by Brynjolfsson in 1993. By examining the level of IT investments at the industrial level, and comparing it to the industrial productivity, Brynjolfsson affirms that no productivity gains follow IT investments.

Research papers that investigate IT Business Value have addressed the problem adopting several approaches (Melville et al., 2004), and theoretical perspectives (Oh & Pinsonneault, 2007). Results of these works have been sometimes found controversial (Im et al., 2001). As a consequence, researchers find difficulties in achieving consensus on findings on IT Business Value.

At the current state of the art of IT Business Value research, there is no clear understanding on whether IT investments contribute to produce value, and therefore contribute to improve organisational performances. There are studies which posit that the relationship between IT investments and organisational performance is positive (and therefore IT investments improve organisational performances), others which posit that such relationship is negative (and therefore IT investments worsen organisational performances) , and finally others which affirm that there is no relationship at all (and therefore IT investments have no impact on organisational performances) (Wagner & Weitzel, 2007).

Summarising, no solution to the productivity paradox seems to have been identified yet. It is therefore about time to adopt a more critical approach, to rethink the way the IT Business Value problem shall be investigated, introducing a discontinuity in this area of research (Kohli & Grover, 2008).

1.1 Investigating IT Business Value

In the study of IT Business Value, two different approaches can be identified. A first approach, that can be called macro, studies the value generated by IT investments by analysing aggregated data that summarise investments and productivity at industrial level. The second approach adopts a different level of granularity, focusing on a single organisation, or even a part of it, investigating how IT alters its performance. In opposition to the previous one, this approach can be called micro.

Following the macro approach Brynjolfsson (1993) identified and defined the productivity paradox. Anyhow, the focus on aggregated organisational outputs as a dimension to study IT Business Value has been criticised since it is considered a limited approach that could prevent a proper understanding of the value generating phenomenon (Mooney et al., 1996).

1.1.1 What we know on IT Business Value

What we actually know on IT business value is summarised by Kohli & Grover (2008). In a recent paper they point out that:

- IT does create value;
- IT creates value under certain conditions;
- IT-based value manifests itself in many ways;
- IT-based value could be latent;
- IT and value are mediated by several factors.

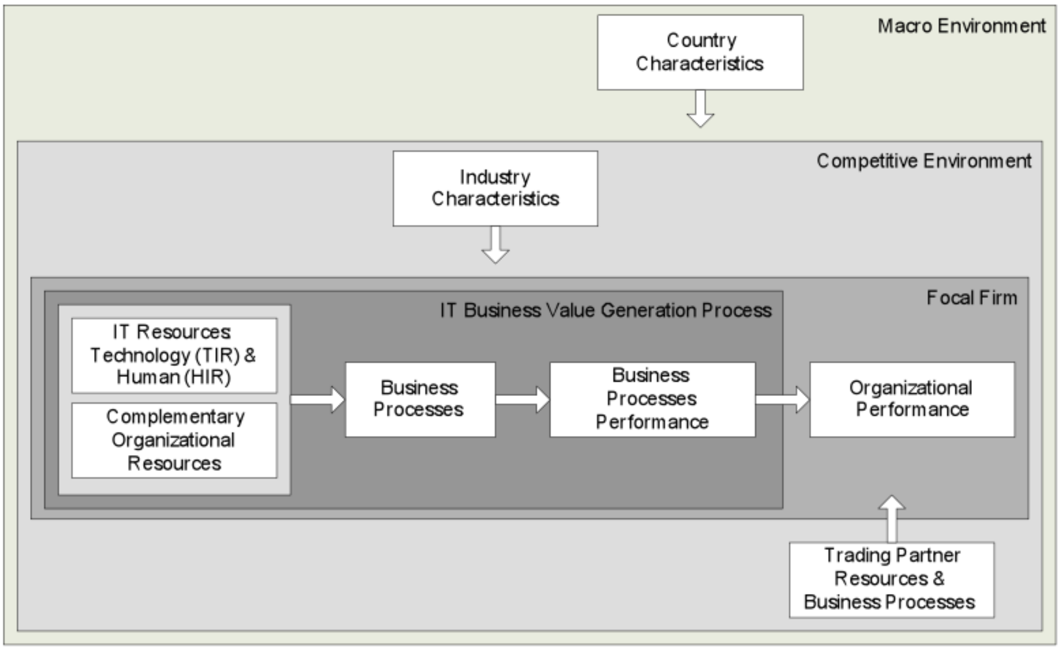
Under a different perspective, Melville et al. (2004) contribute with the identification of the loci where the IT value has already been studied and described. By reviewing a large number (202) of research papers, they propose an integrative theoretical model of IT Business Value, depicted in Figure 1.1 on page 11. This model posits that IT produces value at three different levels, both inside and outside the organisation. These levels are the *Focal Firm*, the *Competitive Environment*, and the *Macro Environment*.

The *Focal Firm* is described as the single organisation that performs the investment in IT. At this level, IT generates value by means of an IT Business Value Generation Process. In this process, IT resources interact with complementary organisational resources and affect business processes execution: the performances of these impacts are measured with business processes performance indicators. The basic idea is that the IT investment should contribute in improving organisational performances, and that such improvements should be evident by looking at changes in key performance indicators values at the business process level. The improvement of single, or several, business processes performances contribute to the improvement of the performance of the whole organisation.

The *Focal Firm* is embedded in a *Competitive Environment*, where resources and business process of the organisation that performs the investment intersect resources and processes of trading partners. At this level IT can produce value too. Specific *Industry Characteristic*, can influence the way single organisation gather value out of their IT resources.

Finally, the *Focal Firm* and the *Competitive Environment* are embedded in the *Macro Environment.* At this level IT value generation can be influenced by specific *Country Characteristics* that can promote or hinder IT investments, and therefore increase or reduce the possibility to obtain benefits out of these investments.

Fig. 1.1 The integrated IT Business Value model proposed by Melville et al. (2004)



1.1.2 How do we investigate IT Business Value

Recently researches have been stressing the necessity to abandon the macro perspective in the investigation of the IT business value phenomenon, mainly because the complexity of the interaction among IT resources and organisational performances is complex, and could benefit from a more granular point of observation and study. Therefore researchers suggest to focus on the micro perspective, proposing to investigate the IT value phenomenon at the level of business processes of the organisation (Parker et al., 1998; Barau et al., 1995; Tallon et al., 2000; Tallon, 2007).

The necessity of investigating how IT produces value at the business process level is supported by two different statements (Ray et al., 2007): IT value tends to be process specific, and IT impacts on a single process cannot affect others. The business process perspective is therefore seen as a dimension of analysis that can contribute to provide further insights on the IT Business Value phenomenon. This new level of analysis could increase the precision of the studies, making their focus more specific, but, at the same time, has to take into consideration the potentially increased complexity, since IT resources can have ripple effects on several business processes simultaneously (Scheepers & Scheepers, 2008).

To be able to investigate IT value impacts at the business process level, a methodology to identify which IT resource affects which business process or activity is therefore necessary. This methodology should help in linking IT resources to activities/processes (Tillquist & Rodgers, 2005; Wagner & Weitzel, 2007) to better investigate their value generating potential.

1.1.3 Current limitations

With the intent to provide a decision framework for analysing the business value potential of IT investments, Scheepers & Scheepers (2008) highlight the necessity to identify processes that will be affected by the IT investment. They propose to identify such processes by drawing on the concepts of the value chain theory (Porter, 1985). So far this is the only approach that has been proposed to identify the relationships among IT resources and business processes activities.

This approach suffers anyhow of two limitations: first of all it is not general, secondly it is quite obscure on how to practically identify the relationships among IT resources and business processes. Regarding the first aspect, the limitations in the generalisation of the approach depend on the value framework adopted. Porter's value chain theory, in fact, is applicable only to large industrial companies, and it is not suitable to describe the value generation logic of service industries. Since Porter's value chain has been extended by Stabel & Fjeldstad (1998), its extensions have to be also taken into consideration in the proposed approach. Finally, regarding the second point, the proposed approach does not offer a feasible method to identify which IT resource impacts which business process.

So far then, a general methodology to identify the impact of IT resources on value generating activities in an organisation, is still absent in literature.

1.2 Research question

All the considerations formulated regarding the current state of the art, and limitations, of IT Business Value research are a necessary foundations for the definition of the research question for this Ph.D. dissertation. From the description of the context given in the previous sections, two issues emerge: the need to study the IT Business Value problem from a process based perspective to identify IT contribution to value generating activities, and the necessity of a method to identify the relationships among IT resources and value generating activities. While the first of the two issues sounds more like a general remark to orient research, the second requires a bit more of attention.

The possibility to identify the relationships among IT resources and value generating activities is a necessary prerequisite to study the IT value phenomenon from a process based perspective. This Ph.D. dissertation aims at addressing this problem. Therefore the research question on which the dissertation builds is the following one:

> *Q: How is it possible to identify, represent, and communicate the impact of IT resources on value generating activities in an organisation?*

Several elements support this research question. First of all, the research question addresses the problem of value generating activities in an organisation. It is generally acknowledged that, in organisational context, value production happens thanks to a set of activities, intended as repeatable patterns of actions that are necessary to deliver product and services to the final customer. Basically, this is what Porter's Value Chain framework posits. Therefore, to be able to answer the research question, it is necessary to identify value generating activities in an organisation, no matter which is the nature (production, service or other) of the business run by it. The following research proposition is thence formulated:

> *Proposition 1: a general method to identify value generating activities in an organisation will be investigated.*

The second set of elements that supports the specified research question is the possibility to identify, represent, and communicate the impact of IT resources on value generating activities in an organisation. These elements are discussed together since they all refer to the same aspect. Having identified value generating activities, and given a certain set of IT resources, the question is now how to identify the impact of the latter on the former. To do so, the investigation of the relationships among IT resources and activities in a necessary task.

Activities per se are not sufficient to explain the value generation process. Activities need to use resources (a subset of which are IT resources), to generate value (Daft, 1983; Wernerfelt, 1984; Barney, 1991a,b). Therefore, a necessary step to identify, represent, and communicate the impact of IT resources on value generating activities requires the identification of IT resources that are used in activities. The following research proposition is then formulated:

> *Proposition 2: the identification of IT resources used to support activities execution will be investigated.*

Finally, once the value generating activities and the resources used are identified, there is the necessity to represent them, in a form that allows the sharing of the understanding gained on the phenomenon to stakeholders. Therefore the following research proposition is formulated:

> *Proposition 3: a form that enables the communication of the relationships of IT resources and business process activities among people interested in the phenomenon will be investigated.*

1.2.1 Research perspective

As described in this chapter, the domain of interest of this Ph.D. dissertation is the one of IT Business Value. IT Business Value is a complex field of research with many branches and sub domains. This Ph.D. dissertation does not address the IT Business Value problem in its broad sense, but it focuses on it according to the perspective that has been described so far.

The contribution that this Ph.D. dissertation aims at providing consists in the definition of a method and a tool to identify the relationships of IT resources on value generating activities. This necessity stems out of the IT Business Value research domain. The Ph.D. dissertation therefore does not address financial calculation problems pertinent to the IT Business Value research, but something that could help in performing such evaluation and assessment. The contribution lies therefore in the definition of an approach suitable to support the identification of impacts of IT resources on value generating activities, being impacts, as affirmed by Soh & Markus (1995), necessary and sufficient condition for IT business value.

1.2.2 Research approach

The approach proposed by this Ph.D. dissertation combines together two different streams of research. The first one is the already discussed IT Business Value, which is the main domain where the problem addressed emerges. The second one is the Business Modelling stream of research. This stream of research is brought into play since it contributes with the concept of Business Model. The Business Model is a theoretical concept that is commonly used to identify value generating activities in an organisation (Magretta, 2002; Bienstock et al., 2002).

This Ph.D. dissertation proposes therefore to integrate the Business Model Ontology (BMO) (Osterwalder, 2004) with the OLPIT ontology (vom Brocke et al., 2009) to obtain a meta-model that can be used to identify, represent, and communicate the relationships among IT resources and business process activities. The dissertation will also provide a test case used to clarify the methodology to implement and adopt the proposed meta model in real life scenarios. The proposal lies on the following two considerations. First of all, the BMO offers a feasible way to describe the components of a Business Model. Doing that, it also offers the possibility to describe the main value generating activities in an organisation embedded with the resources that are necessary to support them. However the BMO does not directly take IT resources into consideration. The OLPIT ontology, instead, describes the relationships among IT resources, IT services, and activities. The integration of the two ontologies offers the opportunity to obtain a comprehensive meta-model that can be used to identify, represent, and communicate the relationships among IT resources and value generating activities in an organisation.

This approach will be described in details in this dissertation as follows. In Part II the Business Model concept, and its implications for this Ph.D. dissertation will be described. Part III addresses the problem of the identification of the relationships among IT resources on business processes activities. Part IV will describe the approach proposed in this dissertation, and will also provide a test case based on a real life scenario. Finally Part IV will summarise and conclude the dissertation, highlighting practical applications of the proposed approach, along with its limitations.

1.2.2.1 Why an ontology

In the past, the usage of ontologies was mainly restricted to philosophy-related research fields. Nowadays ontologies are more and more used as generic instruments to support knowledge representations and exchanges (Guarino, 1998). Grünninger (2003) citing Gruber (1993) defines an ontology as an "*explicit specification of a shared conceptualisation*". An ontology is therefore a suitable tool to create and share a mutual understanding on a specific phenomenon among all actors that are interested in it.

Since ontologies can be described using formal languages, they are good candidates to describe generic enterprise related concepts (Force, 2003), due to their high degree of formalisation. The application of reasoning capabilities to ontologies enables also the reduction of the number of facts to be modelled (thanks to the formulation of axioms and rules). Moreover, ontologies allow queries to be executed on themselves, and are capable of answering queries concerning not only what is explicitly represented in the model (as in the traditional meta-model based approach), but also what is implied by it (Fox et al., 1998).

Under a technical point of view ontologies offer therefore several advantages compared to other model based and meta-model based approaches. Under the knowledge perspective, containing semantics that can be human or machine understandable, ontologies allow the sharing of common understanding of specific phenomenon. The usage of ontologies can be of help in contexts where people find themselves in troubles in sharing a common understanding on phenomenon they are all interested in. The mutual understanding problem has many contact points with the problems addressed by this Ph.D. dissertation: the thematics related to business modelling (as testified by literature, and explained later in the text), and the identification of the relationships between IT resources and value generating activities (as experienced on the field).

In particular, when it comes to IT Business Value aspects, the mutual understanding between IT and business management is identified as a necessary step to gather value from IT and to achieve competitive advantage from it (min Choe, 2003; Bergeron et al., 2004). For this reason the ontology based approach has been judged suitable for this Ph.D. dissertation.

1.2.2.2 Why a new ontology

A large number of ontologies for individual enterprise-related phenomena is already available. Despite this large availability, only two ontologies – the Edinburgh Enterprise Ontology (EEO, see Uschold et al. 1998) and the TOronto Virtual Enterprise (TOVE) (Gruninger, 1998) have been explicitly constructed for the purpose of representing phenomena that encompass the whole organisation (Grünninger, 2003).

The two ontologies considerably overlap in their set of concepts as they both define classes related to organisational aspects, strategy, activities and time. As opposed to EEO, TOVE has been fully translated into a target language and applied within a supply chain management scenario and thus might serve as a core ontology to be extended (Grünninger, 2003).

Both ontologies conceptualise processes, resource usage and costs. However, they do not introduce IT related concepts. Under this perspective they are limited and cannot be applied to solve the problem defined and identified in this Ph.D. dissertation, nor can they be used to properly answer its research question.

Chapter 2
Research design

Under a chronological perspective, the research that this Ph.D. dissertation describes has undergone two different phases. The first phase was concerned with the adoption of the BMO as a conceptual tool to support the identification of the impact of resources on value generation activities, and its consequent test on a real life context. The second phase, instead, was concerned with the development of the OLPIT ontology and the consequent integration with the BMO.

Both steps have been executed in different test environments, and have followed slightly different methodological approaches, due to the differences in the nature of the activities, and in the number and type of subjects involved. Having already defined the research question for this Ph.D. dissertation, some methodological considerations on the research will be described in the following paragraphs.

2.1 Research methodology

2.1.1 First step: the identification and the use of the BMO

The BMO has been identified by means of a literature review (Braccini et al., 2008), and has been tested for eight months in a participatory action research study, during the exploitation phase of the LD-CAST European project. The literature review, and its results, are described in details in (Braccini et al., 2008).

According to Baskerville (1999) action research is a set of research approaches, with a pragmatic foundation (Baskerville & Myers, 2004), which is considered a better strategy to investigate the organisational impact of information systems (Avison et al., 2001). In action research projects, researchers cooperate with domain actors (or experts) to solve practical problems, expanding, at the same time, their scientific knowledge (Baskerville & Myers, 2004). Participatory action research expands the action research approach promoting domain actors to the status of "co researchers", and extending to them the responsibility of theory formulation (Baskerville, 1999). This methodological approach has been chosen due to the active role that people composing the research team, as well as the author of this dissertation, have played in the LD-CAST project, where the BMO has been, firstly identified, then tested.

A description of the BMO will be given in Part II. A small test case for the BMO will be described in section 6.5.

2.1.2 Second step: development of the OLPIT ontology and integration with the BMO

Being concerned with the development of the OLPIT ontology, an artifact that is suitable to solve an organisational problem, the second step of the research has adopted a design science (Hevner et al., 2004) paradigm. In design science, researchers develop artifacts suitable to solve practical problems, and test their goodness in providing solutions to such problems. Knowledge on the phenomenon is gained through the process of building and testing the artifact (Nunamaker et al., 1991).

Design research is essentially an iterative approach (Markus et al., 2002) that usually takes as foundations existing knowledge in the domain of interest. According to Hevner et al. (2004), to ensure rigour in the development and in the evaluation of the artifact, rigorous methodologies have to be adopted during the development activity. In the case of this Ph.D. dissertation, the development effort is connected with the creation of the OLPIT ontology, and with its integration with the BMO. Paragraphs 2.1.2.1 and 2.1.2.2 will describe, respectively, the methodology adopted for the development of the OLPIT ontology, and for the integration with the BMO.

2.1.2.1 Ontology building

The development of the OLPIT ontology, as well as the methodology adopted for it, is largely described in vom Brocke et al. (2009). Major remarks will be given in the current paragraph.

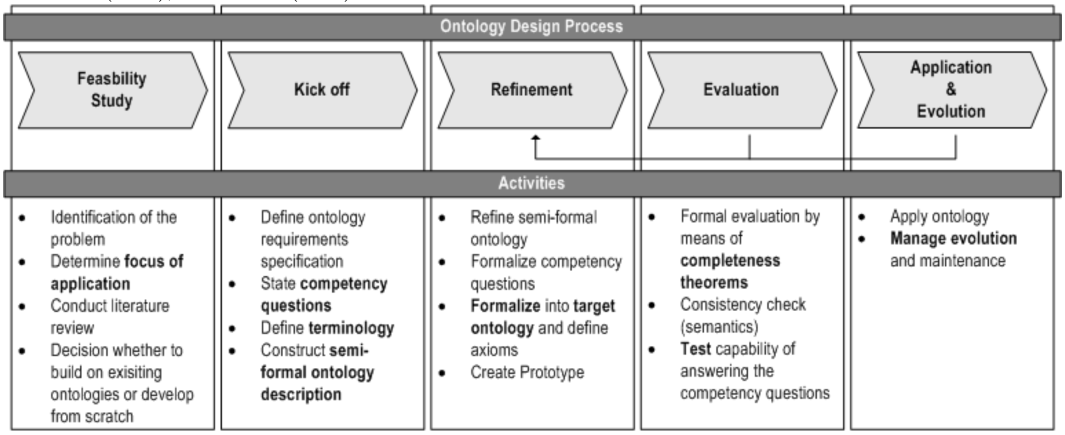
A complete review of ontology building methodologies is out of the scope of both this paragraph and of this Ph.D. dissertation. For such a purpose readers are invited to refer to Corcho et al. (2003). This paragraph will give just brief highlights on ontology building methodologies, and will clarify the one adopted by this Ph.D. dissertation. The first papers discussing ontology building methodologies are due to (Gruber, 1993; Gruninger, 1998; Uschold & Gruninger, 1996; Uschold et al., 1998). These works constitute the foundations of many subsequent seminal contributions and proposals.

The OLPIT ontology has been developed following the more recent approach proposed by Sure et al. (2004): the On-To-Knowledge. This methodology consists of five phases (feasibility study, kick-off, refinement, evaluation, application and evolution). Each one of these phases is divided in further sub-steps. The entire process is depicted in Figure 2.1 on page 19. The On-To-Knowledge methodology is based on an iterative process that matches the iterative nature of the design research. The development of the OLPIT ontology has crossed all the steps defined by Sure et al. (2004). During the feasibility phase the business needs and the problems to be solved have been identified. In the kick-off phase, the requirements of the OLPIT ontology have been defined by means of ontology competency questions (Fox et al., 1998). Sample competency questions defined for the OLPIT ontology are:

- Which services does IT offer to fulfil business requirements?
- What is IT offering to the business in terms of services?
- What are the most critical infrastructure services?
- What happens if a piece of hardware fails?
- What are potential single points of failure in a given situation?
- When is the IT infrastructure running into a bottleneck?
- Which investments are required to solve bottlenecks?
- To what extent are individual services underemployed/overburdened?
- Is the IT infrastructure capable of fulfilling business requests?

The refinement and evaluation phases have been iterated more than one time. They have benefited from the results of several practical and theoretical test cases that have been realised for the OLPIT ontology. The application and evolution phase have been iterated only once.

Fig. 2.1 The On-To-Knowledge engineering process - figure taken from vom Brocke et al. (2009) based on Fox et al. (1998); Sure et al. (2004)



2.1.2.2 Ontology interoperability

Ontologies represent formal and explicit specification of shared conceptualisations (Studer et al., 1998). Different subjects may target the same domain with different ontologies. These ontologies can therefore be based on different sets of vocabularies that are likely to diverge due to the usage of different name-spaces or different naming conventions (Jiménez-Ruiz et al., 2009). Even if some ontologies overlap, they are most likely to be unrelated from a logical point of view (Jiménez-Ruiz et al., 2009). Thence, to be able to inter-operate them, an appropriate correspondence among terms used by the various ontologies is necessary.

Choi et al. (2006) discuss three different processes that support interoperability between two different ontologies, and they qualify them as generic ontology reuse processes. These processes are: ontology merging, ontology alignment, and ontology integration.

The ontology merge process is the process that generates a single coherent ontology starting from two or more existing ontologies related to the same domain (Choi et al. 2006 citing Pinto et al. 1999). The ontology merge process produces, as output, an ontology that includes information from all sources ontologies, which are more or less unchanged. The two (or more) ontologies that undergo the merge process have similar or overlapping domains, but are unique and not revisions of the same ontology (Choi et al. 2006 citing Pinto & Martins 2001).

The ontology alignment process concerns, instead, the task of creating links between two original ontologies. Alignment is necessary if the sources have to become consistent to each others, but they have to be, at the same time, kept separated (Choi et al. 2006 citing Noy & Musen 2000). This process is normally used when the two ontologies to be aligned address complementary domains.

Finally, ontology integration, is the process that generates a single ontology in one domain, starting from two or more existing (and different) ontologies, targeting different domains (Choi et al. 2006 citing Pinto et al. 1999). The different domains addressed by the different ontologies may be interrelated. As a result, some changes are expected to be introduced, and the expected outcome is a single integrated ontology.

2.1.2.3 A comparison among ontology interoperability processes

The description of the different ontology interoperability processes that has been made in the previous paragraph highlights some differences among them. To better clarify these differences, the three processes are confronted, in depth, in Table 2.1 on page 20. The inputs, the outputs, the changes produced to the ontology, and the scenario of adoption are confronted in the table.

Table 2.1 A comparison among ontology interoperability processes

Process	Inputs	Outputs	Changes	Adoption
Ontology Merge	Two or more ontologies	A single coherent ontology	No relevant changes	Different ontologies related to the same subject
Ontology Alignment	Two or more ontologies	Links between the ontologies	No relevant changes	Ontologies addressing complementary domains Need of consistency among ontologies Need of separation among ontologies
Ontology Integration	Two or more ontologies	A single ontology in one subject	Some changes in the single integrated ontology	Creation of an ontology in one subject from different ontologies in different subjects

A broad distinction among the three processes described can be made on the basis of the output produced. In the ontology alignment process the output consists just in a set of links among the two (or more) ontologies that remain separated. In the others two remaining processes (ontology merge and integration), instead, the result is a single, brand new, ontology. The difference between ontology merge and integration lies in the subject addressed by the ontologies. If the two ontologies address the same subject, then the merge process is the one that is necessary to create a single new ontology. If the two ontologies address different subjects, then the integration process is the one that is necessary to create a single brand new ontology.

2.1.2.4 Inter-operating ontologies

The starting point of an interoperability process is the identification of adequate levels of correspondences between the terms used in the sources ontologies (Jiménez-Ruiz et al., 2009). The rationale is to identify which concepts and terms of the ontologies to be inter-operated imply the same meaning. Once identified, the necessary changes to the concepts and the terms of the ontology shall be performed in order to obtain the integration.

