FROM BUSINESS MODELS TO SERVICE-ORIENTED DESIGN: A REFERENCE CATALOG APPROACH

By

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A thesis submitted in conformity with the requirements
for the degree of Master of Science
Graduate Department of Computer Science
University of Toronto

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A Reference Catalog Approach

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2006

Abstract

The service-oriented architecture (SOA) has been emerging as one of the most popular system architectures in both the business and IT communities because of its capability in achieving flexibility, agility, and responsiveness to changing business needs. However, these values can only be delivered if the business needs and strategic concepts are properly analyzed and met by the technical solution. The study of business models, stimulated by innovations in e-business, has become an important step to support such analysis leading to technical system design. This thesis examines the business modeling and analysis needs arising from the business models literature, and considers the potential of the *i** modeling framework [Yu97] in addressing those needs. A reference catalog approach is proposed to capture recurring business models and provide design rationales for service-oriented design. A sample reference catalog is provided. The effectiveness of the proposed approach is evaluated using a real-world case study.

Acknowledgements

I would like to take this opportunity to thank everyone who has supported me over the course of my graduate study.

First, special thanks to my supervisor, Professor Eric Yu, for introducing me to the research area of organizational and business modeling. Without his invaluable advice and guidance, as well as his patience during the preparation and editing phase of this thesis, I would have never completed this work. Also, thanks to Professor Steve Easterbrook for sharing his expertise in requirements engineering during his course and his help in reviewing my thesis.

I am also grateful to my friends and student colleagues for their continuous encouragement and support during my graduate study.

Most importantly, I wish to thank my parents for providing a loving and supportive environment in which I can grow up and pursue my studies freely. I am forever indebted to them for their endless love, patience, and understanding. Therefore, to them I dedicate this work.

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Chapter 1 Introduction

Recently, the service-oriented architecture (SOA) has been emerging as one of the most popular system architectures in both the business and IT communities, mainly because of its capability in achieving a common set of objectives: flexibility, agility, and responsiveness to constantly changing business needs [Brown03]. However, although implementing such architecture with open standard technologies such as Web services will improve on technical issues such as interoperability and system flexibility, the true business values of an SOA can only be delivered if the business needs and strategic concepts are properly uncovered, analyzed and met by the technical solution.

To ensure that business objectives and strategies are effectively captured and communicated, the concept of business models has become a tool of interest in the e-business world since the late 1990's as the Internet gives rise to many new business opportunities and dramatically changes the traditional ways of conducting business [Alt01]. As we expect the concept of SOA will further revolutionize how enterprises use the Internet for business interaction and integration, new types of business models will emerge and have great impact on the underlying IT infrastructure. Consequently, design options will multiply rapidly, and technical system design will need to interact more closely with business design to explore and select among various alternatives.

In recent years, the Information Systems (IS) community has recognized the need to analyze business concepts and improve business/IT alignment through the use of modeling techniques [Gordijn03, Osterwalder05]. They also use the term *business model*, but its meaning is different from the one adopted by the business community. In the business literature, business models refer to the actual design of business, such as a method of doing business [Rappa03] or a company's business architecture [Timmers99]. On the other hand, business models in the IS engineering literature are representation of business concepts in the real world, often with the aid of some graphical notation and business modeling techniques. To avoid potential confusion, we use superscripts to differentiate the two, such that business model^1 denotes a business model defined in the business literature, and business model^2 denotes a business model in the IS engineering

sense. Furthermore, the notion of business modeling discussed in this thesis refers to the design and analysis process of business level concepts using business models[2].

Our research on existing literature indicates that the idea of business models[1] has not yet had widespread impact on IS modeling, and the following questions remain unclear: What IS modeling constructs and techniques will be needed to facilitate a more effective engagement with business model analysis and design? How can business model reasoning be used more effectively and efficiently in guiding the design process of an SOA implementation?

In this thesis, the approach to answer the above questions is twofold: First, we identify the modeling and analysis needs arising from the discussion of business models[1] in the literature, and then consider the potential of extending the *i** modeling framework [Yu97] for addressing those needs as a business modeling technique. There are two reasons for introducing the *i** modeling framework in this context: it has strong analytical and reasoning capability, and many of its concepts, such as goals and strategic actor relationships, are relevant for business modeling; and its extension, Tropos, provides a good basis for deriving technical system design from *i** models, including Web services design.

In the second part of this thesis, we propose the idea of maintaining a set of reference business models in a reference catalog, in which each model is pre-analyzed and comes with a set of reusable and connected design components, so that common design knowledge in recurring business models[2] can be reused to solve similar business problems and help define the technical specifications. Since a reference business model is composed of both the text descriptions that specify the actual business design and also the representation of this design using IS modeling notations, we do not need to use superscripts for this term.

The structure of this thesis is as follows. Chapter 2 provides more background material on SOA and how the design of this type of systems can benefit from business modeling and a reference catalog. In chapter 3, we review related work, including existing business modeling and service-oriented design methodologies, as well as the frameworks we use in our approach – *i** and Tropos. We compare them to our approach, and explain how our work contributes toward them. In chapter 4, we identify the set of

business modeling and analysis requirements advocated in the business model[1] literature, and evaluates the capacity of the extended version of *i** in covering those requirements. Chapter 5 further explains our idea of working toward a reference catalog, in which an expandable set of reference business models is maintained along with its associated set of reusable design components. Then, in chapter 6 we introduce the Northern Electronics case study, and as an example, we explore how the *value chain integrator* business model helps guide the IT solution design for the case study. Lastly, chapter 7 draws conclusions of this thesis and summarizes the contributions, lessons learned and future work.

Chapter 2 Background

2.1 Overview of the Service-Oriented Architecture (SOA)

The concept of service-oriented architecture (SOA) can be viewed and expressed from various perspectives. In simplest term, it is the concept of constructing systems based on entities called *services*, and each *service* is a reusable building block that offers a particular functionality [Stojanovic05].

From a business point of view, [Bieberstein05] defines the SOA as "*a set of flexible services and processes that a business wants to expose to its customers, partners, or internally to other parts of the organization, and the same services can be recombined and supplemented to support changes to or an evolution of business models and requirements over time.*" In this case, the term *service* represents a repeatable task within a business process, which can be either a business service or an IT service.

From a technical point of view, an SOA is expressed as an architectural style consists of service providers and service consumers, in which the service provider publishes the service description and provides the IT service's functionality on demand, while a service consumer dynamically binds and invokes the IT service through standard interfaces and messaging protocols. An SOA may also have a third party acting as a service registry that provides the publishing and discovery of service descriptions, as shown in figure 1.

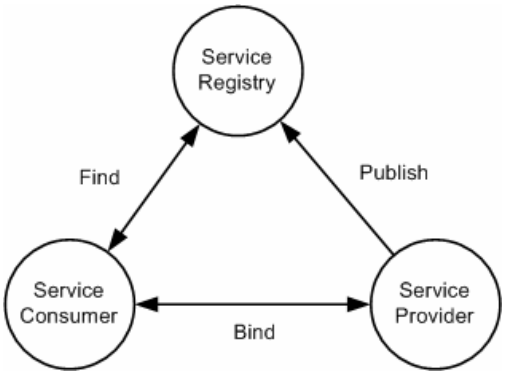

Figure 1. The basic Service-Oriented Architecture

Furthermore, [Erl05] states that although there is no single definition of SOA, it is commonly associated with a set of architectural principles: separation