The process of identifying common meanings among different terms of different ontologies can be manual or automatic. A manual process implies the work of a human being that, at the best of his knowledge, interpret all the concepts in the ontologies to be inter-operated and judges the similarity and the diversity (in meanings) of the terms. An automatic process, instead, is performed by a software agent which scans the different ontologies to be inter-operated, and then establishes equivalence, subsumptions, or disjointness relationships among terms and concepts of the ontologies (Jiménez-Ruiz et al., 2009). An automatic process is generally preferred when ontologies are large and complex enough to make a manual process too burdensome.

2.1.2.5 Validation of the artifact(s)

A relevant aspect in design research is connected with the validation of the artifacts developed. In the context of this Ph.D. thesis, the artifact that are in discussion are the OLPIT ontology and the BMO, as well as their integration. Both of them have been tested in real life scenarios. The validation of the OLPIT ontology has been made thanks to feedbacks received by the IT management of an industrial company where it has been developed (vom Brocke et al., 2009), and thanks to the test cases that have been developed for the needs. The BMO has already been validated by research papers that have already applied it in real situations (Nagle & Golden, 2007; Braccini et al., 2008). The integrated ontology (BMO + OLPIT that will be called IT-BM later in the text) has been tested by means of a test case based on a real life scenario. Such a test case is described in Chapter 12.

Part II
The identification of Value Generating Activities in an organisation: the Business Model

Chapter 3
Introduction

The Oxford English Dictionary (2000) defines the term *Value* as *"the regard that something is held to deserve; importance or worth"*. A second meaning is also given: the "*material or monetary worth*". Despite such a synthetic definition, the term *Value* has indeed a complex history and a complex meaning. While giving a rigorous and historically grounded definition of *Value* is outside the scope of this dissertation, some generic considerations regarding its meaning are given in the following paragraphs.

As a concept, *Value* is of interest for many disciplines, but among them, economics is the one where it has been studied for more than 200 years. Dating back to the origins of classic economics, both Adam Smith and David Ricardo spent words on the definition of *Value*. It is to Adam Smith (1904) that the distinction between a *value in use,* "the utility of some particular object", and a *value in exchange,* "the power of purchasing other goods which the possession of that object conveys", has to be credited. David Ricardo, instead, pointed out that *Value* depends on the "relative quantity of labour" that is necessary to produce the valuable item (called commodity in classic economics). This claims contributed to the definition of the so called *Labour Theory of Value*, where the central point is the productive effort that is necessary to deliver the commodity. The *Labour Theory of Value* is only one among the different theorisation of *Value* that have been formulated in economics. Again, it is of no interest for this dissertation to introduce and discuss all the different value theorisation in economics. Readers that are interested on this topic may refer to classic and neoclassic economics literature to deepen their understanding on the matter.

Definitions of *Value*, specific for the IS literature, are not available. Despite of the great interest and attention payed by IS literature to value, as testified by the numbers of papers cited by some literature reviews like the one of Kohli et al. (2003), Melville et al. (2004), and Kohli & Grover (2008), the discussion on value happens without the need to provide theoretical foundations of the concept. Therefore, in this dissertation the value concept will be defined referring to the meaning that emerges from management literature that is of relevance for IS.

3.1 Value production inside organisations: the Value Chain

The discourse on *Value* as addressed from the perspective of management disciplines is, compared to the one in economics, noticeably younger. A relevant milestone in this field of research is constituted by the work of Michael Porter (1985), who defined the *Value Chain*, as a set of activities through which several inputs are transformed into valuable outputs. Porter's *Value Chain* is, since a longtime, a reference framework to identify value generating activities in a organisation. Porter's *Value Chain* is anyhow modelled around the prototype of the large industrial American firms, therefore it is of no use for small and medium enterprises, or for service providers. Today, Porter's *Value Chain* is an acknowledged framework to describe value creation inside profit oriented organisations. At the same time, along with its merits, also its limitations are acknowledged. For this reasons, extensions and reformulations of the *Value Chain* framework have been proposed in literature, and will be discussed in Chapter 4.

The discourse regarding Porter's framework contribution, and its extensions, to the identification of value generating activities inside a company will be deepened in the following chapters in this part. The contents of this part of the Ph.D. dissertation are mainly targeted at addressing the first research proposition (see section 1.2) concerning the identification of value generating activities in a profit oriented organisation.

Chapter 4
Value Configurations: from Chains to Shops, Networks, and Constellations

Michael Porter introduces the *Value Chain* in his book titled "Competitive Advantage: Creating and Sustaining Superior Performance" (Porter, 1985). The main rationale behind the *Value Chain* framework, is the decomposition of an organisation into a set of strategically important activities, that have large impact on costs and value. While proposing this framework, Porter affirms that the value creation logic described by the *Value Chain* is valid in all industries (Porter, 1985, 1990).

Moreover, the interconnection of local value chains reproduces the value chain framework at industry level, defining a *Value System*. Such a *Value System* is composed by the interconnections of several *Value Chains*. These chains are those of the actors that enter the enter the process that transforms raw materials to final products to be delivered to the customer (Porter, 1985). Following this line of thought, an entire industry is therefore composed by a chain of sequentially interlinked activities that transform raw materials into finished products, which are valuable for the buyer (Stabel & Fjeldstad, 1998).

4.1 The Value Chain

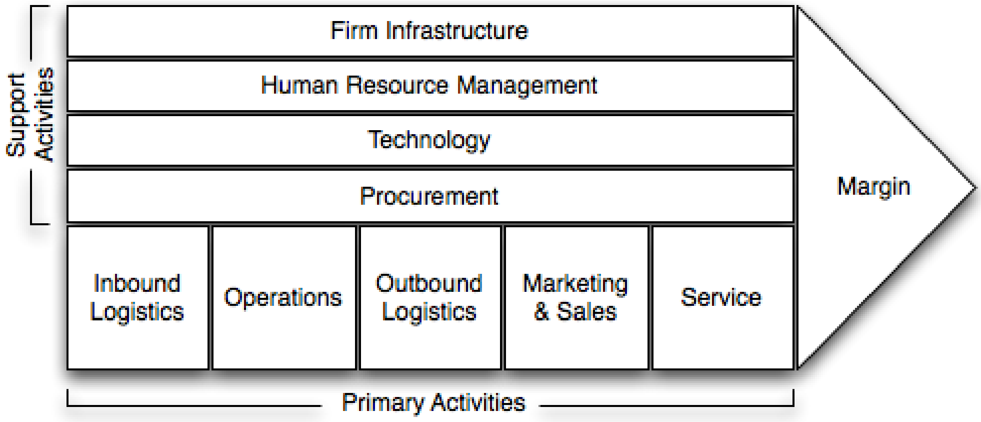
Porter's *Value Chain* framework has been, since a longtime, the accepted language for both representing and analysing the logic of value creation at the organisational level (Stabel & Fjeldstad, 1998). With its simplicity, it describes an ideal linear transformation of an item from a raw material to a final product that can be delivered to the market. This item is therefore the medium that incorporates the value that is transferred to the customer. The item (or the product) is valuable if customers are willing to pay for it.

The *Value Chain* framework, whose schema is represented in Figure 4.1 on page 28, posits that the value generation logic of an organisation is described by a limited set of activities, divided between primary activities and support activities.

The *Value Chain* comprises five generic primary activities that are the main responsible for value creation, as they are directly involved in creating and bringing value to the customer (Stabel & Fjeldstad, 1998). The primary activities composing the *Value Chain* are:

- **Inbound Logistics**: this set of activities includes operations like receiving, storing, inventory control, disseminating inputs to the product, and transportation planning;
- **Operations**: includes activities associated with the transformation of the input into the output, among which machining, packaging, assembly, equipment, maintenance, testing;
- **Outbound Logistics**: includes activities required to deliver the final product to the customers, like warehousing, order fulfilment, transportation, and distribution management;
- **Marketing and Logistics**: includes activities that are necessary for the buyers to purchase the product, like channel selection, advertising, promotion, selling, pricing, and retail management;

Fig. 4.1 Porter's Value Chain (Porter, 1985)



- **Service**: includes activities that provide services to maintain and enhance the value of the product, like customer support, repair services, installation, training, spare parts management, and upgrading.

Primary activities are supported by secondary activities. Secondary activities do not directly contribute to the value creation and delivery to the final customer, but they contribute only indirectly, since they affect the performance of primary activities. The secondary activities included in the *Value Chain* are the followings:

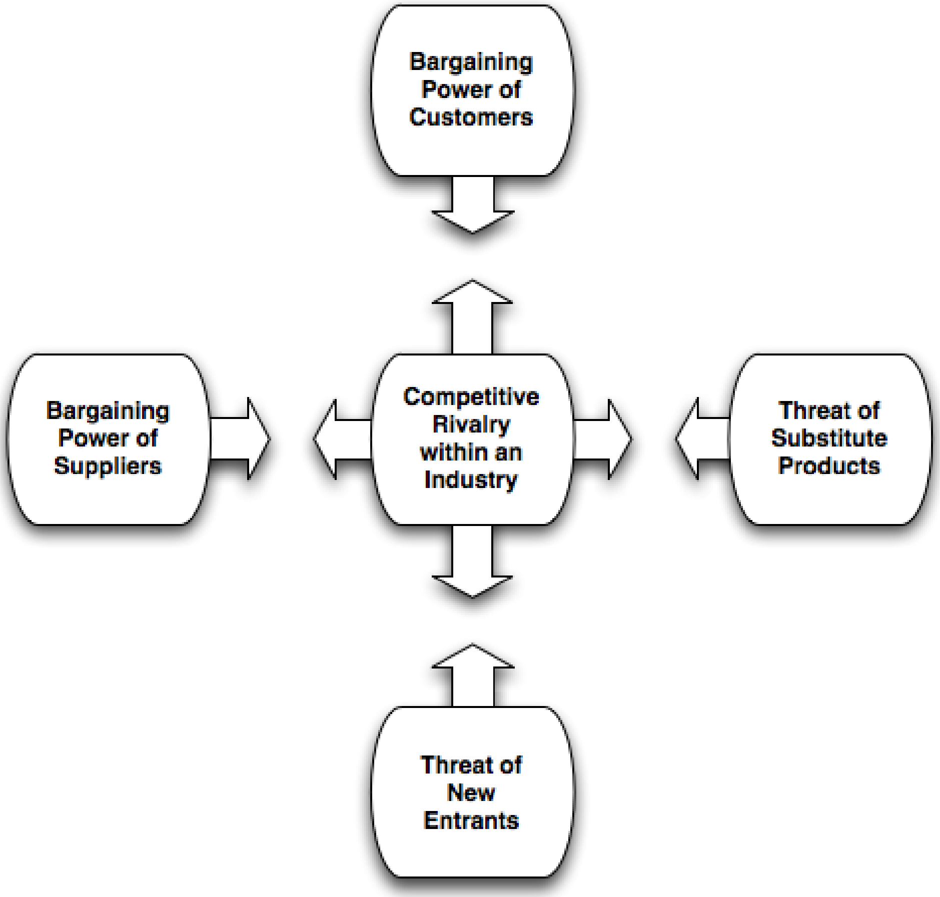
- **Procurement**: includes all activities performed to purchase the inputs used in the value chain, like procurement of raw materials, servicing, spare parts, buildings, machines and others;
- **Technology Development**: includes all activities of technology development that supports others value chain activities, like research and development, process automation, design, and redesign;
- **Human Resource Management**: includes all activities associated with recruiting, training, retention and compensation of all employees and managers;
- **Firm Infrastructure**: includes activities like general management, planning management, legal, finance, accounting, public affairs, quality management, and others.

According to the interpretation of Stabel & Fjeldstad (1998), the graphic representation of the *Value Chain* suggests further considerations. First of all, the entire chain has the shape of an arrow, symbolising an hypothetical direction of the flow of the value production process. In this flow, the primary activities are depicted one after the other, signifying that they have to be executed in a strict sequence. Support activities, instead, span all primary activities, and are depicted not as a sequence, but as a pile, signifying that they are executed in parallel, and that they support all primary activities. Finally, the arrow at the end of the *Value Chain* containing the margin, signifies that all the activities in the chain are costs elements that contribute together to produce the value delivered at the end of the chain.

4.1.1 Value Chain: insights and limitations

Porter's *Value Chain* is, since a long time, an acknowledged framework to describe, represent, and analyse the value generation logic of a profit oriented organisation.The *Value Chain* lies over an industrial organisation competitive analysis framework called the "Five Forces", which is depicted in Figure 4.2 on page 29. Together, these two frameworks have profoundly influenced the managerial discourse on value creation (Huemer, 2006).

Fig. 4.2 Porter's Five Forces Framework



Porter's *Value Chain* has for sure the merit of identifying generic activities that contribute to produce value in industrial companies. Although this framework does not identify strategic activities that contribute to organisational competitive advantage, nor identifies strategic functions inside the organisation chart of an organisation, it describes a simple and linear sequence of activities that contribute to value production.

Along with its benefits, also its limitations are acknowledged. First of all, as Stabel & Fjeldstad (1998) point out, while the *Value Chain* easily describes the value production logic of a traditional manufacturing company, it difficultly adapts to other kinds of industries[1], especially to service industries (Løwendahl, 1992; Armistead & Clark, 1993; Sthonehouse et al., 2001). The problem here is twofold. First of all it is difficult to assign the activities of a service industry to those of the *Value Chain.* Even when this can be done, the resulting chain is quite obscure and does not clearly describes the value creation logic of the service provider (Stabel & Fjeldstad, 1998). What is therefore criticised is both the value configuration (the chain) theorised by Porter, and the number and the kind of activities that form such value configuration.

[1] Stabel & Fjeldstad (1998, p. 414) mainly refer to, amongst others, insurance, banking, metal processing, telecommunication, health services, downstream and upstream petroleum, engineering, and transportation.

4.2 Beyond the Value Chain: Value Shops and Value Network

In an attempt to describe value configurations for competitive advantage that are different from the *Value Chain*, Stabel & Fjeldstad (1998), referring to Thompson (1967) and to his typology of technology, suggest that the *Value Chain* is just one of three generic value configurations.

In an attempt to create a classification scheme that could be generic enough to deal with the range of technologies found in organisations,Thompson (1967) describes three different types of technology that are differentiated by the tasks performed by the organisational unit:

- **Long-linked technology**: such a technology supports tasks or operations that are sequentially interdependent. This technology is characterised by a sequence of fixed and repetitive steps. Each activity can be performed only when the previous one has been completed. This kind of technology is commonly used to support the activity of mass production assembly lines;
- **Mediating technology**: a mediating technology links customers on both the input and the output side of the organisation. A mediating technology supports the activities of a mediator, who links units that are normally independent. This kind of technology is commonly used to support the activities of banks, telephone utilities, employment and welfare agencies, or post offices;
- **Intensive technology**: such a technology represents a response to a diverse set of contingencies. This technology supports tasks that have to deal with a variety and variability of problems that cannot be either planned nor predicted. This kind of technology is commonly used to support the activities of hospitals, universities, research laboratories, or military combat teams.

This classification builds on the assumption that each type of technology supports a specific type of activity. Stabel & Fjeldstad (1998) builds on such distinction, theorising that for each kind of activity there is also an underlying different value configuration. The value configurations that they describe are: *Value Chains*, *Value Shops*, and *Value Networks.* A brief description of the characteristics of these value configurations can be found in Table 4.1 on page 30[2]. Each one of the three configurations will be anyhow, described in the following paragraphs

Table 4.1 Overview of alternative value configurations (Stabel & Fjeldstad, 1998)

	Chain	Shop	Network
Value creation logic	Transformation of inputs into products	(Re)solving customer problems	Linking customers
Primary technology	Long-linked	Intensive	Mediating
Primary activity categories	- Inbound logistics - Operations - Outbound logistics - Marketing - Service	- Problem-finding and acquisition - Problem-solving - Choice - Execution - Control/evaluation	- Network promotion and contract management - Service provisioning
Main interactivity relationship logic	Sequential	Cyclical, spiralling	Simultaneous, parallel
Primary activity interdependence	- Pooled - Sequential	- Pooled - Sequential - Reciprocal	- Pooled - Reciprocal
Key value drivers		- Reputation	- Scale - Capacity utilisation
Business value system structure	- Interlinked chains	- Referred shops	- Layered and interconnected networks

[2] This table is heavily based on the one provided by Stabel & Fjeldstad (1998, p. 415), the only difference is the "Key Cost Driver" row that has not been reported here since it is of no interest for this dissertation.

4.2.1 Value Shops

A *Value Shop* is defined as the value configuration of an organisation that relies on an intensive technology to solve problems of its customers (Stabel & Fjeldstad, 1998). An organisation that adopts this value configuration does not schedule activities in a fixed and sequential way, but it rather arranges them in a way that is suitable to satisfy customers' needs. The intensity of these activities is determined by the nature of the problem. Such a value configuration is typical of professional services (like the ones provided by doctors, lawyers, architects, and engineers) (Stabel & Fjeldstad, 1998).

Value Shops can also be used to understand the value generation logic of just a single unit of the whole organisation, whose entire value creation logic is more easily understood with the *Value Chain*. In other words, a *Value Shop* configuration can coexist in an organisation that works with a *Value Chain* configuration. This is the case, for example, of those departments or organisational units that work as service providers towards the rest of the organisation.

Organisations whose value creation logic is a *Value Shop*, create value solving customers' problems. The value is identified in the gap between customer's initial existing state and the desired state (problem solution). In such a value creation process, customers and providers are in a position of great information asymmetry. Providers usually try to provide customers with more or less standardised solutions, but the value creation process is organised to deal with unique problems (Stabel & Fjeldstad, 1998), which require high professionalism and profound knowledge to be solved.

In spite of problems uniqueness, activities necessary to acquire information to solve the problem are usually the same. During the problem solving process, multiple disciplines and specialities follow each others in a spiral of activities. organisations that create value through the *Value Shop*, are typically populated by specialists and experts (Stabel & Fjeldstad, 1998). A diagram showing the generic interaction among *Value Shop* activities is shown in Figure 4.3 on page 32. The diagram is based on the one proposed by Stabel & Fjeldstad (1998, p. 424).

The generic categories of primary activities for *Value Shops* according to Stabel & Fjeldstad (1998)are the followings:

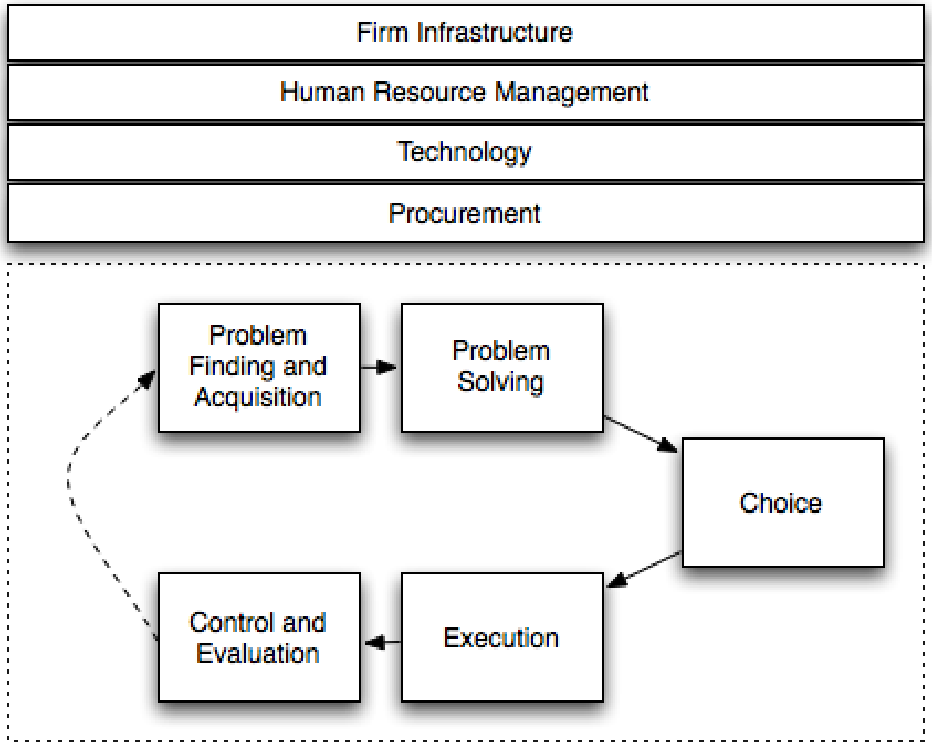
- **Problem finding and acquisition**: these activities are associated with the record, the review, and the formulation of the problem to be solved, and with the choice of the overall approach to adopt to solve the problem;
- **Problem solving**: these activities are associated with generating and evaluating alternative solutions;
- **Choice**: these activities are associated with the choice among alternative problem solutions;
- **Execution**: activities associated with the communication, the organisation, and the implementation of the chosen solution;
- **Control and evaluation**: these activities are associated with the measurement and the evaluation of what extent the implementation has solved the initial problem.

Regarding supporting activities, Stabel & Fjeldstad (1998) point out that many of them are executed within primary activities, therefore they should be taken away from the diagram, nevertheless they have decided to maintain them in the same position they occupy in the *Value Chain,* due to their strategic importance in value creation and competitive advantage generation.

4.2.2 Value Networks

A *Value Network* is the value configuration adopted by an organisation that rely on a mediating technology to link clients or customers who are, or wish to be, interdependent (Stabel & Fjeldstad, 1998). The technology adopted facilitates the exchange of relationships among customers separated by space and time. Such an organisation does not provide the

Fig. 4.3 Diagram of a *Value Shop* (Stabel & Fjeldstad, 1998)



network, but provides networking services. This value configuration is adopted by several organisations that work in a complex and interrelated network of actors, people, and other organisations, playing the role of mediators, relying on positive network externalities.

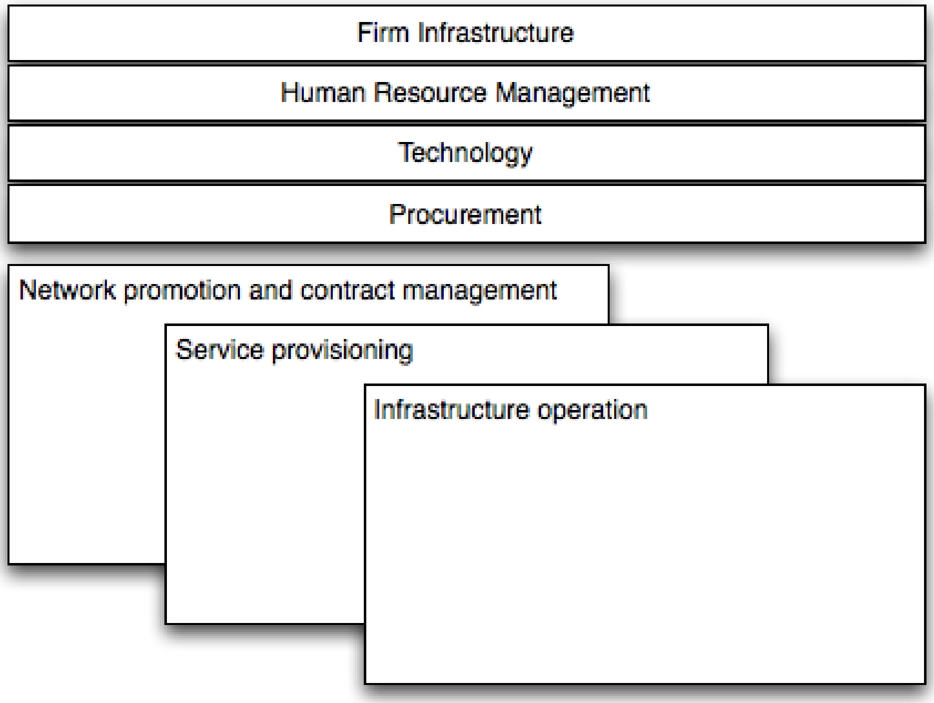
As a mediator, the organisation that manages the network, admits members to the network and charges them for membership, service, and equipment, in a potentially long-term operations phase in which contracts, infrastructure, and service activities are performed concurrently (Stabel & Fjeldstad, 1998). Relationships among actors in the industry are not the ones of suppliers and customers, as in a *Value Chain*, they rather co-perform mediation services. Under this perspective an industry is just a structure of interconnected mediation networks. A diagram showing the generic interaction of activities in a *Value Network* is shown in Figure 4.4 on page 33.

Primary activities in a value network show a certain degree of overlap and interaction. The diagram shows no arrow shape, to signify that the value creation logic has no direction now, and that value is instead created with the intermediation among members of the network. The generic primary activities of a *Value Network* are described by Stabel & Fjeldstad (1998) as follows:

- **Network promotion and contract management**: includes all activities associated with the invitation of customers to join the network, and their subsequent selection. Moreover this group includes also the initialisation, the management, and the termination of contracts governing service provisioning and charging;
- **Service provisioning**: includes all activities associated with establishing, maintaining, and terminating links between customers, including also billing for the value received. Such links can be synchronous or asynchronous;
- **Network infrastructure operation**: includes all activities necessary to keep physical information infrastructure in a status where it is ready to serve customers requests.

Among supporting activities, in organisations adopting a *Value Network* configuration, the ones connected to technology are relevant. They include two important development activ-

Fig. 4.4 Diagram of a *Value Network* (Stabel & Fjeldstad, 1998)



ities: network infrastructure development, and service development. Regarding the others, procurement is heavily connected to network infrastructure, and service development. In a similar way also human resources management is often quite different for infrastructure and service development. Finally, firm infrastructure, has not to be confused with the value network infrastructure.

4.3 The impact of ICT on value configurations: Value Constellations

Chains, Shops, and Networks are just attempts to capture and describe the generic value generation logic of organisations working in specific industries. These frameworks provide guidance for the identification of the activities that generate value inside organisations. To be used in specific contexts, these frameworks need to be instantiated with the names and the descriptions of real activities executed by the organisation whose value configuration has to be described.

It is anyhow disputable whether such value configurations could be practically used to describe the value generation logic of a real organisation, in a context where global competition, instable markets, and new technologies produce continuously new ways of creating value (Normann & Ramirez, 1993). Stabel & Fjeldstad (1998) themselves recognise that more than one value configuration might be found inside a single organisation. To support this claim, they refer to Normann & Ramirez (1993), and to their idea of *Value Constellations*.

According to Normann & Ramirez (1993) successful organisations working in the actual competitive environment do not simply add value, but they rather reinvent it, by reconfiguring tasks, roles, and relationships, among a constellation of actors. The final result is a new configuration of actors where value is now created and circulated in a way that is different from the one before the re-configuration. Normann & Ramirez (1993) provide the example of IKEA to support their theoretical concept of *Value Constellation*. In the paper they describe how IKEA changed the roles of the actors involved in a traditional industry (the furniture industry). They particularly stress the position of the customer that is no longer at the end of the chain, nor is the final recipient of value created by the organisation. In a *Value Constellation* the customer himself is a member of the constellation and, as such, he is not only someone who consumes value, but also someone who contribute to its creation.

The *Value Constellation* concept goes a bit beyond chains, shops, and networks, because, instead of theorising fixed value configurations, it rather describes the value generation logic as an effort of deconstruction and reconstruction of chains, shops, and networks, by means of the reassignment of roles among different actors. ICTs impact on traditional businesses and offer many opportunities to reconfigure them, therefore they offer many opportunities to create new sources of value.

Chapter 5
The Business Model of the firm

The deconstruction of value chains, shops, and networks, and their re-construction in new value configurations offers many opportunities for the creation of new ways of doing business (Schweizer, 2005). The theoretical concept of *Business Model* has been used at the onset of the new economy to synthetically describe new, actual or potential, business ideas or opportunities created by the use of ICT (Lewis, 1999; Feng et al., 2001). Basically a *Business Model* describes the way an organisation "makes money" (Bienstock et al., 2002). The emphasis on the term during the new economy era has to be mainly explained due to the impact of ICTs on methods of doing business. The increased availability of cheap ICT solutions made it much more easy for organisations to work in so-called value webs, because in such environments coordination and transaction costs fall down (Osterwalder et al., 2005). Different organisations (sometimes also competitors) perform therefore business together to deliver value to their customers. This new way of doing business contributed to blur the boundaries of industries, making the business model a good candidate to replace the industry as a unit of analysis to investigate the value generation phenomenon in the new economy era (Osterwalder et al., 2005).

The theoretical concept of *Business Model* has caught much attention both in business practice and in scientific research (Alt & Zimmermann, 2001). In spite of this great interest there seems to be not so much shared understanding of the *Business Model* concept, as common theoretical backgrounds, and even a shared definition of the term are missing (Gordijn et al., 2005). Research on *Business Models* interests several disciplines which study this phenomenon with different objectives and points of view (Tikkanen et al., 2005). As a side effect, research contributions in this area of interest overlap or conflict each others. Even the simple definition of the term is an argument on which acknowledgement among researchers is not easy (Shafer et al., 2005). As a matter of example, table 5.1 and 5.3 show some different definitions that have been found in literature. The list has been derived from previous works, mainly based on a literature review (Braccini, 2008b,a; Braccini & Spagnoletti, 2008; Braccini et al., 2008).

Authors who study *Business Models* rarely perceive the need to provide solid theoretical foundations for the term they are using, nor they perceive the multi-disciplinary nature of this research (Braccini & Spagnoletti, 2008). As a result integration and interoperability among contribution is often not addressed by researchers (Pateli & Giaglis, 2004), leaving room for misconceptions and misleading interpretations of the *Business Model* term, especially in environments where multiple different subjects are interested to the phenomenon.

5.1 Business Model and Value Generation

Reading through the list of available definitions given in table 5.1 and 5.3 it is easy to understand that, although there is a huge variation in structure and contents of proposed definitions, they all orbit around the core concept of value generation. It can therefore be said that the *Business Model* is a generic theoretical concept used to describe the value

Table 5.1 Definitions of *Business Model* available in literature (first part)

Author(s)	Definition
(Betz, 2002)	A business model is an abstraction of a business identifying how that business profitably makes money
(Boulton et al., 2000)	The business model determines whether a company destroys or creates value and in what ways
(Chesbrough & Rosenbloom, 2000)	A business model is a description of how your company intends to create value in the marketplace. It includes that unique combination of products, services, image and distribution that your company carries forward. It also includes the underlying organisation of people and the operational infrastructure that they use to accomplish their work
(Colvin, 2001)	The way we make money
(Dubosson-Torbay et al., 2002)	A business model is nothing else than the architecture of a firm and its network of partners for creating, marketing and delivering value and relationship capital to one or several segments of customers in order to generate profitable and sustainable revenue streams
(Engelhardt, 2004)	It denotes the organisation, production and financing strategies implemented by the typical young, radically innovative, fast-growing and publicly listed company that came to dominate the information technology sectors in the USA
(Feng et al., 2001)	A concept focused on management plans for cost recovery and sources of funding, including the capital market
(Fisken & Rutherford, 2002)	The business model outlines how a company generates revenues with reference to the structure of its value chain and its interaction with the industry value system
(Hamel, 2000)	A business model is simply a business concept that has been put into practice
(Joo, 2002)	The business model is a framework for successful business practices ranging from business ideas to sources of revenue and the distribution structure for partners
(Linder & Cantrell, 2001)	The organisation's core logic for creating value
(Magretta, 2002)	A story that explains how an enterprise works
(Mahadevan, 2000)	A business model is a unique blend of three streams that are critical to the business. These include the value stream for the business partners and the buyers, the revenue stream, and the logistical stream. The value stream identifies the value proposition for the buyers, sellers, and the market makers and portals in an Internet context. The revenue stream is a plan for assuring revenue generation for the business. The logistical stream addresses various issues related to the design of the supply chain for the business
(Mansfield & Fourie, 2004)	A model is an abstract representation of reality that defines a set of entities and their relationships. A business model most commonly describes the linkage between a firm's resources and functions and its environment. It is a contingency model that finds an optimal mode of operation for a specific situation in a specific market
(Miles et al., 2000)	A business model represents a clearly stated plan for adding economic value by applying know-how to a set of resources in order to create a marketable product or service
(Mitchell & Coles, 2004)	A business model is the combination of "who", "what", "when", "where", "why", "how", and "how much" an organisation uses to provide its goods and services and develop resources to continue its efforts

generation logic of an organisation. Understood under this perspective the *Business Model* term assumes the role of an interesting theoretical lens, through which the value generation logic of an organisation can be captured and described, possibly in an easily communicable form.

Referring to the research propositions of this Ph.D. dissertation, the *Business Model* looks like a good candidate for the identification of value generating activities inside organisations. Anyhow, to be able to do so, further clarifications of the concept are necessary. In particular, a way to describe what a *Business Model* actually is, is necessary. The literature is a good starting point to look for such a thing.

Table 5.3 Definitions of *Business Model* available in literature (second part)

Author(s)	**Definition**
(Osterwalder & Pigneur, 2002)	A business model is nothing else than a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenues streams
(Osterwalder et al., 2005)	A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences
(Owens, 2006)	A description of the roles and relationships among a firm's consumers, customers, allies and suppliers that identifies the major flows of product information, money, and the major benefits to the participants
(Schweizer, 2005)	Business models are defined along three dimension: 1. value chain constellation, which means how value is created, 2. market power of innovators versus owners of complementary assets, which means how companies can create sustainable competitive advantages, and 3. total revenue potential, referring to the revenue model
(Shafer et al., 2005)	A representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network
(Timmers, 1998)	An architecture for the product, service and information flows, including a description of the various business actors and their roles; and a description of the potential benefits for the various actors; and description of the sources of revenues
(Vlachos et al., 2006)citing (Rayport & Sviokla, 1995)	A business model is a "collection of a series of bilateral relationships between players of the same or different industries, all participating in the creation of value"
(Voelpel et al., 2005)	The particular business concept (or way of doing business) as reflected by the business's core value proposition(s) for customers; its configured value network to provide that value, consisting of own strategic capabilities as well as other (e.g. outsourced/allianced) value networks; and its continued sustainability to reinvent itself and satisfy the multiple objects of its various stakeholders
(Weill & Vitale, 2001)	The description of the roles and relationships among a firm's consumers, customers, allies and suppliers that identifies the major flows of products, information and money, and the major benefits to participants

Searching the *Business Model* literature is not easy because, first of all, the term is frequently used in many articles, and secondly, a large number of different meaning is set down to it (Schweizer, 2005). Moreover, *Business Model* is a commonly used buzzword in newspaper articles, and also in some research paper.

Pateli & Giaglis (2004), who extensively analysed literature on *Business Models* to provide a framework to interpret it, theorise that literature on this topic can be classified in eight different sub-domains: *Definitions*, *Components*, *Taxonomies*, *Conceptual Models*, *Design Methods and Tools*, *Adoption Factors*, *Evaluation Models*, and *Change Methodologies*. A brief description of each sub-domain can be found in Figure 5.1 on page 38, while the relationships among these sub-domains is shown in Figure 5.2 on page 39[1].

In their review, Pateli & Giaglis (2004) notice that the research effort, measured in number of papers published, is much more strong in the three sub-domains that try to provide

[1] The relationships among sub domains is represented by means of arrows and take into consideration two main criteria: Integration (that shows which sub domain builds on which other), and Timeliness (that shows which sub domains emerges after which other) (Pateli & Giaglis, 2003).

Fig. 5.1 Sub domain in research on *Business Models* (Pateli & Giaglis, 2004)

Sub Domain	Focus
Definitions	Definition of purpose, scope, and preliminary elements of a Business Model, including the relationships with other business concepts like Strategy and Business Processes
Components	Decomposition of the Business Model concept into its fundamental constructs
Taxonomies	Categorization of Business Models into a number of typologies constructed with various criteria
Conceptual models	Organization of the information about a Business Model around a number of different perspectives, finalized at the identification and description of the relationship between its elements
Design methods and tools	Development and use of languages, standards, and software to automate the process of designing a Business Model
Adaptation factors	Analysis of factors that influence the organizational adoption of Business Models
Evaluation models	Identification of criteria to assess feasibility, viability, and profitability of new Business Model or to compare it against alternatives and best practices
Change methodologies	Formulation of guidelines to change existing Business Model, to chose a new one, or to adapt to a new business or technology innovation

definitions, components, and taxonomies of a *Business Model*. Therefore, the three sub-domains called *Definitions*, *Components,* and *Taxonomies,* are the most promising ones for the identification of a tool that allows the description and the representation of a generic *Business Model*. Osterwalder et al. (2005) instead describe the evolution of research paths on *Business Models* as show in Figure 5.3 on page 39.

While the research framework provided by Pateli & Giaglis (2004) is of great help in interpreting literature on *Business Models*, Osterwalder et al. (2005) contribute a bit more in the identification of possible research papers that might suggest tools to define a *Business Model*. In the evolution of the research path shown in Figure 5.3 on page 39, the fourth step, called "Model business model elements", seems to be the last step of a definition and clarification effort. In his Ph.D. dissertation, where he studied the *Business Model* term, and a tool to describe it, Osterwalder (2004) clarifies that among all proposed definitions, the ones that show more rigour are those that make use of an ontology, where as an ontology, citing Guarino & Giarretta (1995), he understands a "conceptualisation as an intentional semantic structure which encodes the implicit rules constraining the structure of a piece of reality" (Osterwalder, 2004).

After having been applied in the field of artificial intelligence, and later by knowledge engineers, ontologies are increasingly used in IS and IT (Osterwalder, 2004) as generic instruments for the representation and exchange of specific knowledge concepts that need to be exchanged and shared among people (Guarino, 1998; Guarino & Musen, 2005).

A basic issue in research on *Business Model* is the identification of a shared understanding of what a *Business Model* actually is. This is directly testified by the numbers of definitions available. As a matter of fact, the definition effort is both the basis of Pateli and Giaglis' (2003) diagram of the relationships among sub-domains of research in *Business Models*, and the starting point of Osterwalder's et al. (2005) path of research evolution. Provided

Fig. 5.2 Relationships among sub domains in Business Model research (Pateli & Giaglis, 2003)

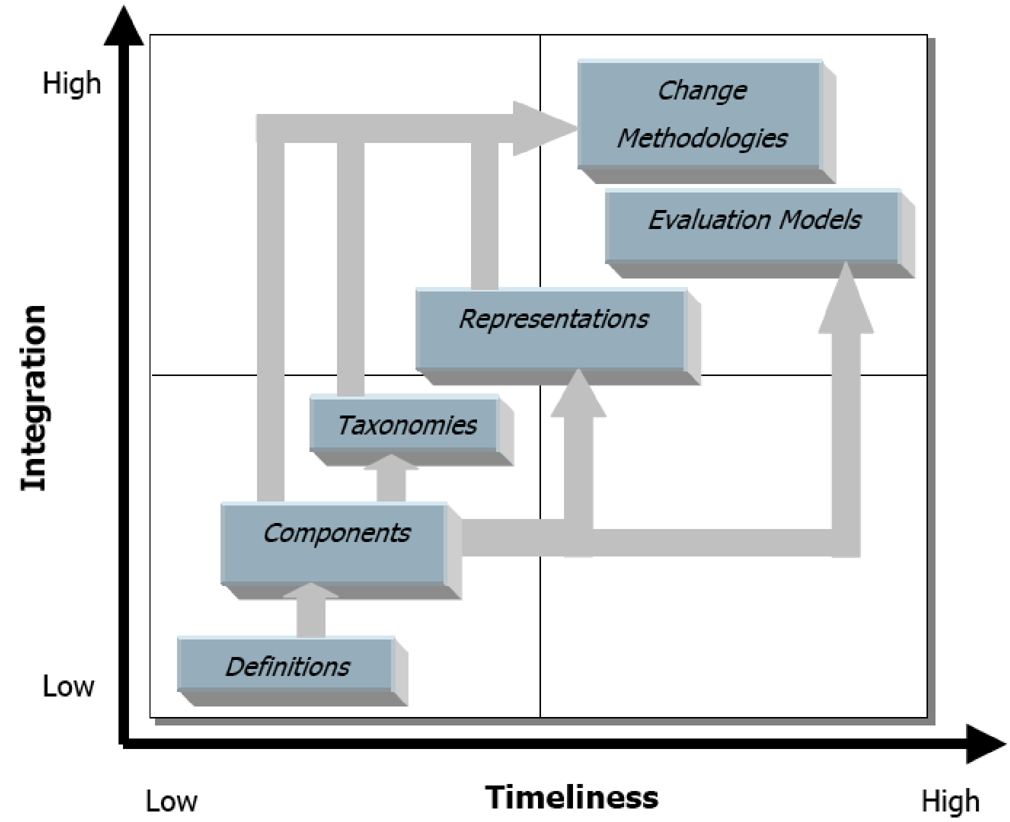
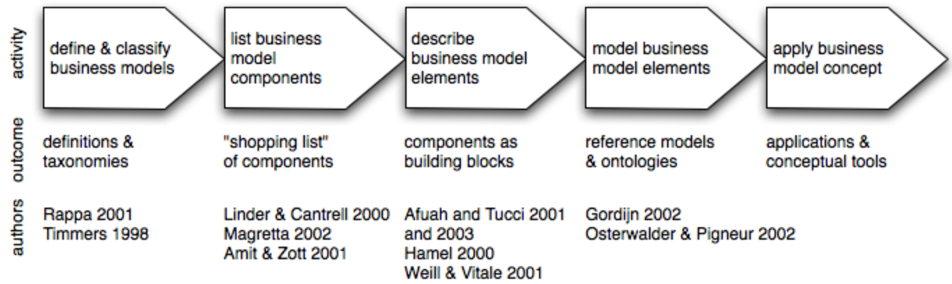


Fig. 5.3 Evolution of research paths on *Business Models* Osterwalder et al. (2005)



this, ontologies in research on *Business Model* provide a twofold advantage: first of all they contribute in the identification of a shared conceptualisation of a potentially vague and blurred term, moreover, at the same time, they provide enough rigour to such a definition, thanks to the use of the formalism that are normally used to define and describe an ontology.

In *Business Model* literature a small number of ontologies have already been proposed to describe the term. To judge whether they are helpful or not to provide an answer to the research question of this Ph.D. thesis, these ontologies will be described and analysed in the next chapter.

Chapter 6
Available ontologies to describe Business Models

A literature review (Braccini & Spagnoletti, 2008; Braccini, 2008b; Braccini et al., 2008) helped in the identification of three ontologies suitable to describe what a *Business Model* is. These ontologies are: the Business Model Ontology (BMO), the e3-Value Ontology, and the Resource Event Agent (REA) ontology. The results of this literature review are also confirmed by what is stated by Andersson et al. (2006) and Gordijn et al. (2005).

Each one of these ontologies contains concepts that are pertinent to the domain of *Business Models*. A comparison and an analysis of the three ontologies will be provided in the following paragraphs.

6.1 The Business Model Ontology

In an effort to systematise the scanted literature on *Business Models*, Osterwalder (2004) introduces the Business Model Ontology (BMO). In his Ph.D. thesis, Alexander Osterwalder (2004) performs an extended literature review on the topic and, from each selected paper, identifies the components that, according to the author(s) of the papers he analysed, compose a *Business Model*. By aggregating all the components that have been cited by at least two authors, Osterwalder creates an ontology that describes a *Business Model* as formed by four pillars and nine building blocks (see Table 6.1 on page 42 for a brief description of the BMO structure). Along with the ontology, Osterwalder also defines the term *Business Model* as follows:

> "A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams" (Osterwalder, 2004).

The structure of the BMO is a bit more complex than the one described in Table 6.1 on page 42. In the BMO jargon, all the building blocks are nothing but classes of the ontology. The BMO goes much more into details describing several sub-classes that are linked by several relationships to the ones constituting the building blocks of a *Business Model*. For each class the BMO also defines a set of attributes and, sometimes, their allowed values. Semantics is used to give proper meaning to each one of the classes in the BMO, as well as to their relationships.

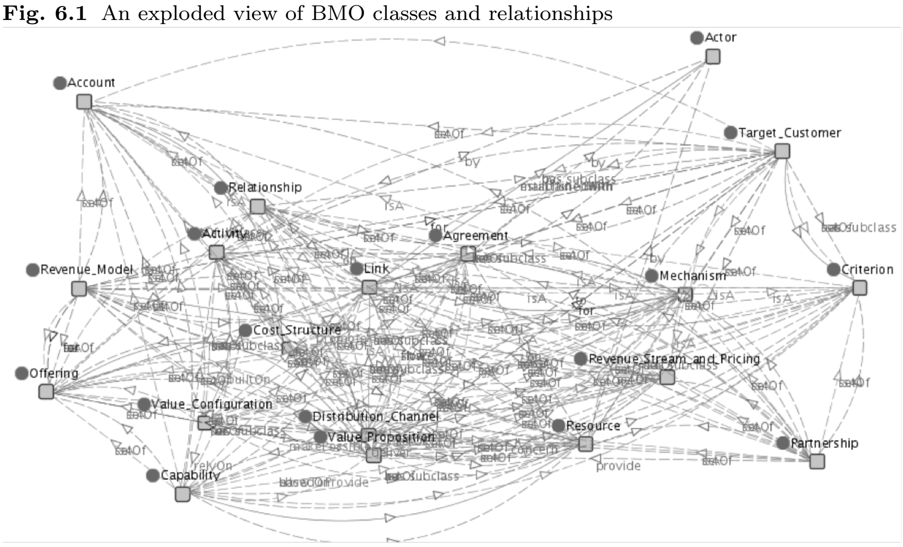
The complexness of the complete BMO structure (Figure 6.1 on page 42 shows an exploded view of all the classes of the BMO and their relationships[1]) allows for several kinds of alternative representations of a *Business Model* that has been modelled with it. The most complete representation requires the creation of instances of all the classes described by

[1] The image is not intended to be readable, it has just been shown here to give a visual representation of the complexness of the full schema of the BMO. The image represents only classes and relationships. Attributes of each classes are not depicted in the image.

Table 6.1 Structure of the Business Model Ontology (Osterwalder, 2004)

Pillars	**Building Blocks**	**Description**
Product	Value Proposition	The overall view of a company's bundle of products and services that are of value to the customer
Customer Interface	Target Customer	The segments of customers a company wants to offer value to
	Distribution Channel	The means of getting in touch with the customer
	Relationships	The kind of link a company establishes between itself and the customer
Infrastructure Management	Value Configuration	The arrangement of activities and resources that are necessary to create value for the customer
	Capability	The ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer
	Partner Network	A voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer
Financial Aspects	Cost Structure	The representation in money of all the means employed in the business model
	Revenue Model	The way company makes money through a variety of revenue flows

Fig. 6.1 An exploded view of BMO classes and relationships



the ontology[2]. A less detailed representation addresses only the building blocks level. This representation is also called the bird eye view of a *Business Model*, since it allows to have a quick overview of a single *Business Model*. The results of the literature review supports the assumption that the bird eye view is the most frequently used representation for business models modelled with the BMO.

Normally the BMO is used to describe the Business Model of a single organisation (Andersson et al., 2006), adopting therefore, an intra-organisational perspective. The BMO explores the details of the *Business Model* structure but does not go to much into details. In its form, the structure described by the BMO almost corresponds to the structure of a whole organisation. Anyhow, as specified by Osterwalder, the detail level of the BMO is between the strategic and the process level (Osterwalder, 2004, p. 148). The BMO, in fact, only defines the part of the organisation that is concerned with the value generation process.

[2] The BMO is a meta-model, since it describes how a *Business Model* is composed. To be used to describe e *Business Model* of an organisation, the BMO has to be applied, and its classes have to be instantiated with real life instances.

Osterwalder himself considers the possibility of extending the BMO, especially the pillar called “Infrastructure”, to reach the process level, and to increase the level of details of the relationships and the relevance of value generating activities.

6.2 The e3-Value ontology

The e3-Value ontology has been proposed by Gordijn & Tan (2005) with the purpose of identifying exchanges of value objects among actors in a business case. The ontology contains a simplified set of concepts that should be of easy usage to model the reality of interest. The e3-Value ontology includes some basic constructs and defines linkages among them. The defined constructs are: Actors (an independent economic entity), Value Objects (objects, like services, goods or similar exchanged among actors), Value Ports (used by an actor to show its willingness to exchange value objects), Value Interfaces (a set of individual Value Ports offering or requesting value objects) and Value Exchanges (represents a potential trade of value objects between value ports). All these constructs can be linked among each others with different elements: Dependency Elements, Connection Elements, Stimulus Elements, AND/OR Connection Elements, and Value Interfaces revisited. A brief description of the constructs of the e3-Value ontology can be found in Table 6.2 on page 43, while Table 6.3 on page 43 shows a description of the e3-Value ontology connections.

Table 6.2 e3-Value ontology constructs definitions (Gordijn & Tan, 2005)

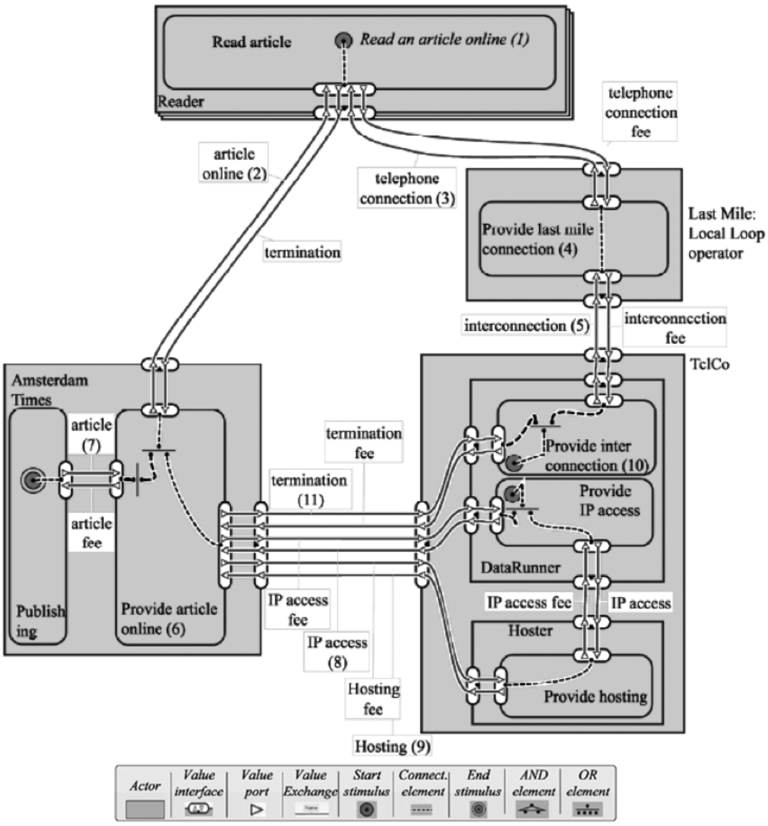
Construct	Definition
Actor	An actor is an independent economic (and often legal) entity. An actor performs value activities, making profits or increasing utilities. Store, Wholesaler, and manufacturer are examples of actors.
Value Object	A value object can be a service, a right, a good, or even a consumer experience that is exchanged by actors. A value object represent a value for one or more actors.
Value Port	An actor uses a value port to show its environment that it wants to provide or request value objects.
Value Interface	Actors have one or more value interfaces formed by individual value ports offering or requesting value objects.
Value Exchange	A value exchange represent one or more potential trades of value objects between value ports. A value exchange therefore connects two value ports with each other.

Table 6.3 e3-Value ontology connections definitions (Gordijn & Tan, 2005)

Connection	**Definition**
Dependency element	A path es expressed by dependency elements interconnected by connection elements. Essentially a path gives the dependencies between value interfaces so that one can reason for an entire value model what will happen with other value interfaces if values are exchanged via one particular value interface.
Stimulus element	Paths start with one or more start stimuli. A start stimulus represents an event, possibly caused by an actor. A path also has one or more end stimuli.
AND and OR elements	An AND element connects a dependency element to one or more dependency elements. The purpose is to propagate the counter of dependency element one over the other dependency elements. An OR element models a continuation of the path in one direction chosen from a number of alternatives.
Value Interface revisited	Value interfaces can also be used to connect dependency elements.

The constructs and their linkages in the e3-Value Ontology can be used to model a Value Network, composed by different actors that exchange value. If such a value network describes

Fig. 6.2 An example of a value network modelled with the e3-Value ontology (Gordijn & Tan, 2005)



value exchanges of an organisation with its suppliers, customers, or business partners, the e3-Value ontology can therefore be used to describe a *Business Model*. After having modelled the *Value Network*, the e3-Value ontology can also be used to perform a profitability evaluation of the network and, therefore, of the *Business Model*.

Each one of the constructs of the e3-Value ontology has its own graphical representation. The e3-Value ontology comes with a design tool that can be used to graphically build the value network. Figure 6.2 on page 44 shows an example of value network modelled with the e3-Value ontology. The design tool provided with the e3-Value ontology is also capable of producing this kind of visual representations.

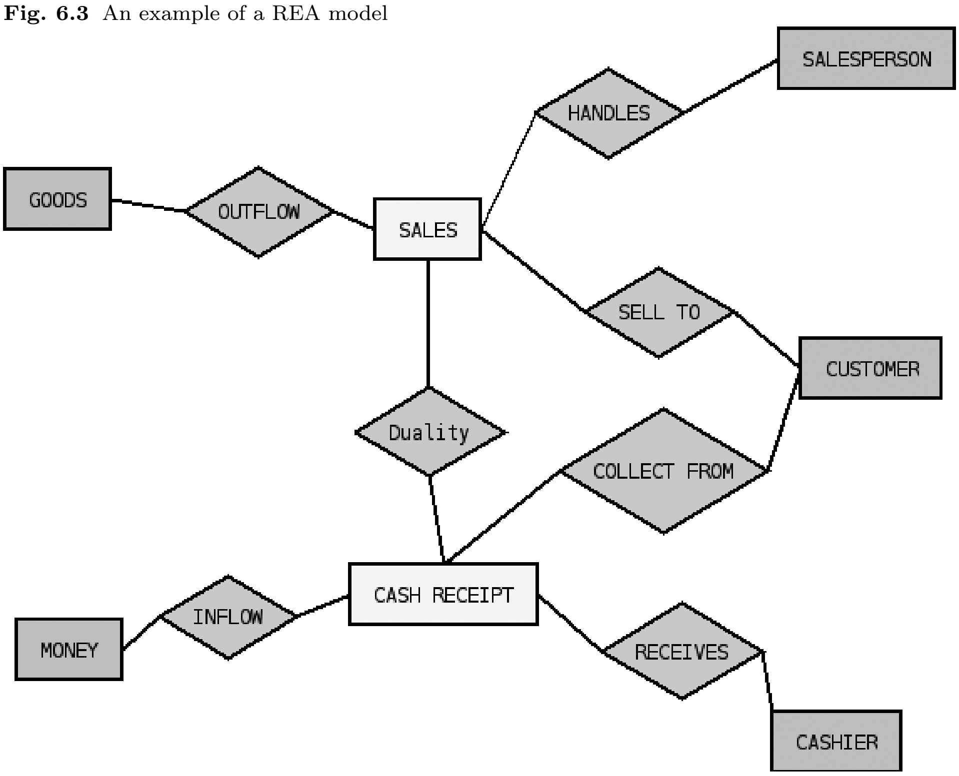
Given the network perspective adopted by the e3-Value ontology, the *Business Model* represented by means of this ontology constructs, focuses more on the external aspects (referred to an organisation) of the value generation process: the exchange of value among different organisations. For these reasons, the e3-Value ontology adopts an inter-organisational perspective.

6.3 The Resource Event Agent ontology

Compared to the BMO and the e3-Value ontology, the Resource Event Agent (REA) is the only one that has not directly been proposed for the *Business Model* domain. This is directly confirmed by what Andersson et al. (2006) affirm. According to them, that the REA ontology has been originally formulated by McCarthy (1982), and subsequently extended by Geerts & McCarthy (1999) to be adopted for domains closed to traditional business accounting.

The structure of the REA ontology is based on McCarthy's (1982) accounting model. The REA ontology is commonly used in teaching cases in accounting information systems, but it is less used in real business applications. The REA ontology gives a virtual representation of the business reality by means of three core concepts: Resources (like goods, services, or money), Events (like business transactions, or agreements that affects resources), and Agents (human actors or other human agencies like companies). For each business process, a complete REA model needs to be instantiated. The REA ontology interprets a business process as a functional department, or a function, in Porter's value chain.

Fig. 6.3 An example of a REA model



The core of each REA model is a duality of events linked by an exchange relationship. In one of these two events a resource is usually given away or lost, while in the other a resource is received or gained. For example, in the sales process, one event would be "sales" (where the resource good is given up), and the other would be "cash receipt" (where the resource is received). These two elements are linked since normally a receipt is issued after a sale and vice versa. Relationships can be more complex than these, and may involve more than two events. REA systems are usually modelled as relational databases.

6.4 A comparison among selected ontologies

The BMO, the e3-Value, and the REA ontology, use different approaches to represent a *Business Model*. As a result, they may lead to different consequences when adopted to describe a *Business Model*. An in-depth comparison among the three ontologies will be given in the current paragraph. The analysis will be made with the intent of choosing, out of the three, the ontology that best suits the need of identifying value generating activities in an organisation (necessary to answer the research question of this dissertation).

Table 6.4 on page 46 summarises the differences among the constructs offered by each ontology. The comparison among the three ontologies is made using the structure of the BMO as a reference, since the BMO possesses the most detailed set of constructs. Table 6.4 shows that the e3-Value ontology, and the REA ontology, only cover a small portion of the focus of the BMO. What this table shows is that the structure of the *Business Model* as defined by the BMO is much more wide in scope and in structure compared to the one of the e-3value and REA ontology. The comparison depicted in 6.4 has not to be intended as a class equivalence, but rather as a generic analogy among constructs proposed by the three ontologies.

Table 6.4 Constructs comparison of selected ontologies

	BMO	**e3-value**	**REA**
Offer related constructs	Value Proposition	Value Objects Value Interface Value Port	Resource
Customer related constructs	Target Customer Distribution Channel Relationship Mechanism	Actor Value Exchange	Actor Event
Network related constructs	Value Configuration Resources/Core Capability Partnership Agreement Actor		Event
Financial related constructs	Revenue Stream Cost Account		

Further considerations can be formulated taking into consideration Table 6.5 on page 46. First of all, among all the three ontologies, only the BMO stems out of the area of research on *Business Model*, and is directly targeting this domain. The others have been created for different purposes but, due to their structure and the constructs they include, they can also be used to represent *Business Models*.

The second row of table 6.5 shows the theoretical perspective adopted by each of the proposed ontology. While the REA is mainly based on Porter's (1985) *Value Chain* framework, the e3-Value refers to the Value Networks (Stabel & Fjeldstad, 1998), while the BMO refers to the Resource Based View of the firm (Wernerfelt, 1984, 1995). These theoretical backgrounds have been identified in the papers describing the ontologies. Anyhow, among all the three, the one that does not directly refer to a theoretical perspective is the e3-Value. Since e3-Values focuses on modelling the relationships among actors connected in a network, in an e-business scenario, Value Networks can act as a theoretical backgrounds supporting it.

Table 6.5 Comparison of selected ontologies

	BMO	**e3-Value**	**REA**
Origin	Business Model Research	E-Business	Accounting
Theoretical perspective	RBV	Value Network	Value Chains
Value Configuration	Chain/Shop/Network	Network	Chain
Focus	Internal	External	Internal
Plus	Guidance Definition Layered representation	Profit analysis Modelling freedom Supporting tool	Model simplicity Relational Database
Minus	Complexity Partially fixed model Model development Lack of supporting tools	No guidance	Accounting perspective

Each one of the three proposed ontologies supports a specific value configuration. The more generic is the BMO which can represent *Business Models* no matter which is the value configuration adopted. The e3-Value focuses instead only on *Value Networks*, while the REA refers to the traditional *Value Chain*.

The focus adopted by the three ontologies is also different. While the BMO and the REA focuses at the internal structure of the organisation they describe, the e3-Value, modelling a network, sees the organisation from the exterior, as immersed in a network of relationships with others organisations (or more generically, actors) with which it exchanges value.

The last two rows of the table show main advantages (plus) and disadvantages (minus) of the application of the specific ontologies. The main advantages of the BMO are the guidance in the definition of the *Business Model*, the availability of a definition of what a *Business Model* actually is, and the possibility to represent a *Business Model* with different levels of complexity.

Regarding the first aspect, the semantics included in all the classes help in understanding what they are intended to describe. Meanwhile, the set of relationships that connect each class to others, forms a path that has to be followed to describe a *Business Model* of an organisation. For this reason, the BMO offers a guidance to the person/organisation wishing to adopt it, since it shows a path that, when followed, leads to the description of the *Business Model*.

Finally, the layered representation offers the possibility to show a *Business Model* with different degrees of complexity. The BMO allows users to give a short and effective representation of a *Business Model* by means of the bird eye view. Drilling down into more detailed representations is anyway also possible. Although this possibility is interesting, it actually remains partially on paper, since the absence of an automated (software based) supporting tool makes it more difficult to practically take such an opportunity. The lack of supporting tools is therefore one of the largest disadvantages of the BMO. Actually there is no automatic tool[3] that can support data collection, storage, or analysis of a *Business Model* modelled with the BMO. Among disadvantages also the complexity of the complete model, as testified by 6.1, shall be mentioned. Moreover, the model seems not to have the same depth of development in all its components. As a matter of example, the financial part (especially the cost side) is far less developed compared to the rest of the model. This might call for future model extensions. Finally, another limitation is constituted by the partially fixed model. The BMO describes the components and their relationships, and there is no way to force a different relationship among them. The BMO has been built on the basis of literature. This warrants that it is good enough to represent what a *Business Model* is intended to be, up to now. If future works will find other components of a *Business Model*, the BMO shall be revised or extended.

The e3-Value ontology offers, among the advantages, a complete modelling freedom to those who want to adopt it. While the BMO defines an internal structure of a *Business Model*, the e3-Value defines constructs of a network, but not how the network shall be composed. Therefore the user is left free to model its own network. Moreover, the e3-Value ontology also comes along with a supporting tool with which the user can model networks. Such a tool also supports profitability analysis of modelled networks. When a network is modelled with the tool, this one can produce a profitability analysis of it on an excel sheet. The modelling freedom, anyhow, reverts from an advantage to a disadvantage when the network to be modelled is complex. In this case the user is left without guidance, and only past experience (if any) can support him in the modelling effort.

Finally the REA ontology has mainly two advantages: it proposes a much more simple model compared to the BMO and the e3-Value, moreover this model can easily be represented with a relational database (a tool that is almost of everyday usage). This circumstance ensures that normal databases can be used to store data pertaining to a reality that has been described by the REA ontology. Anyhow, the origins of the REA ontology (the accounting discipline), also represent another limitation since, among all the three, the REA is probably the most distant one from the concept of *Business Model*.

[3] Actually a web-based tool to support business modelling with the BMO has been proposed by Boris Fritscher (2008) in his master thesis. So far his approach helps in the data collection with interviews, using an interactive screen application. This approach is anyhow not so deepened, and does not address the full schema of the BMO.

6.4.1 The choice of the ontology

On the basis of all the considerations formulated in the previous paragraph, the BMO seems the most suitable to be used for the purposes of this Ph.D. dissertation. In spite of all its limitation the BMO is the one that is more close to the *Business Model* domain. It is also the one that proposes the more extensive model. Moreover the BMO does not adopt a fixed value configuration but can be used to model *Business Models* of any organisation, no matter which is the value configuration adopted. Given these premises, the BMO seems suitable to extend the approach proposed by Scheepers & Scheepers (2008) to identify value generating activities in an organisation to investigate IT Business Value.

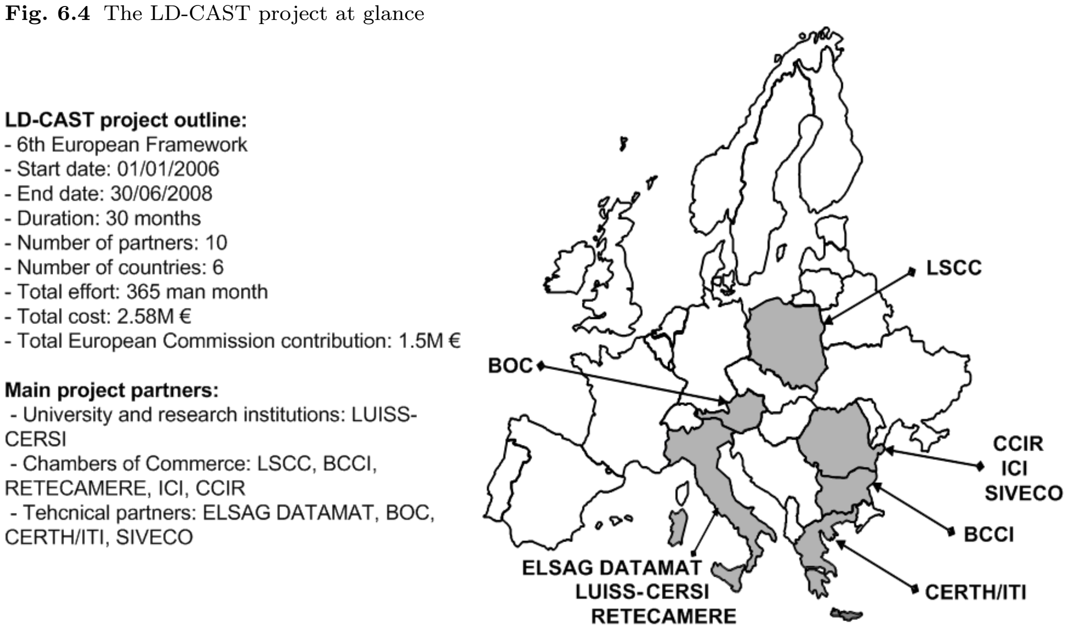
Moreover, the BMO has, among its constructs and classes, the ***`Value Configuration`*** class that is composed by a set of ***`Activities`***. This class, even if it needs to be extended, enables the use of the BMO to model activities in a business process, making a process based assessment of the value delivered by IT possible.

6.5 A test case for the BMO: the LD-CAST project

This section, and the following sub-sections, will provide a test case of the application of the BMO in the context of the LD-CAST European project. This test case has been published by Braccini et al. (2008).

The LD-CAST project, funded by the EC under the 6th Framework Programme, aims at enabling cross border cooperation between the European Chambers of Commerce towards the more general objective of supporting the development of private company initiatives. With this aim, and in accordance with the European Interoperability Framework (EIF) guidelines, the project partners defined a cooperation framework methodology, and developed a prototype platform based on the use of innovative semantic technologies and service-oriented architectures.

Fig. 6.4 The LD-CAST project at glance



The project consortium is made up of universities and research institutes (which are mainly involved in the definition of the ontologies and process models), of IT partners (for the development of the prototype), and of the Chambers of Commerce in four EU member states (Bulgaria, Italy, Poland and Romania) that act as service providers and support the definition of the processes and services to be addressed.

6.5.1 The LD-CAST project exploitation issues

Among the quantifiable objectives of the project, the definition of an effective exploitation plan was considered a key issue since the kick-off both by the Project Officer and reviewers, by the EU Commission, and by all project partners. As a matter of fact, the project proposal states that:

> "The research will produce an exploitation plan containing 1) a detailed description of the exploitable results; 2) the addressed markets, with an analysis of the potential market and possible penetration; 3) sales strategy, including an analysis of how products and services shall be proposed and sold to potential prospects (direct vs. indirect channels, packaging of products, licences vs. ASP models, . . .); 4) the consequent overall and individual exploitation plan."

During the project, the CCs (and through them, the enterprises they represent) played a key role: they were actively involved in the validation of the exploitation plan, by taking part to the process of submitting results to the CCs officials, business consultants, business analysts, business associations and entrepreneurs. The most successful aspect of the project was the active participation of players mostly involved in business episodes and, as a consequence, the possible exploitation of results.

The main exploitation capabilities of the LD-CAST project rely on the possibility to market and sell automated or semi-automated service provisioning applications. The marketing targets of the LD CAST project are public or private organisations supplying services to companies, mainly to SMEs, by means of call centres, interactive information portals and direct interaction with visiting customers. Among such organisations the CCs play a major role.

Typical SMEs are too small to have at their disposal all the internal procedural and legal competences required to extend their business beyond country borders. For this reason, they need to rely on services provided either by individual consultants or by organisations specifically devoted to support SMEs in such efforts. CCs (and similar organisations) can make profit by including the offer related to accessing LD-CAST service portals to their customers (i.e. mainly SMEs), as part of the additional services that CCs (or similar organisations) normally provide to SMEs, either on a pay-per-use basis, or included in their annual enrolment fees as an optional package.

6.5.2 The LD-CAST BM definition process

During the first phase of the project, a detailed analysis of the "as is" scenario was performed, and a number of issues arose in terms of diversity between organisational contexts in each country. Starting from the four pillars of the BMO, it has been observed that despite a common agreement among partners on the LD-CAST main value proposition, other areas such as the definition of customer interfaces, infrastructure management and financial aspects required a deeper understanding for each involved partner. Therefore a deeper analysis was needed in order to understand the multiple contexts involved and to find an agreement to define different strategies at a local level.

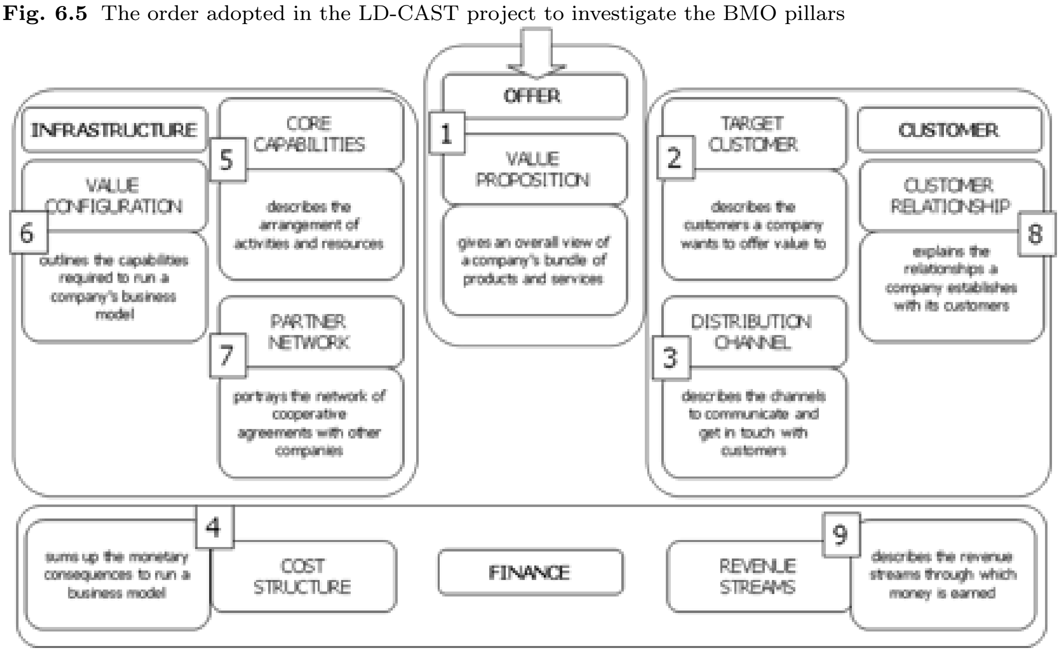
First and foremost, every CCs agreed on the fact that the main value proposition was the "offering of day-to-day services, enhancing and catalysing cross-border business ventures, by providing services mostly supporting businesses in completing bureaucratic procedures, quickly and accurately". This was useful in the identification of a first set of services to be provided through the new platform (i.e. search of trustworthy partners, company legal verification, company fiscal verification, technical and quality standard verification, etc.). Moreover, further services are planned to be implemented in the future.

Second, the first exploitation issues arose with reference to customer interface in terms of who are the target customers of the LD-CAST project, how it plans to provide products and services, and how it intends to build a strong relationship with them. Not all customer segments apply to all national markets in the same way. For example, even if the most suitable targets seem to be individual businesses and entrepreneurs, the overall target segmentation is different in each country and the following positions are covered by aspiring entrepreneurs and students in Italy, business consultants in Poland and Bulgaria and professional associations in Romania.

Third, in the infrastructure management area, the CCs need to define: (i) how LD-CAST will effectively manage infrastructural and logical issues, (ii) the partners they intend to do business with, and (iii) the kind of enterprises/bodies involved. This area describes the value system configuration necessary to deliver services and maintain customer interface, including the activities to create and deliver services, the capabilities (in-house or involving an outside actor) and the partnership network. Also in this case there are national differences mainly due to the statutory differences among the CCs (voluntary or mandatory membership) and to the relationship with other national service providers. For instance, the Italian case is quite different from the others due to the fact that CCs are public bodies, and membership is mandatory for all businesses.

Finally, from the financial point of view, the revenue model was taken into account by looking at the differences of cost structures due, for example, to the maturity level of technologies supporting services and to the effectiveness and efficiency of existing processes. Figure 6.5 on page 50 shows the four pillars and the nine building blocks of the BMO . The numbers in the figure represent the order by which data were collected and analysed during the LD-CAST project. The resulting LD-CAST BM was built upon the concept of LD-CAST Local agency, the "virtual" point-of-sale of LD-CAST services, which corresponds to an interoperable one-stop business portal, run (directly or indirectly) by one of the above mentioned organisations. All the building blocks of the BMO were analysed in order to figure out the time frame of a return on investment and a cost-revenues projection over the next two to five years after the end of the project. Data were collected from each country through a direct interaction with targeted users; customer data were stored for a certain period of time and were analysed on the basis of the kind of product, geographical location, etc.

Fig. 6.5 The order adopted in the LD-CAST project to investigate the BMO pillars



6.5.3 The LD-CAST BM definition process: an example

This paragraph describes how the BMO has contributed to the definition of the LD-CAST business model. The ontology schema was used as a guide for interviews or surveys among partners. The definition process required several interactions among partners, and was carried out in the WP 8.1 “Dissemination and Exploitation”, which covers the whole duration of the project, and deals with business model related concepts during the last year of the project.

As indicated in the previous paragraph, and in Figure 6.5 on page 50, the value proposition represented the starting point as all the partners involved agreed to consider it as the core of the business model. Several services (offerings) that could be offered via the LD-CAST platform were defined as a set of individual services offered by CCs in the four countries. Services included are mainly traditional services provided by CCs (such as company legal verification, company fiscal verification, fiscal information and the like). In the BMO, each offering element is linked to other components. This paragraph will provide an example of a single service: “Company fiscal verification”.

Having defined a set of possible services, the following step was the definition of the target customer. LD-CAST project partners used four different profiles of traditional CCs customers: individual businesses, business consultants, professional associations and the CCs as well. For each offering element, the partners defined the customers that might be interested in it. In the case of the present example, the “Company fiscal verification” service was offered to only three target customers: individual businesses, professional associations and CCs. During this step, some figures were also calculated to estimate LD-CAST market size.

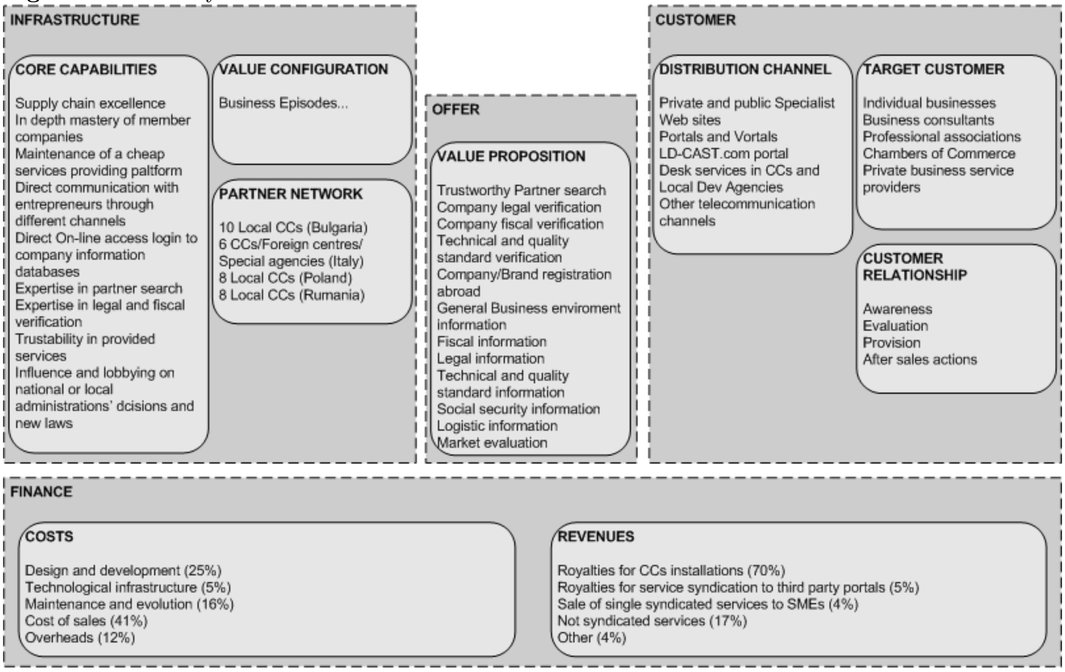
Other customer-related BM components are the Distribution Channel and the Customer Relationship. The main LD-CAST distribution channel is the LD-CAST platform itself (as it is used to deliver services). Thinking of a way to reach more customers, the partners indicated different ways to let customer access to the LD-CAST platform (for example, portals or vortals, desk services in CCs, local development agencies). Partners indicated different links to reach customers, but they did not indicate actors involved in this link (as required by the BMO).

The next step in the definition process was mainly linked to the definition of the business model infrastructure. Partners defined Core Capabilities as a set of general capabilities necessary for LD-CAST to run the BM (for example: supply chain excellence, maintenance of cheap services providing platform, trustability in partner search). Resources were indicated by partners in combination with the Value Configuration and were divided into the following groups: human resources (partners required 13 units, ranging from the CEO to the technical staff, as the basic need for the LD-CAST agency), tangible resources (office, furniture, PCs, servers, internet connection, telephones, fax machine, software and others), and intangible resources (agreement with local service providers, training, contract for services provision and others). Partners did not define activities in the Value Configuration, since they were deeply discussed and described in a previous phase of the project.

Finance was the last issue faced in the BM definition process. The BMO requires a clear definition of Costs and Revenues of the proposed business model. While other elements in the BMO are linked by different relations, finance is a general element and only revenues are linked to target customers. As a matter of fact, partners found more convenient to define business model economics using the traditional Business Plan. Partners indicated a set of costs that are (probably) beyond the scope of the business model, as they indicated the initial design and development costs, technological infrastructure costs, maintenance evolution costs, marketing and cost of sales deriving a total cost estimation for five years. As for Revenues, partners were involved in the definition of possible revenue strategies as well as a possible break even point analysis. At this stage, they have not defined pricing policies yet, but they formulated a few hypotheses to calculate the break even point. As a result, finance became the most developed part of the business model, but even the most far from the BMO since in this phase ontology was not used.

It is interesting to notice that costs and revenues in the BMO are the less integrated components in the rest of the business model. Probably costs and revenues do not require

Fig. 6.6 The bird eye view of the LD-CAST business model



too much effort to be understood by stakeholders or, under a different point of view, it is quite difficult to link each item (especially on the basis of costs) to other items in the BMO.

Figure 6.6 on page 52 shows the bird eye view of the LD-CAST business model.

Part III
IT resources and business processes: the OLPIT Ontology

Chapter 7
Introduction

The identification of the relationships among IT resources and value generating activities in an organisation has been identified as a necessary pre-requisite for a process based assessment of the value delivered by IT. In the first part of this Ph.D. dissertation, the lack of practical methods to identify such relationships has been highlighted.

The second part of the dissertation has identified the BMO as a general framework to locate value generating activities in an organisation. The BMO alone, even if it helps to answer the research question, it is not sufficient to identify IT resources that support or affect the execution of value generating activities that have been identified.

Thence, this part of the Ph.D. dissertation, focuses on this specific aspect. In this part, a complementary ontology to the BMO will be described and then tested. Such ontology, once integrated with the BMO, can be used to identify the relationships among IT resources and value generating activities in an organisation.

Chapter 8
Relationships among IT infrastructure resources and Business Processes

An IT Infrastructure is normally composed by a set of components that interact among each others, delivering IT capabilities to activities or processes, and, in the end, to the entire organisation. A method to identify the relationships between IT infrastructure components and activities in a business process is required. Depending on the complexity of both the IT infrastructure, and the interaction between the infrastructure and business processes, the identification of these relationships can be easily or difficult.

Up to date best practices in IT managements see the IT delivering its capabilities to the organisation by means of a set of services. Anyhow they do not say how.

An outcome of the practical experience made with this Ph.D. project is that the word “service” cannot be used for these purposes in this way: it is too generic and can have unambiguous meanings. What IT services really are, and how IT infrastructure components relate to them, has to be clarified. It is with this objective in mind that the following paragraphs will describe how to identify the relationships among IT resources and activities.

8.1 IT Management best practices

IT Management is concerned with exploring and understanding IT as a corporate resource that determines both the strategic and operational capabilities of the organisation in designing and developing products or services for maximum customer satisfaction, corporate productivity, profitability, and competitiveness (Badawy, 1998).

Recently IT Service Management has been discussed in IT Management to stress more the importance of managing the IT infrastructure loosing the focus on technology and organisation, and gaining the perspective of service quality and customer satisfaction (van Bon, 2002). To guide organisations in reaching this goal, several collections of best practices in IT Management and IT Service Management have been proposed. Among all of them, the ones mostly cited and used are ITIL v3 and CoBIT v4.1. These collections will be described in the following paragraphs, focusing only on the aspects that are relevant for the objective of this Ph.D. dissertation. In particular, given the need to extend the BMO to identify the relationships among IT resources and value generating activities, these collections of best practices will be analysed in order to identify useful information for the identification, and the definition, of classes that could be used for the extension.

8.1.1 ITIL v3

ITIL is the acronym of *Information Technology Infrastructure Layer*, it has been developed in the 1980's by the United Kingdom's Central Computer and Telecommunications Agency[1], mainly for government agencies. ITIL has been created as a set of recommendations, in response to the growing dependence on IT of UK public administration departments, and to the problem that without standard practices, government agencies and private sector contracts were independently creating their own IT management practices. ITIL developed, therefore, since the very beginning, as a collection of books, each one covering a specific aspect of IT service management. ITIL has had a great success with the second revision, that has been, anyhow, withdrawn in 2009.

ITIL is actually at the third revision, and offers a collection of procedures constituting best practices in IT service management. ITIL offers a good guidance to organisations wishing to implement IT Service Management. ITIL also forms the foundations of the ISO/IEC 20000 international standard (Clark, 2007). In its actual revision ITIL adopts a process model for IT Service Management that is heavily centred on the PDCA (Plan-Do-Check-Act) cycle, as shown in Figure 8.1 on page 58.

Fig. 8.1 ITIL 3 - Overview of processes

Given the objectives of this Ph.D. dissertation, examining the ITIL v3 framework in full details is of no interest. It is anyhow important to discuss two elements of the ITIL framework that could give interesting insights: the glossary of terms, and the Configuration Management Data Base (CMDB).

[1] Both the names ITIL and IT Infrastructure Library are registered trademarks property of the United Kingdom's Office of Government Commerce.

8.1.1.1 ITIL: Glossary of terms

The ITIL framework comes with a glossary of terms that contains the definitions of most relevant concepts in IT service management. Being part of a collection of best practices, this glossary of terms can be used as a source to obtain information that could help in clarifying what an IT service is, and how IT components deliver value and capabilities to activities and business processes. The ITIL glossary has therefore been scanned to look for key terms that could help in identifying the relationships between IT infrastructure components and business processes activities. The key terms that have been identified to be more relevant for the purposes are the followings:

- Business Process;
- Process;
- IT Service;
- Service;
- Application;
- Component.

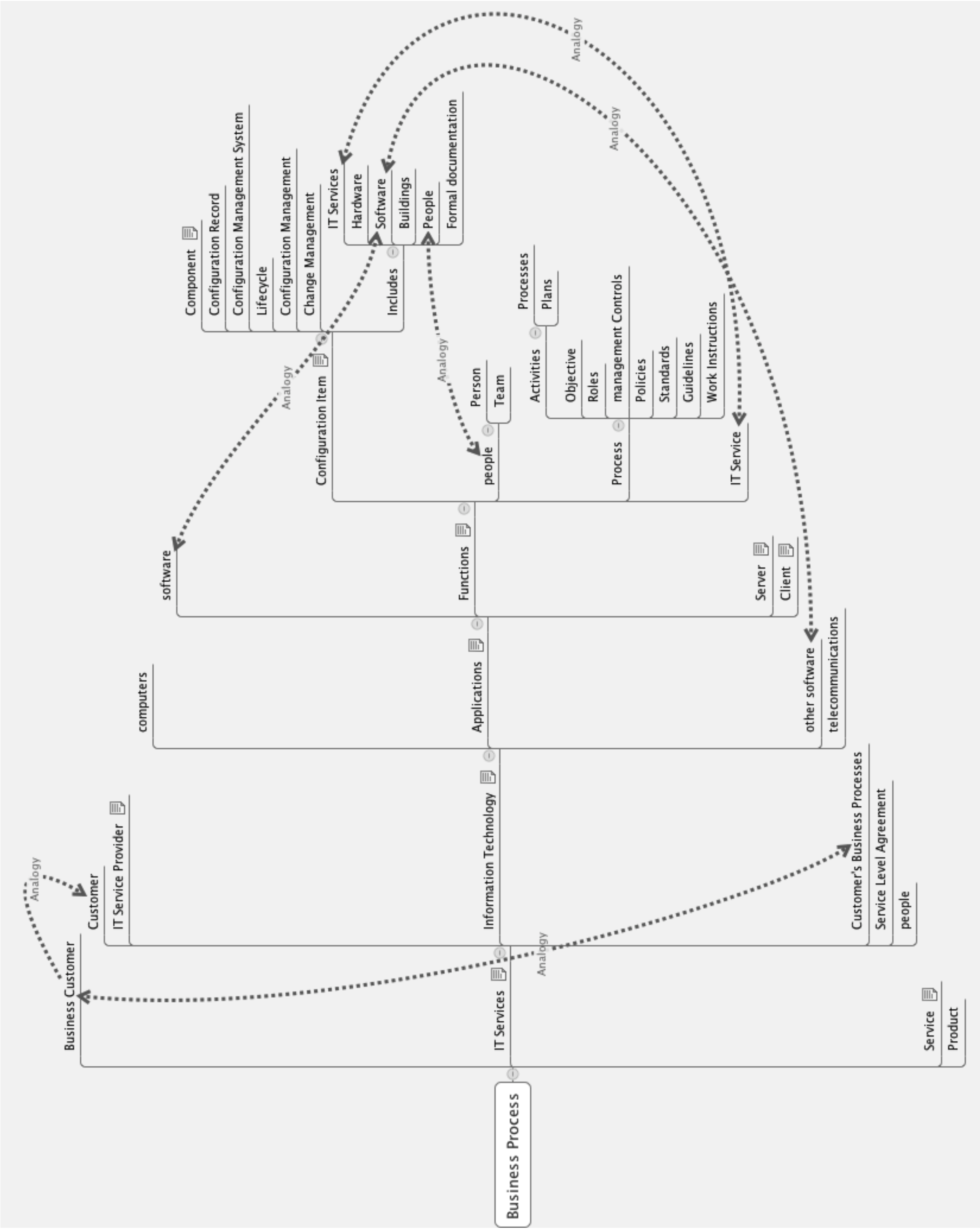
Each of the terms that have been selected references others in the ITIL glossary. These references produce a hierarchy of relationships that can contribute to identify the relationships of the concepts that these terms refer to in the reality. For this reason, the meaning and the hierarchy of the relationships among selected terms from the ITIL glossary have been taken into consideration during the development of the OLPIT ontology. The meanings of ITIL key terms are shown in Table 8.1 on page 59.

Table 8.1 Definitions of ITIL key terms

Term	Definition
Business Process	A Process that is owned and carried out by the Business. A Business Process contributes to the delivery of a product or Service to a Business Customer. For example, a retailer may have a purchasing Process which helps to deliver Services to their Business Customers. Many Business Processes rely on IT Services
Process	A structure set of Activities designed to accomplish a specific Objective. A Process takes one or more defined inputs and turns them into defined outputs. A Process may include any of the Roles, responsibilities, tools and management Controls required to reliably deliver the outputs. A Process may define Policies, Standards, Guidelines, Activities, and Work Instructions if they are needed.
IT Service	A Service provided to one or more Customers by an IT Service Provider. An IT Service is based on the use of Information Technology and supports the Customers' Business Processes. An IT Service is made up from a combination of people, Processes and technology and should be defined in a Service Level Agreement.
Service	A means of delivering value to Customers by facilitating Outcomes Customers want to achieve without the ownership of specific Costs and Risks.
Application	Software that provides Functions that are required by an IT Service. Each Application may be part of more than one IT Service. An Application runs on one or more Servers or Clients. See Application Management, Application Portfolio.
Component	A general term that is used to mean one part of something more complex. For example, a computer System may be a component of an IT Service, an Application may be a Component of a Release Unit. Components that need to be managed should be Configuration Items.

The hierarchy and the relationships among the selected terms are depicted in Figure 8.2 on page 60. The figure is a direct screenshot from a mind map manager tool. The map has been built by reading the descriptions of ITIL key terms and tracing the cross-references to other terms provided by the ITIL glossary. Each item in the figure represents one concept that is stated in ITIL definitions. The figure has almost the shape of a tree, stemming

Fig. 8.2 ITIL key terms



from the core concept of Business Process, and going into details. Concepts that are cross referenced in the ITIL glossary, and that do not respect the hierarchy, are connected by means of curved dotted lines.

8.1.1.2 ITIL: Configuration Management Data Base

The second contribution that ITIL offers to the objectives of this dissertation is the so called Configuration Management Data Base (CMDB) tool. A CMDB is just a repository of information related to all the components of an information system, that is implemented with a software tool. CMBDs have been commonly used in IT departments for many years so far, but ITIL makes an explicit reference to them. In the ITIL context, a CMDB represents the authorised configuration of the significant components of the IT environment.

The main purpose behind the adoption of a CMDB is the identification of relationships among components, and the tracking of their configuration. A CMDB records all the Configuration Items (CI)[2], and their relevant properties. Relevant attributes recorded in a CMDB spans usually over three dimensions: technical, ownership, and relationship. A key capacity of a CMDB is the automatic discovery of CIs, and the subsequent tracking of the modifications of their configurations. Anyhow, a CMDB only addresses the relationships among Configuration Items that are defined, like components that need to be managed in order to deliver an IT service. The idea behind the CMDB concept can therefore be useful to identify the relationships among IT resources themselves. Anyhow, the CMDB alone is not capable of identifying relationships among IT resources and value generating activities.

8.1.2 CoBIT v4.1

The Control Objectives for Information and related Technology (CoBIT) is a collection of best practices for IT management that have been created by the Information Systems Audit and Control Association (ISACA) and the IT Governance Institute (ITGI) in 1996. CoBIT offers a set of measures, indicators, processes, and best practices, to assist organisations in maximising the benefit of their IT. CoBIT has undergone four major releases (1996, 1998, 2000, and 2005).

Like ITIL, also CoBIT contributes with the definition of key terms that relate IT components to business processes activities. The set of key terms defined by CoBIT are the following:

- Process;
- Enterprise Architecture for IT;
- Infrastructure.

The definitions of all the CoBIT key terms that have just been listed above are provided in Table 8.2 on page 61.

Table 8.2 Definitions of CoBIT key terms

Term	Definition
Process	Generally, a collection of procedures influenced by the organisation's policies and standards that takes input from a number of sources, including other processes, manipulates the inputs, and produces outputs, including other processes, for process customers. Processes have clear business reasons for existing, accountable owners, clear roles and responsibilities around the execution of the process, and the means to measure performance.
Enterprise Architecture for IT	IT's delivery response, provided by clearly defined processes using its resources (applications, information, infrastructure and people).
Infrastructure	Technology, human resources, and facilities that enable the processing of applications.

The hierarchy and the relationships among the selected terms are depicted in Figure 8.3 on page 62. This figure has been built with the same tool and the same method for the one already discussed for the ITIL glossary.

[2] ITIL defines a Configuration Item as any Component that needs to be managed in order to deliver an IT Service. A Configuration Item is therefore an IT resource.

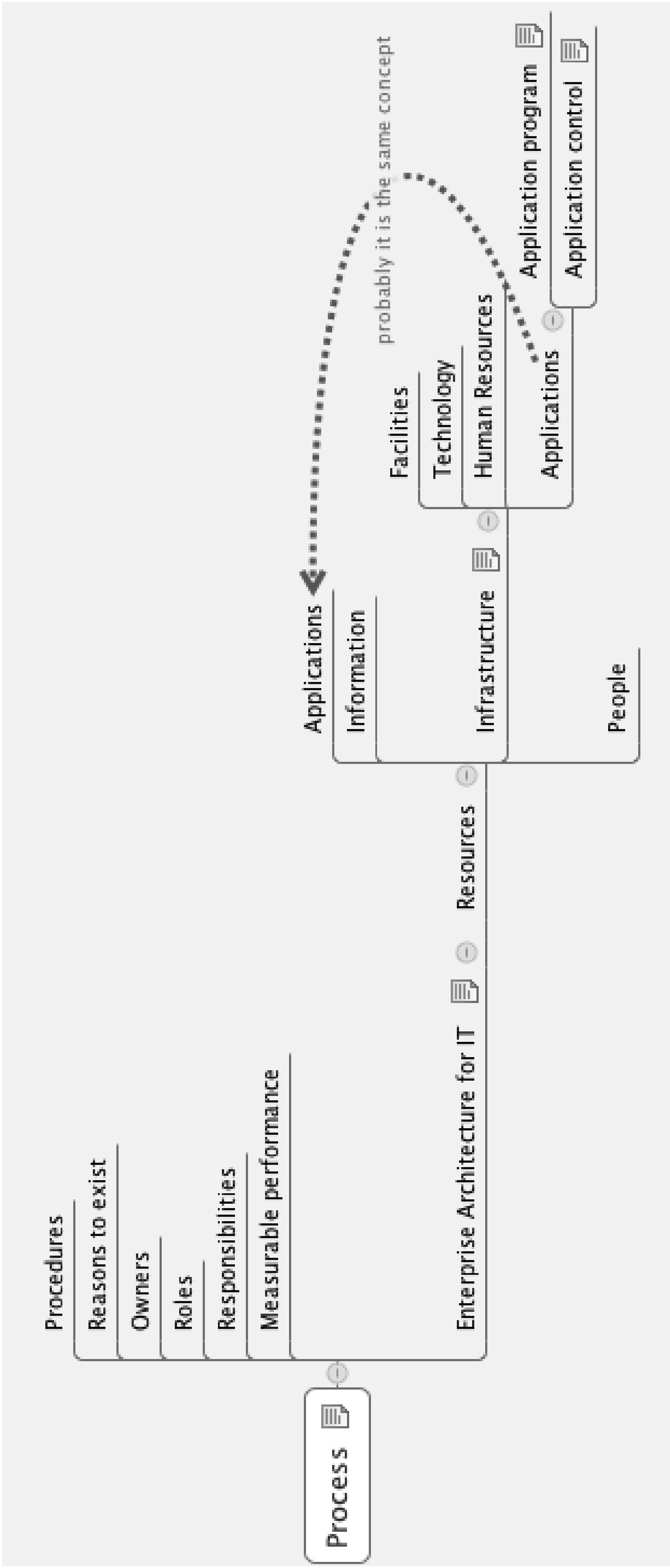


Fig. 8.3 CoBIT key terms

8.2 Enterprise Architecture

An Enterprise Architecture is generally a model created with the intent of fostering a common understanding of an enterprise. Among domains of interest addressed by Enterprise Architecture, the alignment between IT and Business is many times taken into consideration (Lankhorst, 2003; Winter & Fischer, 2007). Enterprise Architectures do not only address IT artifacts, but they also include business and organisational artifacts, realising a comprehensive model of the organisation. As discussed by vom Brocke et al. (2009), Enterprise Architecture usually adopts a hierarchical approach for modelling an enterprise, and distinguishes among several architectural layers in a relationships of superordinate/subordinate among each others.

There are several methods and tool with which the structure of an enterprise can be documented and understood adopting the Enterprise Architecture approach. All these tools are commonly called artifacts and they normally describe the logical organisation of business strategies, metrics, business capabilities, business processes, information resources, business systems, and networking infrastructure within the enterprise. A collection of such artifacts, suitable to describe the enterprise in an useful way, can be considered an enterprise architecture.

Enterprise Architectures can be described at several different level of formalisation: glossary, meta-models, and ontological theories (Force, 2003). The degree of formalities increases moving from glossary (which is the less formalised form of Enterprise Architecture), to meta-models, and to ontological theories (which is the most formal way of describing an Enterprise Architecture).

8.2.1 Ontologies for Enterprise Architecture

The Enterprise Architecture area offers plenty of ontologies, but lots of them address only individual enterprise related phenomena. Among those ontologies, only two have been proposed for the purpose of modelling an entire enterprise (Grünninger, 2003). These two ontologies are the Edinburgh Enterprise Ontology (EEO) (Uschold et al., 1998), and the TOronto Virtual Enterprise (TOVE) (Gruninger, 1998).

These two ontologies show a considerable degree of overlap in their set of concepts. They both define classes related to organisational aspects, strategy, activities, and time. Anyhow, among the two, only the TOVE ontology has been fully translated into a target language and applied within a supply chain management scenario (Grünninger, 2003).

The TOVE ontology has been developed by the TOVE project, with the aim of realising a set of integrated ontologies for the modelling of both commercial and public enterprises. The TOVE ontology is composed by the following ontologies: Activity, Resources, Organisation, Product and Requirements, ISO 9000 Quality, Activity-Based Costing. The full structure of the TOVE ontology is depicted in Figure 8.4 on page 64.

The Edinburgh Enterprise Ontology is instead composed by a collection of terms and definitions that are relevant to business enterprises. The Edinburgh Enterprise Ontology has been defined within the Enterprise Project, a collaborative effort to provide a method and a computer tool for enterprise ontology.

Table 8.3 on page 65 shows instead all the terms that are formally defined in the Edinburgh Enterprise Ontology (Uschold et al., 1998). The terms are listed, within each column, in the same order as they appear in the ontology description (Uschold et al., 1998). There is no relationship between terms that happen to be in the same row.

Anyhow, as already indicated in a previous section, both the TOronto Virtual Enterprise and the Edinburgh Enterprise Ontology do not include terms and/or constructs that directly address IT resources with an adequate level of complexity. Moreover, they all refer to activities no matter which is their importance and relevance in terms of the value generation phenomenon.

Fig. 8.4 The TOVE ontology

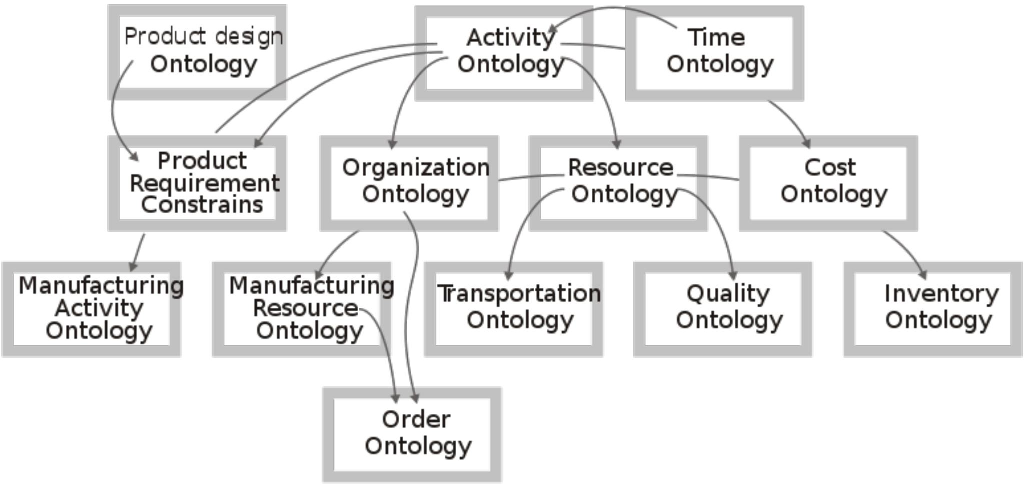


Table 8.3 The Edinburgh Enterprise Ontology list of terms

ACTIVITY	ORGANISATION	STRATEGY	MARKETING	TIME
Activity	Person	Purpose	Sale	Time Level
Activity Specification	Machine	Hold Purpose	Potential Sale	Time Interval
Execute	Corporation	Intended Purpose	For Sale	Time Point
Executed Activity Specification	Partnership	Purpose-Holder	Sale Offer	
T-Begin	Partner	Strategic Purpose	Vendor	
T-End	Legal Entity	Objective	Actual Customer	
Pre-Condition	Organisational Unit	Vision	Potential Customer	
Effect	Manage	Mission	Customer	
Doer	Delegate	Goal	Reseller	
Sub-Activity	Management Link	Help Achieve	Product	
Authority	Legal Ownership	Strategy	Asking Price	
Activity Owner	Non-Legal Ownership	Strategic Planning	Sale Price	
Event	Ownership	Strategic Action	Market	
Plan	Owner	Decision	Segmentation Variable	
Sub-Plan	Asset	Assumption	Market Segment	
Planning	Stakeholder	Critical Assumption	Market Research	
Process Specification	Employment Contract	Non-Critical Assumption	Brand	
Capability	Share	Influence Factor	Image	
Skill	Shareholder	Critical Influence Factor	Feature	
Resource		Non-Critical Influence Factor	Need	
Resource Allocation		Critical Success Factor	Market Need	
Resource Substitute		Risk	Promotion	
			Competitor	

Chapter 9
An Ontology to link IT infrastructure components and Business Processes Activities

Both the IT Service Management and the Enterprise Architecture field do not offer approaches that could extend the BMO to identify the relationships among IT resources and value generating activities. IT Service Management offers guidance in the understanding of the IT in organisational contexts (especially for its management), but do not provide a solid methodology to represent and eventually communicate the relationships among IT infrastructure components and key value generating activities. Enterprise Architecture, on the other side, do not offer ontologies that could be easily integrated with the BMO.

For this reasons, due to the possibility of extending ontologies to include new concepts, and therefore, to extend their domain of application, a new ontology (called OLPIT) has been developed to clearly represent the relationships between IT infrastructure and business processes (vom Brocke et al., 2009).

The OLPIT ontology has been developed to be compatible with, and to serve (also) as an extension to, the BMO. As discussed by vom Brocke et al. (2009), the OLPIT ontology has been developed within the context of the IT division of an international tool producer company. It has been developed on the basis of a set of interviews, and theoretical and practical test cases.

9.1 The OLPIT ontology

The OLPIT ontology represents the relationships between IT infrastructure components and activities in a business process, by means of IT services. The ontology builds on a set of classes that are used to model the IT infrastructure of an organisation, the relationships among services, and the activities in a business process.

The OLPIT ontology uses the following classes:

- Business Process;
- Value Activity;
- Business Service, Application Service, and Infrastructure Service (all part of the IT Service abstract class);
- Hardware, Virtual Hardware, and Groups (all part of the Infrastructure Component abstract class);
- Cost Account.

The following paragraphs will give a brief description of all the classes of the OLPIT ontology. For each defined class a table showing the following information will be provided: class name, parent class name, description, attributes, and properties.

9.1.1 Business Process

Referring to definitions available in literature (Davenport, 1993; Hammer & Champy, 1993; Johansson et al., 1993; Rummler & Brache, 1995), the OLPIT ontology defines a `Business Process` as a collection of activities influenced by organisation's policies and standards that takes inputs from a number of different sources (including other processes), manipulates the inputs, and produces outputs.

A `Business Process` is composed by a **set** of `Activities`. A `Business Process` is identified by a name and a description.

Class Name	Business Process
Parent Class Name	-
Description	A collection of activities influenced by organisation's policies and standards that takes inputs from a number of different sources (including other processes), manipulate the inputs, and produces the outputs
Attributes	NAME DESCRIPTION
Properties	set of Activities

9.1.2 Activity

An `Activity` is a single atomistic operation performed by an IT service. An `Activity` contributes to the output production of a business process. An `Activity` can have a predecessor and a successor. A set of `Activities` composes a `Business Process`.

An `Activity`, to complete its execution, may require an IT Business Service. An `Activity` is identified by a name and a description.

Class Name	Activity
Parent Class Name	-
Description	A single atomistic operation performed by an IT Service. An Activity contributes to the output production of a business process
Attributes	NAME DESCRIPTION
Properties	predecessor (Activity) successor (Activity) requiresBusinessService (Business Service)

9.1.3 IT Services

IT Services are services provided by an IT Service Provider, on the basis of the use of Infrastructure Components. IT Services can be of one of the following three kinds: Business Service, Application Service, and Infrastructure Service.

9.1.3.1 Business Service

A `Business Service` is a service that delivers value of the IT infrastructure to the customer side (by means of `Activities` and `Business Processes`). A `Business Service` can contribute to execute (part of) the `Activities` in a `Business Process`.

A `Business Service`, to be executed, might require one or more `Business Services`, or one or more `Application Services`. A `Business Service` is identified by a name and a description.

Class Name	Business Service
Parent Class Name	IT Service
Description	An IT service that delivers value of the IT infrastructure to the customer side, by means of Activities and Business Processes
Attributes	NAME DESCRIPTION
Properties	affectsActivity (Activity) requiresApplicationService (Application Service) requiresBusinessService (Business Service) hasCostAccount (Cost Account)

9.1.3.2 Application Service

An `Application Service` delivers the functions provided by a software. To be executed, an `Application Service` might require one or more `Application Services`, or `Infrastructure Services`.

An Application Service is identified by a name and a description.

Class Name	Application Service
Parent Class Name	IT Service
Description	An IT service that delivers the functions provided by software tools to business services
Attributes	NAME DESCRIPTION
Properties	affectsBusinessService (Business Service) requiresInfrastructureService (Infrastructure Service) requiresApplicationService (Application Service) hasCostAccount (Cost Account)

9.1.3.3 Infrastructure Service

An `Infrastructure Service` delivers value of `IT Infrastructure Components` to other services. An `Infrastructure Service` is the most close service to `IT Infrastructure Components`.

An `Infrastructure Service`, to be executed, might require one or more `Infrastructure Services`. An `Infrastructure Service` is based on the capabilities of `IT Infrastructure Components`. An `Infrastructure Service` is identified by a name and a description.

Class Name	Infrastructure Service
Parent Class Name	IT Service
Description	An IT service that delivers capabilities of IT Infrastructure Components to Application Services
Attributes	NAME DESCRIPTION
Properties	affectsApplicationService (Application Service) requiresInfrastructureComponent (IT Infrastructure Component) requiresInfrastructureService (Infrastructure Service) hasCostAccount (Cost Account)

9.1.4 IT Infrastructure Components

`IT Infrastructure Components` are IT resources that enable the delivery of `IT Services`. `IT Infrastructure Components` can be one (or more) of the followings: `Physical Hardware`, `Virtual Hardware`, and `Groups`.

9.1.4.1 Physical Hardware

A `Physical Hardware` is an hardware of any kind (like a computer, a server, a printer, or a network component) that is part of an IT infrastructure. A `Physical Hardware` is identified by a name and a description.

A `Physical Hardware` can be part of a `Group`. A `Physical Hardware` can host a `Virtual Hardware`.

Class Name	Physical Hardware
Parent Class Name	IT Infrastructure Component
Description	An hardware of any kind that is part of an IT infrastructure
Attributes	NAME DESCRIPTION
Properties	affectsInfrastructureService (Infrastructure Service) belongsToGroup (Group) hosts (Virtual Hardware) hasCostAccount (Cost Account)

9.1.4.2 Virtual Hardware

A `Virtual Hardware` is any hardware that exists only in a virtual machine. A `Virtual Hardware` is not physical, but it only exists inside a virtualisation software. A `Virtual Hardware` is identified by a name and a description.

A `Virtual Hardware` can be part of a `Group`. A `Virtual Hardware` can host another `Virtual Hardware`.

Class Name	Virtual Hardware
Parent Class Name	IT Infrastructure Component
Description	An hardware that exists only in a virtual machine
Attributes	NAME DESCRIPTION
Properties	affectsInfrastructureService (Infrastructure Service) belongsToGroup (Group) hosts (Virtual Hardware) runsOn (Physical Hardware) hasCostAccount (Cost Account)

9.1.4.3 Group

A `Group` is a collection of IT Infrastructure Components that are (logically or physically) interconnected among each others (like in the case of network components or of a cluster composed by several nodes). Both a `Physical Hardware` and a `Virtual Hardware` can be part of a `Group`. A `Group` is identified by a name and a description.

Class Name	Group
Parent Class Name	IT Infrastructure Component
Description	A collection of IT Infrastructure Components that are (logically or physically) interconnected among each others
Attributes	NAME DESCRIPTION
Properties	affectsInfrastructureService (Infrastructure Service) composedBy (Physical Hardware, Virtual Hardware, Group) hasCostAccount (Cost Account)

9.1.5 Cost Account

A `Cost Account` is any sum of cost associated with an IT Infrastructure Component, or with a service of any kind (`Business Service`, `Application Service`, `Infrastructure Service`).

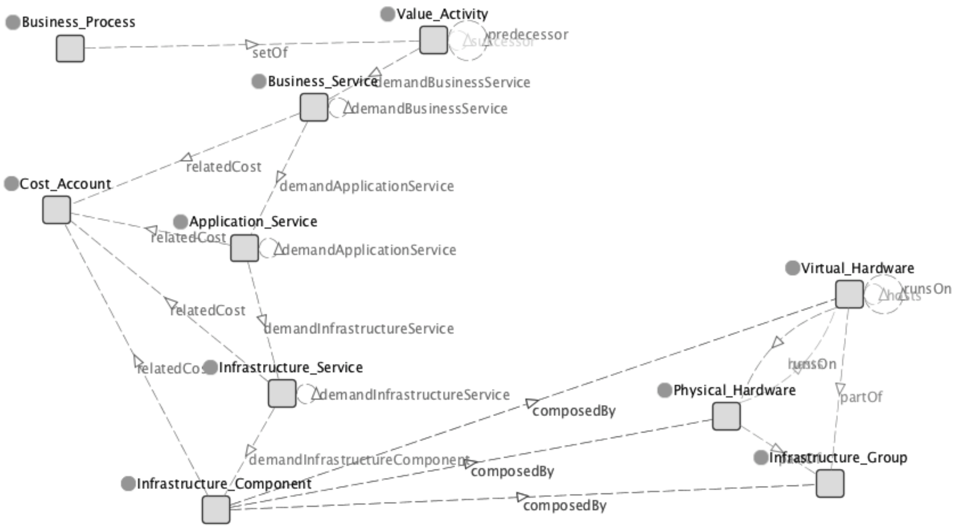
A `Cost Account` is identified by a name, a description, an amount, and a cost type.

Class Name	Cost Account
Parent Class Name	
Description	Any sum of cost associated with an IT Infrastructure Component, or with a service of any kind
Attributes	NAME DESCRIPTION AMOUNT COST TYPE
Properties	

9.2 Considerations on the structure of the OLPIT ontology

The OLPIT ontology has been modelled using the software Protégé v. 3.4.1 and the OWL language. The complete structure of the OLPIT ontology, as reproduced by a visualization plug-in (Jambalaya) of Protégé is depicted in Figure 9.1 on page 72.

Fig. 9.1 The OLPIT Ontology Schema



For readability purposes, all the inverse properties (excluded those related to IT Infrastructure Components) have not been shown. The OLPIT ontology has been developed with the first intent to support costs calculation and cross-charging of IT costs. In particular, the OLPIT ontology has been used to aggregate the costs of IT components into services, in order to assess the costs of different IT services (vom Brocke et al., 2009). The OLPIT ontology has been firstly published by vom Brocke et al. (2009). The author of this Ph.D. dissertation is also an author of that paper, and has contributed to the development of the OLPIT ontology.

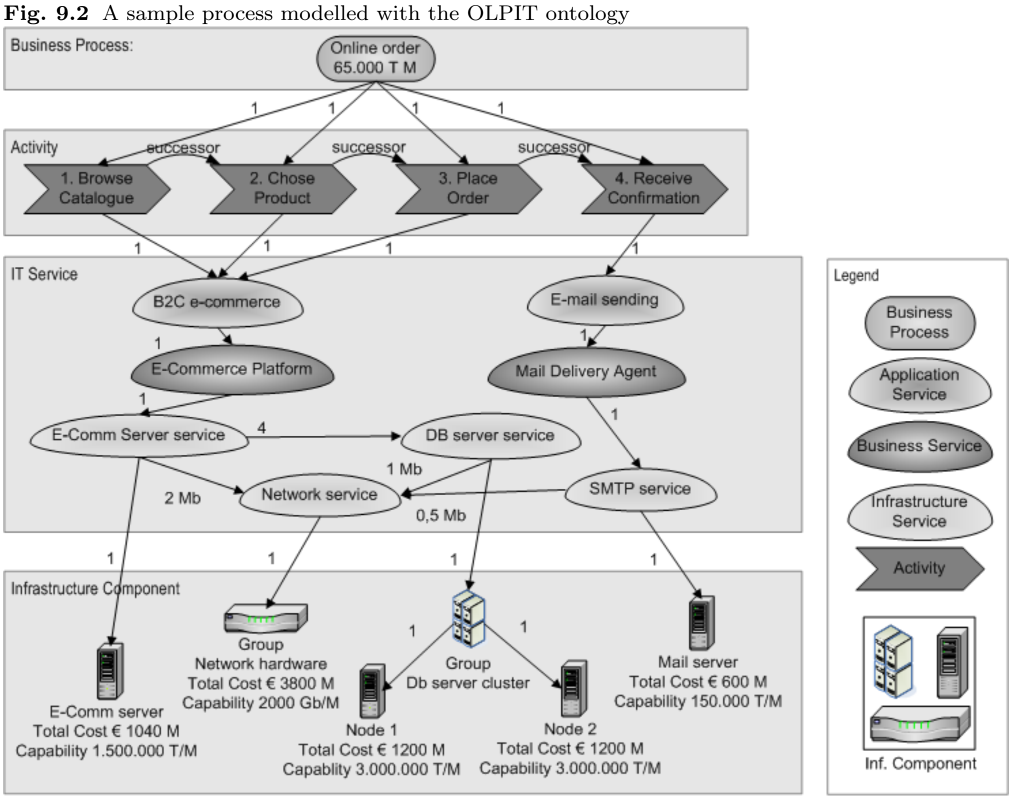
9.3 A test case for the OLPIT ontology

During its development, the OLPIT ontology has been tested with many scenarios pertinent to different aspects of both real and hypothetical IT infrastructures. A test case of the application of the OLPIT ontology has been produced to evaluate the OLPIT capability of solving three practical problems: the assessment of IT infrastructure capabilities, on the basis of actual (and future) business demand, the identification of possible points of failures of the IT infrastructure, and the calculation of the total cost of a single service. This example has been published by vom Brocke et al. (2009) and is reproduced in the rest of the this paragraph.

The test case regards an hypothetical process that describes the purchase of goods from an e-commerce web site. The process is called “On-line order”. The structure of the process is depicted in Figure 9.2 on page 73. In this process the customer browses the catalogue (Activity 1), chooses a product (Activity 2), places an order (Activity 3) and finally receives a confirmation of the order via mail (Activity 3). The business process is executed 65.000 times per month (M). To simplify costs and capability calculations, the time frame is always the month (M). Due to lack of space, costs are directly indicated as total per month per component. Each component has its own capability associated to it: the capability is indicated by a number, a unit and a time frame. For example, the capability of the e-commerce server is indicated as 1.500.000 T/M, indicating that this server can offer 1,5 millions Transactions (T) per Month[1]. The numbers that are indicated in the relationships among components specify the demand: the time frame is always the month and, whenever not indicated, the unit is always "Transaction".

Figure 9.2 on page 73 indicates the network of relationships among all IT Components, IT Services and Activities. This network can highlight which IT Infrastructure Component affects which phase in a business process. The OLPIT ontology can be used to represent the relationship among IT infrastructure with different levels of granularity. In the test case, for example, the network has been modelled as a Group, without going too much into the details.

Fig. 9.2 A sample process modelled with the OLPIT ontology

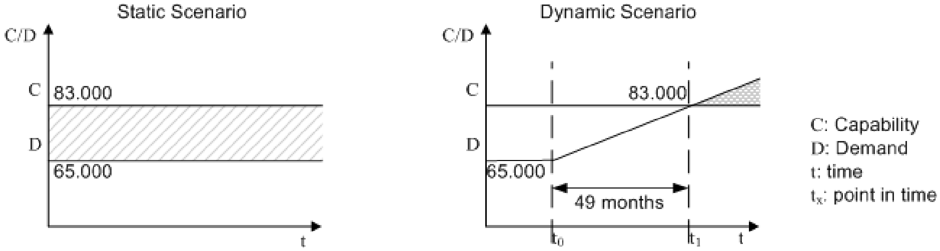


On the basis of the Capability and the Demand values presented in Figure 9.2 on page 73, it is possible to evaluate the balance between IT Infrastructure Capability and IT Business Demand. The actual used capability of the IT infrastructure is estimated by multiplying the demand of the business side with all the factors of the relationships among the classes of the ontology and, afterwards, summing up all the demands that belong to the same Infrastructure Component. The maximum capacity of the IT Infrastructure can therefore be evaluated maximising the function composed by the sum of all the capacity of each component multiplied by each factor: for this test case the maximum capacity of the infrastructure is close to 83.000 executions of the "On-line order" process per month.

Figure 9.3 on page 74 (left side) shows the actual capability (C) of the infrastructure, as well as the actual request from the business side (D). If we move from a static scenario (Figure 9.3 on page 74, left side) to a dynamic scenario (Figure 9.3 on page 74, right side),

[1] In this context we use the word "Transaction" to indicate a generic request made by a service to a component: as a matter of example, a transaction for the DB server could be a query, and a transaction for the mail server could be a mail message to be sent.

Fig. 9.3 IT infrastructure capability evaluation (static and dynamic scenario)



and hypothesise that the total demand increases at a constant rate (0,5% each month in this example) from the point in time t0 time it is possible to notice that the IT Infrastructure will no longer be able, ceteris paribus, to fulfil business needs at the time t1 (49 months later). Furthermore, using the capability and the demand values modelled in the ontology, possible bottlenecks can be identified. The "Usage %" column in Figure 9.4 on page 74 shows the actual percentage of used capacity of each IT infrastructure component. Looking at the percentages it is possible to identify the components that are about to run out of capacity (in our example, the network, with a usage percentage of 78,29%).

Fig. 9.4 IT services costs calculation

IT Services Cost Calculation – Service: B2C e-commerce							
Item	**Class**	**Request M**	**Capability M**	**Unit**	**Usage %**	**Total Cost M**	**Unitary Cost**
B2C e-commerce	IT Business Service	195.000		T/M		€ 7.137,30	€ 0,0355
E-Commerce Platform	IT Application Service	195.000		T/M		€ 7.137,30	€ 0,0355
E-Commerce Server Service	IT Infrastructure Service	195.000		T/M		€ 1.040,00	€ 0,0045
Database Server Service	IT Infrastructure Service	780.000		T/M		€ 2.400,00	€ 0,0020
Network Service	IT Infrastructure Service	1174,32		Gb/M		€ 3.697,30	€ 0,0038
E-Commerce Server	IT Infrastructure Component	195.000	1.500.000	T/M	13,00%	€ 1.040,00	€ 0,0045
Db Cluster	IT Infrastructure Component						
- Node 1	IT Infrastructure Component	780.000	3.000.000	T/M	26,00%	€ 1.200,00	€ 0,0010
- Node 2	IT Infrastructure Component	780.000	3.000.000	T/M	26,00%	€ 1.200,00	€ 0,0010
Network Hardware	IT Infrastructure Component	114,32	1.500	Gb/M	78,29%	€ 3.800,00	€ 0,0227
Total demand (M)	65.000						

Finally, the cost information modelled with the ontology enables the reconstruction of the total cost of each service. By means of an example Figure 9.4 on page 74 shows costs associated with each component. The total cost of the services is the total sum of all the costs of the components that belong to it. For shared services (like the network in our case), the cost is divided on the base of the total usage. In the example, the total cost of the Network Hardware is equal to € 3.800 but the actual cost of the Network Service (which will be part of the total cost of the B2C e-commerce service) is only € 3.697,30 (a quota calculated on the basis of the amount of network traffic generated by this service). The other quota forms the total cost of the "E-Mail sending" business service, not covered in this example.

Part IV
Integrating the OLPIT with the BMO

Chapter 10
Introduction

Not the BMO, nor the OLPIT ontology, when used alone, are capable of answering the research question of this Ph.D. dissertation. On one hand, the BMO can be used to identify the value generating activities of an organisation, no matter which is the value configuration adopted. Anyhow, the BMO does not directly address IT resources. Therefore, the BMO alone is not capable of identifying the impact of IT resources on value generating activities.

On the other hand, the OLPIT ontology describes in depth IT resources, and their relationships with activities and business processes. Anyhow, no information regarding the relevance in terms of value generation of these activities is available in the OLPIT ontology. The OLPIT ontology alone is capable of identifying the impact of IT resources on generic activities, but it is not capable of discovering their value delivery potential.

Both the BMO and the OLPIT ontology are formal explicit specification of a shared conceptualisation, and they address domains with some degrees of overlapping and complementarity. The integration of the two ontologies can, therefore, be seen as a mean to achieve the objective of this Ph.D. dissertation. Anyhow, especially when ontologies have been independently developed (Jiménez-Ruiz et al., 2009), they most often cannot inter-operate they way they are (Shvaiko & Euzenat, 2008).

To ensure interoperability between the BMO and the OLPIT ontology, one of the three interoperability processes described in section 2.1.2.3 is therefore necessary. The BMO and the OLPIT ontology address two different domains that are, anyhow, partially overlapping. The intention here is to derive another ontology that is capable of addressing the problem of the identification of impacts of IT resources on value generating activities in an organisation. Therefore, the final result will be a new ontology, which will address a domain that is different from (both) those addressed by the BMO and the OLPIT ontology.

Given these premises, among the three interoperability processes for ontology engineering that have been identified in the section on methodology (see 2.1.2.2), the ontology integration process is the one that is necessary to achieve the intended results. The integration of the two ontologies will be described in the following chapters.

Chapter 11
The integration of the BMO and the OLPIT ontology

Section 2.1.2.4, describing the methodology to inter-operate different ontologies, shows that both a manual and an automatic approach are possible. The automatic interoperability among different ontologies requires an algorithm (and thence a software tool) that establishes the relationships among terms, and meanings, of the ontologies to be inter-operated. Anyhow, automatic ontologies interoperability processes are not infallible, as errors are likely to occur. Errors might occur due to the integration process itself, or due to conflicting descriptions of overlapping entities (Jiménez-Ruiz et al., 2009). A necessary pre-requisite for the automatic ontology interoperability process is the availability of the ontology described with a formal language. A software based approach has to be preferred when the size of the ontologies to be integrated makes the manual approach too burdensome.

The interoperability between the BMO and the OLPIT ontology has been obtained in this dissertation adopting a manual process. There are two main reasons motivating this choice. First of all, the dimension of the constructs of the two ontologies is not so large, and can therefore be addressed with a manual process. Secondly, for the BMO, the description with a formalised language was not available.

On the basis of these considerations, the integration of the two ontologies has been made executing the following set of activities:

1. identification of the classes composing the BMO;
2. identification of the classes composing the OLPIT ontology;
3. comparison of the classes definitions of the BMO and the OLPIT ontology;
4. identification of correspondences among classes;
5. design of the new ontology.

All these steps will be described in details in the following paragraphs.

11.1 Identification of similar concepts in the BMO and in the OLPIT

A first step in the integration process between the two ontologies consists in the identification of the areas of overlap. For this reason, Table 11.1 on page 80 and Table 11.2 on page 80 show the list of the classes of both the BMO and the OLPIT ontology. The classes of the BMO are classified in areas. Each area indicates a portion of the reality (the organisation) to which the classes refer. These areas have not been invented but are explicitly indicated in the description of the Osterwalder ontology. The areas of the BMO that are most likely to overlap with the OLPIT ontology are the followings: Infrastructure Management (shortened in the table in Infrastructure Mgmt), and Financial Aspects.

Table 11.1 The Business Model Ontology: class hierarchy

Class	Sub-Class	Sub-Sub-Class	Area
Value Proposition	Offering		Product/Service
Target Customer	Criterion		Customer Interface
Distribution Channel	Link	Actor	Customer Interface
Relationship	Mechanism		Customer Interface
Value Configuration	Activity		Infrastructure Mgmt
Capability	Resource		Infrastructure Mgmt
Partnership	Agreement		Infrastructure Mgmt
Cost Structure	Account		Financial Aspects
Revenue Model	Revenue Stream & Pricing		Financial Aspects

Table 11.2 The OLPIT Ontology: class hierarchy

Class	Sub-Class
Business Process	
Value Activity	
Business Service	
Application Service	
Infrastructure Service	
Infrastructure Component	Infrastructure Group
	Physical Hardware
	Virtual Hardware
Cost Account	

11.1.1 Financial Aspects

Regarding the Financial Aspects, the integration is quite straightforward. The Financial Aspects area includes the `Cost Structure` and the `Revenue Model`. Among them, the `Cost Structure` is the only class that has an alter ego in the OLPIT ontology. The `Cost Structure` measures all the costs the organisation incurs in order to create, market, and deliver value to its customers (Osterwalder, 2004). A `Cost Structure` is a set of `Accounts`. An `Account` simply defines specific types of expenditures. This can be a detailed account, according to accountancy theory, or an aggregate of expenditure (Osterwalder, 2004). The `Account` class in the BMO overlaps with the `Cost Account` class in the OLPIT ontology. Table Table 11.3 on page 80 confronts in depth the two classes.

The `Revenue Model` is not addressed by the OLPIT ontology, therefore this class has no overlaps with others classes in the OLPIT ontology.

Table 11.3 Account (BMO) and Cost Account (OLPIT)

Ontology	Name	Description	Attributes
BMO	Account	Specific type of expenditures. It can be a detailed account according to accountancy theory or an aggregate of expenditures.	Name Description Sum Percentage
OLPIT	Cost Account	A Cost Account is any sum of cost associated to an Infrastructure Component, or to a service of any kind (Business Service, Application Service, Infrastructure Service).	Name Description Sum

11.1.2 Infrastructure Management

The identifications of overlaps in the Infrastructure Management area is a bit more complex. The BMO describes the Infrastructure Management area as composed by the `Value Configuration`, the `Capability`, and the `Partnership` classes. These classes have, respectively, three further sub-classes: `Activity`, `Resource`, and `Agreement`. Among these classes, `Partnership` and `Agreement` do not have correspondents in the OLPIT ontology. The others are instead very close to the classes of the OLPIT ontology that have not been taken into consideration, so far, to discuss the interoperability.

The BMO defines a `Value Configuration` as the description of the main purpose of an organisation (value creation for its customer). The value produced for customers is the outcome of a configuration of internal and external (to the organisation) activities and processes. Therefore, the `Value Configuration` class represents all activities, and the links among them, that enable value creation for the customer (Osterwalder, 2004). The `Value Configuration` in the BMO has been modelled on the basis of Porter's value chain framework (Porter, 2001) and its extensions (Stabel & Fjeldstad, 1998), in order to describe the value generation logic of both an industrial company, a service provider, a broker, or an intermediary (Osterwalder, 2004).

A `Value Configuration` is defined as a set of `Activities`. `Activities` are at the heart of what an organisation does. They are actions an organisation performs in order to create and market value and generate profits (Osterwalder, 2004). An activity is executed by and `Actor` and is related to `Resources` that can be owned by the organisation itself, or by one of its partners (Osterwalder, 2004). Since the `Value Configuration` class is concerned with the set of `Activities` that are necessary to deliver a certain product or service, there are some correspondences with the `Business Process` and `Value Activity` classes of the OLPIT ontology. Table 11.4 on page 81 compares, in depth, the classes that have just been described.

Table 11.4 Value Configuration (BMO), Activity (BMO), Value Activity (OLPIT), and Business Process (OLPIT)

Ontology	Name	Description	Attributes
BMO	Value Configuration	Arrangement of one or several Activities in order to provide a Value Proposition (Product or Service)	Configuration Type (Chain, Shop, Network)
BMO	Activity	An action a company performs to do business and achieve its goals	Name Description Activity level (Primary, Support) Activity Nature: - for Chain: Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales, Service - for Shop: Problem Finding and Acquisition, Problem Solving, Choice, Execution, Control and Evaluation - for Network: Network Promotion and Contract Management, Service Provisioning, Network Infrastructure Operation
OLPIT	Value Activity	An Activity is a single atomistic operation performed by an IT service. An Activity contribute to the output production of a business process.	Predecessor Successor Name Description
OLPIT	Business Process	A collection of activities influenced by organisation's policies and standards that takes inputs from a number of different sources (including other processes), manipulates the inputs, and produces the outputs.	Name Description

Regarding the `Capability` class, the BMO defines it as a repeatable patterns of actions, necessary to create, produce, and/or offer, products or services to the market (Osterwalder, 2004). Therefore an organisation needs to have specific `Capabilities` in order to provide its `Value Proposition`. These `Capabilities` depend on the assets and the `Resources` controlled by the organisation and, from time to time, on those outsourced to business partners (Osterwalder, 2004). A `Resource` is then necessary to create value (Wernerfelt, 1984, 1995). Resources can be tangible, intangible, and human. Tangible resources include plants, equipments, and cash reserves. Intangible resources include patents, copyrights, reputation, brands and trade secrets (Osterwalder, 2004). These classes have some degrees of overlap with the following classes in the OLPIT ontology: `Infrastructure Component`, `Infrastructure Group`, `Physical Hardware`, `Virtual Hardware`, `Business Service`, `Application Service`, `Infrastructure Service`. Table Table 11.5 on page 82 confronts, in depth, these classes. Since the OLPIT ontology targets the IT domain of an organisation, all these classes are then meant to represent IT resources.

Table 11.5 Infrastructure Management classes (BMO) and related classes in the OLPIT ontology

Ontology	Name	Description	Attributes
BMO	Capability	Ability to execute a repeatable pattern of actions	
BMO	Resource	Inputs into the value-creation process	Name Description Type (Tangible, Intangible, Human)
OLPIT	Infrastructure Component	IT facilities that enable the delivery of IT Services	
OLPIT	Infrastructure Group	A collection of pieces of hardware that are (logically or physically) interconnected with each others	Name Description
OLPIT	Physical Hardware	An IT hardware of every kind that is part of an IT infrastructure	Name Description
OLPIT	Virtual Hardware	Any IT hardware that exists only in a virtual machine	Name Description
OLPIT	IT Business Service	An IT service that delivers capabilities of the IT infrastructure to Activities and Business Processes	Name Description
OLPIT	IT Application Service	An IT service that delivers capabilities provided by a software	Name Description
OLPIT	IT Infrastructure Service	An IT service that delivers capabilities of the IT infrastructure to the IT services	Name Description

11.2 Integration of the classes of the two ontologies

In the previous sections the overlaps of the two ontologies have just been highlighted. The comparison of the classes help in identifying the areas that need intervention for the integration. After having identified the overlaps, the practical integration of the two ontologies is described in this section.

The integration of classes related to the `Financial Aspects` is probably the most easy, because the two ontologies include two classes that are almost equivalent. The only distinction (besides the name that is slightly different: `Account`, for the BMO, and `Cost Account`, for the OLPIT) concerns their properties. In fact, in the BMO, the `Account` class has an attribute (percentage) not present in the OLPIT equivalent class.

The integration of the infrastructure management area is a bit more complex. The most easy integration is the one among `Resource` (BMO) and `Infrastructure Components` (OL-

PIT). Each `Infrastructure Component` (`Physical Hardware`, `Virtual Hardware`, and `Infrastructure Group`) is an intangible `Resource`.

The discourse regarding `IT Services` requires a bit more of attention. Being services, `IT Services` might be part of the `Value Proposition` (that in the BMO identifies products and services delivered by the company to its customers). This first conclusion is anyhow misleading. The OLPIT ontology, in fact, defines `IT Services` as services that offer IT infrastructure capabilities to activities and business processes. Therefore, also `IT Services` are part of the Infrastructure Management and, in particular, they are part of the `Capabilities` a company must possess to be able to deliver product and services. Since a `Capability` is a set of `Resources`, `IT Services` can be again seen as `Resources` of the intangible type.

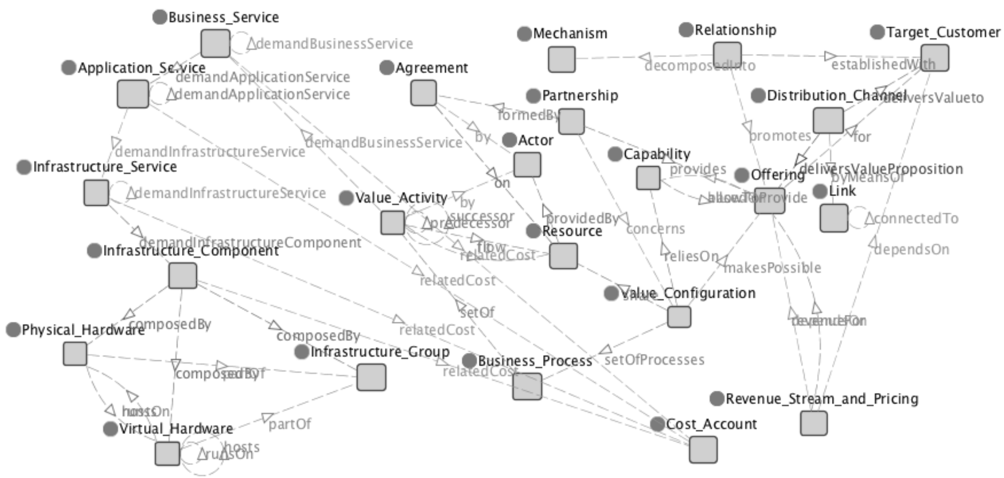
Finally, the integration of `Activities` and `Business Processes` is again easy. The BMO proposes no classes to model business processes, but addresses only activities as part of `Value Configurations`. An `Activity` in the BMO is equivalent to a `Value Activity` in the OLPIT ontology. The integrated class results as the integration of such two classes and their properties.

The `Business Process` class of the OLPIT ontology has no equivalence in the BMO, even if in the description of the ontology the concept of business process is many times recalled (Osterwalder, 2004). The OLPIT defines a `Business Process` as a set of `Activities`. Therefore, to integrate the BMO and the OLPIT, the following solution is proposed. A `Value Configuration` is composed by a set of `Business Processes`, each one of it is composed by a set of `Activities`.

11.3 IT-BM: the integrated OLPIT+BMO ontology schema

The integrated OLPIT and BMO ontology schema is depicted in Figure 11.1 on page 83. Due to the increased number of classes the structure of the BMO is no longer clearly recognisable in this schema. As a guidance, the right part of the schema is mainly composed by classes belonging to the BMO, while the left part of the schema is composed by classes belonging to the OLPIT.

Fig. 11.1 The integrated BMO + OLPIT ontology schema



This integrated ontology schema will be called IT-BM in the rest of the text. The name has been chosen to highlight the two main components of this ontology: the Business Model (described by the BMO), and the IT resources (described by the OLPIT ontology).

Chapter 12
Test case: ITHUM Srl

With the aim of testing the IT-BM ontology on a real case, this chapter describes the business model and the IT infrastructure of ITHUM Srl, an Italian small enterprise working in the ICT domain. This test case has been built on the basis of data gathered with interviews with key figures in the organisation. This chapter describes the ITHUM case. The description will focus on the key elements of the BMO. Among those ITHUM's business model and the IT infrastructure of the organisation will be described. A few examples of the application of the IT-BM will then be provided.

12.1 ITHUM Srl

ITHUM Srl is an Italian small medium enterprise that offers consultancy and training services in the ICT field. The company is located in Rome, in the centre part of Italy. It is composed by professionals and partners with a long-lasting and certified experience in the ICT field.

The name of the enterprise, ITHUM, stems from the slogan “IT is for HUMan”, which has a double meaning: “It is for human”, and “IT is for human”. The company mission is therefore to bring technologies to their original meaning, as tools to support human beings activities.

Selling its services, ITHUM approaches customers with a traditional process to tailor solutions on users' needs. When ITHUM approach customers it starts a cycle of activities that guide it in the understanding of their needs. Usually these activities are: identification of users' needs, formulation of a proposal for the intervention, delivery, training, and after sales support.

ITHUM directly participates in others organisations and institutions. In 2006 ITHUM founded and promoted the consortium “Accademia del Levante”, an organisation which has in professional training its mission. The consortium is a Cisco Regional Academy and can enact and coordinate Local Academies in other training centres, schools, and universities. The consortium is actually formed by three companies: two of them offer training services in foreign languages and management, and the other offers IT services in the centre/southern part of Italy.

In 2007 ITHUM promoted and supported a spin-off in the Basilicata region, in the southern part of Italy. The spin-off is named Enetech Srl. Enetech (ENErgy & TECHnology) aims at replicating ITHUM's competencies and services in the construction industry, offering specific services devoted to energy savings, renewal energies, and reduction of environmental impacts. ENETECH is formed by ITHUM's members, three professionals from the Basilicata region, and a company located in Taranto (in the southern part of Italy). ITHUM's role in ENETECH is the provision of technical and scientific coordination, and organisational & strategical support.

ITHUM's members also contributed to found a non-profit organisation called ICT ACADEMY. The ICT ACADEMY offers nation-wide training and education services. It is formed by several categories of professionals like: project financier, lawyers, training experts, consultants, and teachers.

12.1.1 ITHUM's Business Model

In brief, ITHUM's business model is centred on the provision of training and consultancy services in the ICT domain. ITHUM is therefore a service provider that supplies its services in the ICT market. In the following sections ITHUM' business model will be described according to the structure of the IT-BM ontology.

12.1.1.1 ITHUM's Value Proposition

A value proposition is a set of offerings, or better to say, a set of single products and services that are valuable for specific customers. In the case of ITHUM, the value proposition is basically composed by four different offerings: consultancy on networking, consultancy on new technology, training, and design of training initiatives. ITHUM's offers therefore four main services to its customers. The services described here are more like family of services rather than individual services themselves. As a matter of fact, when it comes to practice, ITHUM has to fulfil a plethora of different customers' needs. Anyhow, all these requests refer to the family of four services that will be described in these sections. Thence, for reasons of generalisation, and in order to make the test case not too complex, only these four families of services will be described.

Consultancy services are of two kinds: a first kind of consultancy services offered is the one related to networking. ITHUM offers consultancy services on networking mainly on CISCO Systems hardware. Consultancy on CISCO Systems hardware components covers different aspects connected with network appliances manufactured by CISCO. ITHUM takes care of aspects like installation, configuration, and maintenance of CISCO Systems hardware located in customers' offices.

The second kind of consultancy services offered by ITHUM deals with New Technologies in general. This service covers mainly consultancy aspects connected with unbranded ICT solutions, for which ITHUM offers generic consultancy services tailored on customers' needs.

The third service offered is no consultancy service, but it is a training service. ITHUM, by means of its employers and co-workers, offers training on several topics connected to the ICT domain. ITHUM's training activity is directly supported by ITHUM's practical activity (the two consultancy service offered that have just been described) that renders ITHUM's training services up to date, and in line with the state of the art of the IT market.

Besides to training services, ITHUM also offers the design of training initiatives as a service. With it, ITHUM offers its experience in training in the IT domain to the customers, supporting them in the design and in the creation of training initiatives on the basis of customers' specific training needs.

12.1.1.2 ITHUM's Customer Interface

ITHUM sells its services mainly to two groups of customers: small medium enterprises, and individuals. No service appears to be specifically targeted on a specific group of customers. In terms of relevance on ITHUM's turnover, anyhow, the group formed by small medium enterprises tends to be prevalent.

ITHUM's services are delivered to customers by means of two channels: direct contact, and intermediary partners. Direct contact can have many forms. Besides face to face contacts, also telephone, e-mail, and web sites are used too.

The relationships with customers are mainly managed by means of service provisioning activities and after sales support. Service provisioning activities are all those that ITHUM requires to practically deliver the services to its customers. They include all activities necessary to identify customers' needs, to identify a solution that suits them, and to deliver such a solution to the customers. After sales support includes instead all the activities executed when the service has already been sold.

12.1.1.3 ITHUM's Infrastructure Management

ITHUM's value proposition is supported by its infrastructure. Its partners play a key role in ITHUM's business model. ITHUM has so far partnerships agreements with the following organisations: Accademia del Levante, CISCO Systems, Enetech, ICT Academy, SUN Microsystems, and ZyXEL. ITHUM's degree of influence in some of these partnership agreements is strong, as ITHUM itself is a co-founder of the partner organisation (especially in the case of Accademia del Levante, and of Enetech), as explained in the beginning of this chapter.

ITHUM's offering is also supported by its capabilities. Being a consultancy service company, ITHUM's capabilities are basically centred on its personnel (employers and co-workers). ITHUM's capabilities are mainly composed by a set of certifications that the organisation possesses directly, or by means of its employees and stable co-workers. These certifications ensure that ITHUM is capable of offering a specific service. The list of certifications that ITHUM possesses is the following:

- CISCO Academy Network Partner;
- CISCO Challenge and Reward Partner;
- CISCO Channel Partner Program;
- CISCO Express Foundation;
- CISCO Premier Certified Partner;
- CISCO Registered Partner;
- CISCO SMB Selected Partner;
- CISCO SMB University;
- CISCO SMB Specialisation;
- CISCO Security Specialisation;
- CITRIX Access Essentials;
- CITRIX Access Partner;
- F-SECURE Certified Partner;
- MICROSOFT Authorised Education Reseller Certified;
- MICROSOFT Registered Partner;
- Watchguard Professional Partner;
- ZyXEL Certified Partner;
- ZyXEL Specialist Security Partner;
- ATLANTIS Club Partner.

ITHUM's services are offered thanks to a specific configuration of interconnected activities. These activities are slightly different for each family of services. These activities are shown in Table 12.1 on page 88. Since the two consultancy services are offered by means of the same set of activities, they are described together in the table.

ITHUM's infrastructure management relies on a set of resources. Human resources are mainly composed by three full-time workers (two of which are also ITHUM's co-founders), plus all the ITHUM's co-workers (about 80 potential co-workers[1]), and ITHUM's administrative personnel.

Another relevant aspect of ITHUM's infrastructure management is the infrastructure itself. Since the IT infrastructure is also part of the infrastructure, it will be described later in section 12.1.2.

[1] Out of the total amount of this number, circa 30 persons are stable co-workers, they are therefore regularly employed in ITHUM's offerings, while the rest are only occasional co-workers.

Table 12.1 ITHUM's Value Configuration

Service	Activities	Activity Level
Consultancy on Networking and New Technologies		
	Analysis of Customer's Needs	Problem Finding and Acquisition
	Identification of the Solution	Problem Solving
	Configuration	Choice
	Implementation	Execution
	Support	Control and Evaluation
Design of Training Initiatives		
	Analysis of Training Needs	Problem Finding and Acquisition
	Identification of Training Needs	Problem Finding and Acquisition
	Design of Training Initiative	Choice
	Identification of Training Resources	Choice
Training		
	Preparation of Didactic Material	Choice
	Delivery of Didactic Material to Instructor	Execution
	Delivery of Didactic Material to Students	Execution
	Lecture	Execution
	Follow-up	Control and Evaluation

12.1.1.4 ITHUM'S Financial Aspects

ITHUM's Financial Aspects are illustrated in Table 12.2 on page 88. The table shows ITHUM's main costs accounts and revenue streams. For each item the table shows its relevance as a percentage on the total amount of costs and revenues of the year.

Table 12.2 ITHUM's costs and revenues

Costs	%	Revenues	%
Connectivity	1,0%	Training	45,0%
Energy	2,0%	Design of Training Initiatives	25,0%
Rents	3,5%	Consultancy on New Technologies	15,0%
Wages	50,0%	Consultancy on Networking	15,0%
Consumable goods	0,5%		
External co-workers	4,0%		
Sales	36,0%		
Consultancy services	2,0%		
Transports	1,0%		
Total	100%	Total	100%

12.1.2 ITHUM's IT Infrastructure

Being a consultancy service company, whose services are mainly human based, ITHUM possess no complex IT infrastructure. Under a geographical point of view, ITHUM's IT infrastructure is divided in two main locations (both of them are located in the centre part of Italy, in Rome).

In the first location, ITHUM has 3 servers: a VOIP server, a web intranet server, and a web server that hosts the Moodle e-learning platform. In the second location ITHUM has 1 server and 4 desktop workstations. The server is used to run Microsoft software like Microsoft Exchange, and Microsoft Sharepoint. This server also works as a file server. The four desktop workstations are used to support employers' and administrative personnel's work. Network appliances are used to establish LAN/WAN connectivity in both locations, and to grant internet access to the whole IT infrastructure.

In terms of IT services, Table 12.3 on page 89 lists all those offered by ITHUM's IT infrastructure.

Table 12.3 ITHUM's IT Services

IT Service Name	IT Service Type
VOIP Hosting Service	IT Infrastructure Service
Moodle Hosting Service	IT Infrastructure Service
Intranet Web Hosting Service	IT Infrastructure Service
Microsoft Hosting Service	IT Infrastructure Service
Network Service 1	IT Infrastructure Service
Network Service 2	IT Infrastructure Service
Apache App	Application Service
Exchange App	Application Service
File Server App	Application Service
Moodle App	Application Service
Sharepoint	Application Service
VOIP Agent	Application Service

12.1.3 ITHUM's Infrastructure

Besides IT resources and human resources, ITHUM possess no other relevant resources supporting its business model. The only resources that are worth to be mentioned here are the two physical locations where IT resources are hosted, and where ITHUM's administrative personnel, and also co-workers, work.

Besides ordinary office facilities (like desks, chairs, one meeting rooms, and bookshelves), also a rack is present in both locations to host network appliances.

12.1.4 ITHUM's Business Model at Glance

As described in Section 6.1, the BMO offers many ways to represent a business model. Among these, a short and effective representation is the so called "bird eye view" which shows, at glance, all the main components of a business model.

Having described all the main components of ITHUM's business model, Figure 12.1 on page 90 shows the bird eye view of ITHUM's business model.

The bird eye view of ITHUM's business model clearly shows that a relevant element in ITHUM's business model is the set of capabilities (and in the specific case, the set of certification) that the company possesses, and that support its value proposition.

The bird eye view is, anyhow, not suitable to show the impact of the IT infrastructure on ITHUM's business model. In other words, the bird eye view is not suitable to provide a representation that shows the relationships among IT resources and activities. Showing only the contents of the 9 pillars of the BMO, the bird eye view does not go in deep details, displaying all the components of the business model. To clearly show the impact and the relevance of ITHUM's IT infrastructure on its business model, a different representation is then necessary.

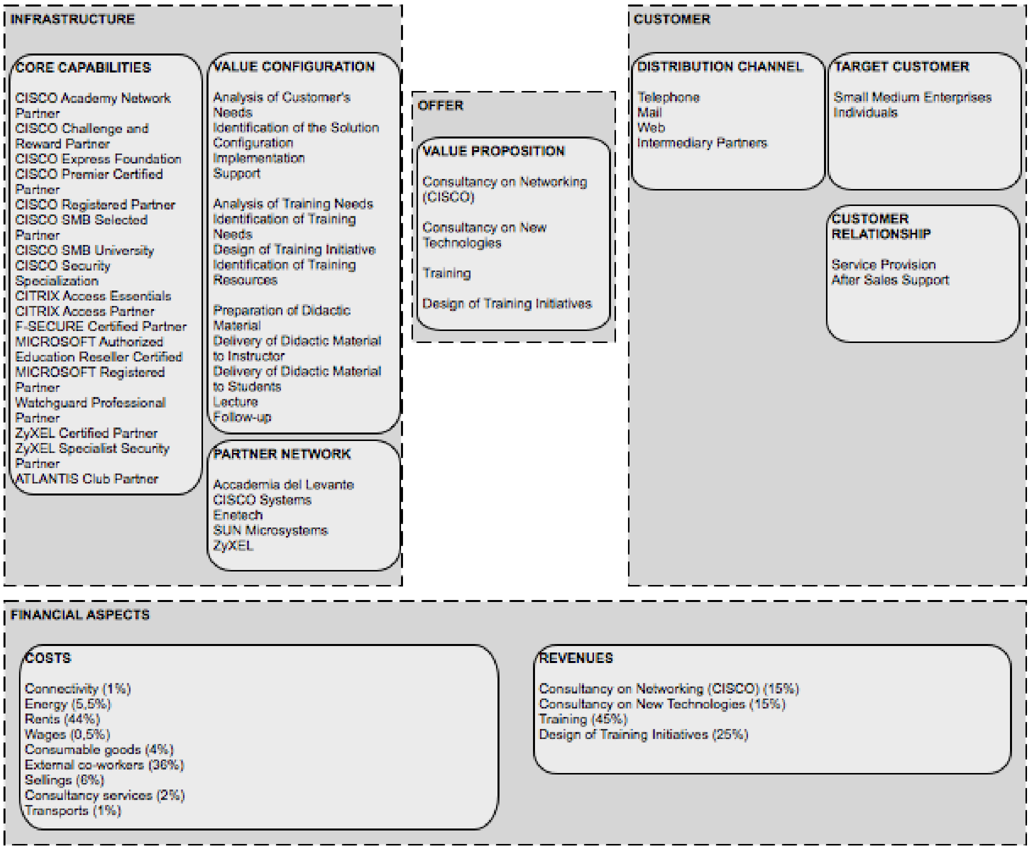
12.1.4.1 Graphical representation of ITHUM's Business Model and IT infrastructure

All the data gathered from the interviews with ITHUM's management have been used to instantiate an IT-BM ontology schema. A set of supporting tools has been used to store data gartered from these interviews. These tools are: Protégé OWL v. 3.4.1 (build 537)[2], and one of its plug-ins, Jambalaya v. 2.7.0 (build 69).

Protégé is a software tool that helps with ontology engineering processes. Protégé has been used to store all the data gathered from the interviews. Jambalaya is instead a plug-in

[2] The same software has also been use to assist in the modelling of the OLPIT ontology and in the integration of this one with the Business Model Ontology.

Fig. 12.1 ITHUM's business model at glance



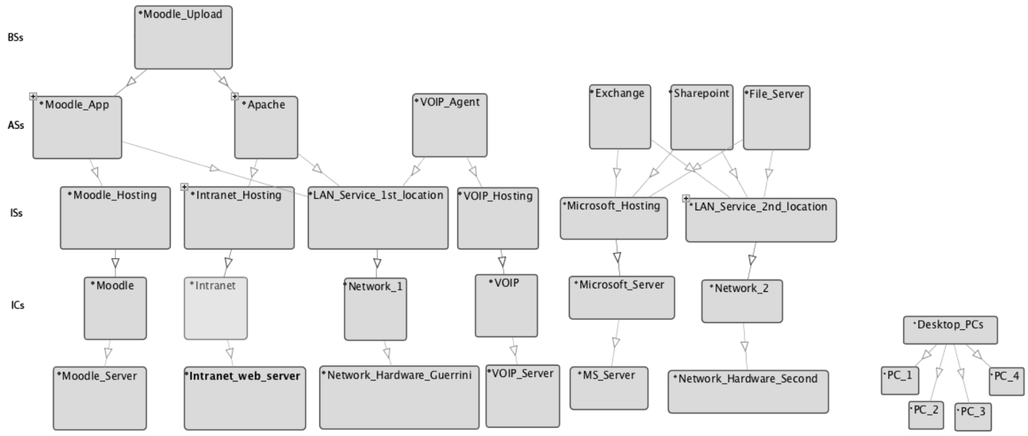
that produces graphical representations of ontology schemas, and of ontology instances. This plug-in has been used to produce the graphical representations of both the IT-BM ontology instantiated with ITHUM's data. The jambalaya plug-in has therefore been used, in this thesis, to provide a comprehensive representation of ITHUM's IT infrastructure impact on value generating activities.

12.1.4.2 ITHUM's IT infrastructure in details

As described before, ITHUM possesses a simple IT infrastructure that supports its value proposition. Figure 12.2 on page 91 shows ITHUM's IT infrastructure as produced by the Jambalaya plug-in in Protégé. Jambalaya offers few output customisation possibilities. Thence, to improve the readability of the figure, the classes have been ordered in a hierarchical way, starting with business services (in the higher part of the figure) and ending up with infrastructure components (in the lower part of the figure). In the left side of the figure four acronyms have been added to clarify the meaning of the boxes displayed. Provided that, each box in the figure represents an instance of a specific class of the IT-BM integrated ontology schema, the four acronyms help in identifying which kind of services they refer to. The acronyms have the following names:

BSs: Business Services;
ASs: Application Services;
ISs: Infrastructure Services;
ICs: Infrastructure Components.

Fig. 12.2 ITHUM's IT infrastructure



The figure has therefore to be interpreted per rows: the row of boxes next to the BSs acronym represents all business services (in this case there is only one). The row of boxes next to the ASs acronym represent all application services, and so forth. The last two rows of boxes in the figure represents infrastructure components. Size of the boxes has no meaning in this figure and in the others that will follow.

The figure shows that ITHUM's IT infrastructure is composed by three different parts: these parts can be identified by looking at group of classes that have direct connections with each others. The first part (the leftmost one) is the one that is located in the first of the two ITHUM's locations. This part supports the Moodle e-learning platform and the VOIP agent operations. The second part (the one in the centre) is the one located in the second of the two ITHUM's locations. This part mainly supports Microsoft's applications: Exchange, Sharepoint, and the file server operations. The third, and last, part (the rightmost one) is still located in the second of the two ITHUM's locations, and is only composed by desktop workstations used to support daily work of administrative personnel. They are also used from time to time by ITHUM's co-workers.

Among all resources (components and services) provided by ITHUM's IT infrastructure, only the ones connected to the Moodle e-learning platform are directly used in a value activity.

12.1.4.3 The impact of ITHUM's IT infrastructure on value activities

After having instantiated an IT-BM schema, the relationships among IT infrastructure components and value generating activities in ITHUM can be identified by querying it. Figure 12.2 on page 91 shows that only the Moodle e-learning platform, and the part of IT infrastructure that supports its operations, are used inside one business process in ITHUM's business model. Therefore this section focuses only on that part of the IT infrastructure.

Figure 12.3 on page 93 shows a large part of ITHUM's business model modelled with the IT-BM ontology. Each grey square in the figure is an instance of a specific class. To improve readability some classes have not been included in the figure. Moreover, all the elements of ITHUM's business model that are not directly connected to the part of the IT infrastructure that is discussed in this section, have been reduced in size (and their name is thence not readable in the figure).

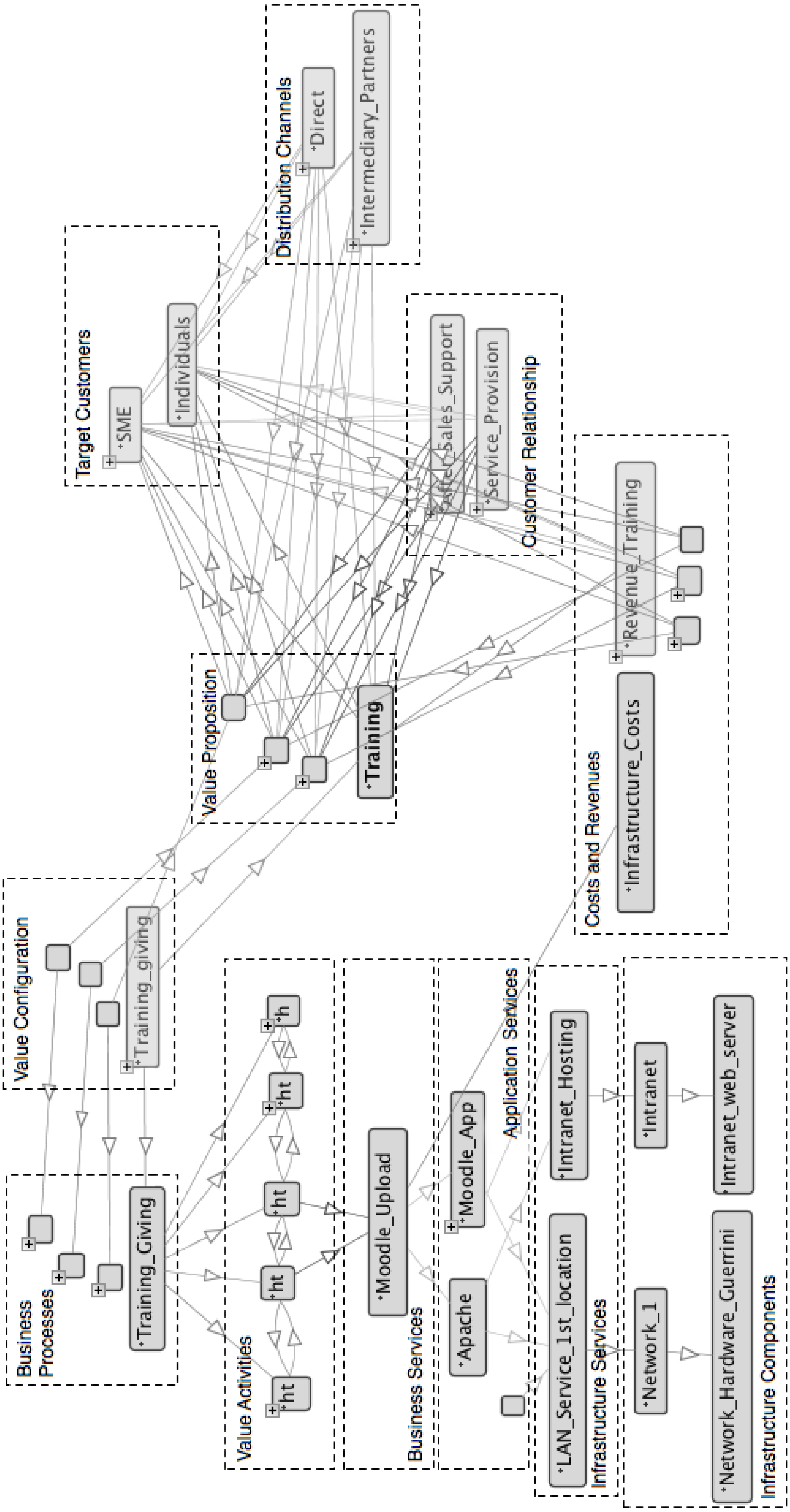
Starting from the left part, the figure shows that one of the three parts of ITHUM's IT infrastructure supports one of the four ITHUM's value propositions (Training). The part of the infrastructure that supports this value proposition is composed by network hardware, an intranet web server, two applications (Apache and Moodle), and the business service that delivers Moodle's functionalities to the business process with which ITHUM provides training services. Out of the five activities that composes this business process, only the second and the third (the distribution of the didactic material to instructors and to students) make use of the IT infrastructure.

The business process in discussion (which is called "Training_Giving" in the figure) supports the Training offering. The BMO posits that activities supports value propositions by means of value configurations. Normally a value configuration is composed by a set of activities. Since in the integration with the OLPIT the BMO has been extended with the `Business Process` class, in this case the value proposition is composed by one single `Business Process`, and a `Business Process` is composed by a set of activities.

The right part of the figure shows that the Training value offering is directed to two groups of customers (individuals, and SME), through two distribution channels (the direct channel, and the intermediary partners). The relationships with the customers are managed by means of the service provision activity and the after sales support.

Finally the costs and revenues section informs that the Training offering generates a revenue (Revenue_Training), and that the IT infrastructure also generates some infrastructure costs. Even if it is not directly indicated in the figure (but it is clearly indicated in Table 12.2 on page 88), the revenues on the Training service forms 35% of the total revenues of ITHUM. Therefore it can be affirmed that the part of the IT infrastructure that is shown in the figure supports 35% of the total revenues of the company. A similar discourse can be made also for the cost side.

Fig. 12.3 The impact of ITHUM's IT infrastructure on value generating activities



Part V
Conclusions

Chapter 13
Answering the research question

This Ph.D. dissertation has been motivated by a research question that has been described in details in Section 1.2. Being the objective of the dissertation the identification of a suitable way to identify relationships between IT resources and value generating activities in an organisational context, this dissertation proposes an approach based on an ontology obtained by the integration of the BMO and the OLPIT ontology.

The proposed approach offers a rigorous conceptual schema that can be used to derive conceptual models of the relationships between IT and activities inside organisations. The ontology approach offers both the meta model that enables the identification, the representation, and the communication of such relationships, and the semantic that is necessary to instantiate the meta model in real life environments.

This section concludes the Ph.D. dissertation and points the attention towards a couple of elements. First of all, the contribution of this Ph.D. dissertation will be described, distinguishing both between academic relevance and practical relevance. Later, possible applications of the proposed approach, and its further developments, will be described and discussed, along with actual limitations and possible risks embedded into it.

In particular, the research question of this Ph.D. dissertation was: "*How is it possible to identify, represent, and communicate the impact of IT resources on value generating activities in an organisation?*". To answer the research question three research propositions have been formulated.

The first research proposition was pertinent to the identification of a method to identify value generating activities. The concept of *Business Model*, and its representation by means of the BMO, have been found to be suitable methods to identify value generating activities.

The second research proposition was instead pertinent to the identification of IT resources used by activities. The OLPIT ontology has been identified as a suitable tool to achieve such a goal.

Finally, the last proposition required the investigation of a form that could enable the communication and the shared understanding on the phenomenon among all people interested in it. The use of ontologies, and their formalisation with the OWL 2.0 description language, fosters communicability. The semantics of ontologies fosters the shared understanding of the same phenomenon. In the end, the IT-BM ontology is thence a suitable tool to identify, represent, and communicate the impact of IT resources on value generating activities in an organisation.

Chapter 14
Ph.D. thesis contribution

A long lasting debate interested IS scholars in the definition of rigour and relevance of IS research (Applegate, 1999). Historically IS research has been criticised for scarce application of rigorous methods. Benbasat & Zmud (1999) describe five major explanations for this problem:

- an emphasis on rigour over practical relevance;
- a lack of a cumulative research tradition;
- the rapid and continuous rate of change associated with information technologies;
- the limited extent to which IS academicians are exposed to the business and technological contexts in which IS phenomena transpire;
- the institutional and environmental constraints that influence the freedom of action within academia.

The first aspect is mainly related to the youth of the IS discipline. In order to establish IS as an academic discipline and to gain respect in business schools, researchers and editors of top IS journals have tended to emphasise rigour over relevance in their works, and in their views of appropriate promotion and tenure criteria (Benbasat & Zmud, 1999). This strategy has been adopted in reaction to critics received by IS research at its birth. Today IS research is as rigorous as others research fields, but this prolonged initial habit contributed to move relevance in the background.

Regarding the second aspect IS researchers, compared to other researchers in other fields, have found more difficulties in developing a cumulative research tradition (Keen, 1980). Benbasat & Zmud (1999) affirm that this is mainly due to three reasons. First of all, in IS research, more than one theoretical framework is usually available to study the same phenomenon. Secondly, IS scholars, being technophiles at hearth, prefer to invent, rather than to adopt. Finally, the number of journals publishing IS research is big. IS journals were already a lot 10 years ago, and the number has continued to grow. This circumstance makes the identification and the access to other works difficult.

The dynamism of information technology impacts on relevance too. Even if dynamism is one of the main motivators of IS research (Benbasat & Zmud, 1999), it also tends to make things harder, adding complexity and uncertainty, and contributes to let IS research a step beyond IS practice.

The final two aspects are related to the context where IS research takes place. Benbasat & Zmud (1999) affirm that IS researchers tend to be too far from IS practice, and tend not to be involved in relevant contexts due to teaching workloads and budgets limitations. These circumstances decrease the chance that relevant problems are studied by IS researchers. Finally, the institutional and political context (academic and political institutions) also pushes IS researchers towards a direction that is far from practical relevance, favouring theory and mathematical modelling based research (Benbasat & Zmud, 1999).

Even though Benbasat and Zmud's paper has been published 10 years ago, relevance in IS research is still an open issue. Some of this considerations have lost their relevance nowadays, mainly those related to the relative youth of IS research, but they still continue to affect it. Anyhow, these five considerations summarise consolidated traditions of research in the IS field. As a consequence, for a longtime, IS journals have published papers that are far from practice. At first, it could be argued that IS journals have published for years irrelevant papers, but this claim is probably far from the truth. A more comprehensive consideration could be that for years IS journals have published papers that were relevant for IS scholars and for the IS academic community only, but not for practitioners. Even though practical relevance is more and more stressed in IS research, it can be argued that IS research pursues two kinds of relevance: academic relevance and practical relevance.

Regarding the present Ph.D. dissertation, thence, the following sections will highlight its academic and practical relevance, also clarifying how the five problems described by Benbasat and Zmud eventually affect it.

In brief, the main contribution of this Ph.D. dissertation is the definition of an ontology schema that extends the BMO with the OLPIT ontology, and that is capable of addressing the problem related to the identification of the impact of IT resources on value generating activities in an organisation. The practical and the academic relevance of this contribution will be described in the following two paragraphs.

14.1 Academic relevance

From the academic point of view, this Ph.D. thesis contributes identifying a possible solution to a problem that stems from literature. The introduction of this Ph.D. dissertation described the need, and the domains where this problem stems from. The problem addressed regards the possibility to identify the relationships among IT resources and value generating activities in an organisation, in order to stimulate progresses in the IT business value research.

This problem emerges from real needs. This justifies, therefore, the relevance. Anyhow, before being practical the problem addressed by this Ph.D. dissertation is academic, since it is highlighted in literature, and pertains, firstly, scholar's needs.

This Ph.D. dissertation has also benefited from past experiences in literature. Whenever possible literature has been used as a theoretical framework to support and orient the work. As much as possible, tendency to reuse, adapt, and extend existing things has been preferred to the tendency of creating something new. The contribution of this Ph.D. dissertation is therefore no invention (as in the meaning of the Latin word *inventus*, past participle of the verb *invenire*, meaning discovering something through research), but an innovation (as in the meaning of the Latin word *innovationem*, meaning the action of *innovare*, or the action of altering the order of things to get new things).

14.2 Practical relevance

This Ph.D. dissertation has also benefited from tight contact with real life scenarios. Besides being academic relevant, the problem addressed by this Ph.D. dissertation is also practical relevant. Part of the research this Ph.D. dissertation refers to, has taken the premises from activities that have been carried out in an industrial company and that have been devoted to solve a practical problem the organisation was experiencing.

Practical relevance of this Ph.D. can also be identified by referring to recent practice of major IT vendors in the field of IT management consultancy. As IT becomes more and more necessary inside nowadays productive environments, IT management standards change and tend to be more and more aligned towards a customer/supplier relationship, seeing the IT as a service provider for the organisation it is embedded in. The identification of the relationships among IT resources and value generating activities is also a direction towards which IT consultancy companies are addressing their services.

Moreover, to further practical relevance, the contribution of this Ph.D. dissertation, as much as possible, has been tested in real life scenarios, by means of test cases.

Chapter 15
Possible applications of the proposed approach

The proposed approach offers a method to identify the relationships among IT resources and value generating activities in an organisation. The previous chapter clarified that the main reason why this approach has been developed is to further IT business value research. This approach offers therefore the opportunity to establish a more close and clear link among IT resources and activities composing business processes, allowing a more close analysis of the benefits and the value eventually delivered by IT resources to business processes activities.

15.1 Identifying the impact of IT resources

The proposed method starts from the identification of value generating activities in an organisation. The activities identified, classified in business processes, are those that are mainly responsible for the profitability of the organisation. The proposed approach helps in identifying which IT resources impact value generating activities.

The identification of this link can be of support for a certain kinds of applications. A first possible application of the proposed approach could be the identification of which IT resources are necessary for the execution of value generating activities. Since the proposed method groups activities on the basis of the value delivered to the customer, and also indicates their contribution to the total profitability of the company, it could be possible to identify which are the key strategical IT resources that better contribute to the value generation process of the organisation. This could allow managers (both IT and not) to take decisions on the IT infrastructure on a profit, or customer, oriented base.

15.2 IT and Business shared understanding

To be able to identify the impact of IT resources on value generating activities, the proposed approach requires a certain amount of investigation. When the approach has to be applied in a real life scenario, there is the necessity to investigate the structure of the business model and the structure of IT resources in the organisational context. Usually knowledge on these aspect can be found in many places inside an organisation. Depending on the size and the complexity of the organisation, knowledge on this specific aspect can be found in one or more spots.

In any case, the application of the approach requires a global effort, that involves both the IT management and the business management side. The proposed approach has therefore the capability of putting IT and business managers around the same table, to discuss about a common problem, and to share a common understanding on the IT/Business relationships, fostering a shared understanding, crucial to derive competitive advantage from IT resources (Ray et al., 2007).

15.3 Better communication between IT and business

In the proposed approach IT resources impact activities and business processes by means of a set of services. Under this perspective the proposed approach sees the IT as an internal service provider for the organisation. To align the proposed approach to business practice, established IT service management practices have been, as far as possible, taken into consideration.

In the previous section it has been said that the proposed approach can promote a shared and mutual understanding between IT and business. There is also another aspect to take into consideration. As seen from the IT perspective alone, the proposed approach can help IT management in explaining and communicating, in a more comprehensive way, which is the contribution of the IT division to the organisation.

15.4 IT infrastructure assessment

A further possible application of the proposed approach lies only in the IT management field. The proposed approach, and in particular the OLPIT ontology, promotes a more deep understanding of IT resources that encompasses the resources themselves, their use, and their interdependencies. This understanding can promote IT management, pushing approaches like the adoption of CMDBs a bit further.

IT manager could have the possibility to assess their IT infrastructure under a customer/supplier perspective, by identifying its readiness and its capability of fulfilling business needs and requests. A prototypical application that shows how to do such infrastructure assessments can be found in vom Brocke et al. (2009), and has also been reported in this dissertation as a test case for the OLPIT ontology

Chapter 16
Limitations

Even though the approach proposed in this Ph.D. dissertation has been developed and tested, as much as possible, in real life scenarios, being proposed for the first time, its limitations have also to be taken into consideration.

There are two main kinds of limitations to discuss. The first kind of limitations regards the research in itself, and will be discussed in Section 16.1. The second kind of limitations regards the possible scenarios on which the proposed approach might be applicable or not, along with the practical outcomes that the approach could offer in these situations. These kind of limitations will be discussed in section Section 16.2.

16.1 Research limitations

As many times stressed so far, this Ph.D. dissertation has had a twofold contact with real life. First of all the problem stems out of real life. Secondly, the proposed approach has also been tested in real life scenarios.

Under this point of view, a possible limitation of the approach proposed in this Ph.D. dissertation, regards the limitations of the different amount of scenarios in which the approach has been tested. Being based on a meta-model, the outcome of the proposed approach feels the effect of the reality that is under investigation. IT resources can impact value generating activities in different ways in each of the three possible value configurations defined by Stabel & Fjeldstad (1998). This is even more true since Stabel & Fjeldstad (1998) define their three value configurations according to three different kinds of technologies defined by Thompson (1967). The proposed approach has been mainly tested on value shops configurations. Since IT resources could impact activities in a different way when they are part of a value chain, a value shop, or a value network, even though the approach is general, considerations on its outcomes on any kind of value configurations require further research.

16.2 Applicability limitations

A second set of possible limitations regards the scenarios in which the proposed approach can be applied or not, the conditions in which it can be applied, and the level of understanding that it contributes to gain on the IT/activity relationships phenomenon.

First of all, to be applied, the proposed approach requires that the organisation has an IT infrastructure that (almost) directly contributes to its value proposition. The proposed approach could not therefore be applied in contexts where there is no IT (and this is of course obvious), or where the IT is not directly involved in business activities.

The proposed approach identifies the link between IT resources and activities only in the case these resources deliver values to activities. This value delivering process consists in practical capabilities of these IT resources that make possible, or simply support, the execution of activities and business processes. The more the link between these IT resources and the activities is blurred, the less is the usefulness of the IT-BM application. There are some IT resources that are not directly involved inside business processes (for example, the act of sending and e-mail). Being not part of a business process execution, they are unlikely to be captured by the IT-BM approach.

To try to clarify with an example, the desktop workstations in the ITHUM test case can be taken into consideration. In the given example they are not used by any activity in the business process. In this case, the application of the IT-BM does not provide too much help in understanding how these resources supports ITHUM's value delivery, even though they do, since they support ITHUM's personnel administrative work. Probably it is easy to understand that in an industrial company an ERP or a CRM system contribute better to organisational performance than desktop computers. Anyhow, desktop computers allow individuals to work inside the organisation. Simple activities like e-mail sending, web browsing, document writing, and others, are indirect parts of the value generating process, but are, so far, not easily captured with the application of the IT-BM.

Another aspect that has to be taken into consideration is the level of granularity. In the test cases that have been described in this Ph.D. dissertation, the level of granularity was intentionally intermediate. This is due to the necessity of keeping the instantiated model as simple as possible, mainly because complexity might reduce communication effectiveness. Also some attestations from industrial contexts where the OLPIT ontology has been developed suggest that pursuing the maximum level of details is counterproductive, as it might led in the failure of the initiative due to an excess of complexity and information overloads.

The understanding of the relationships among IT resources and value generating activities that the IT-BM approach contributes to gain, also depends on the type of IT infrastructure that is under investigation. Under a theoretical point of view IT resources can be shared among several activities. Thence a single IT resource can provide more than one service (for example, an entire ERP system). The degree of understanding that the approach contributes to gain can therefore decrease with the increase of the number of shared resources in the IT infrastructure.

A final remark regarding the practical application of the proposed approach regards eventual supporting tools. Even if they are simple, the two test cases (the OLPIT test case and the ITHUM test case) that have been shown in this Ph.D. dissertation are based on a conspicuous amount of data representing the two realities that have been investigated. These data have been collected by means of interviews or direct observations, and they have been stored in different instances of the IT-BM ontology schema, using the Protégé ontology editor software. The Protégé software acted therefore as a supporting tool for the application of the IT-BM. This software offers many functionalities that are mainly targeted to support the ontology engineering process. The software supports the development activity in a proper way, but it is a bit limited (and in some cases it is even too complex) in supporting the everyday usage of the ontology. The two test cases described in this dissertation benefited from visualisation and query capabilities of Protégé and its plug-ins. Anyhow, to be able to fully exploit the potential of the proposed approach, a dedicated supporting tool should be identified (or developed).

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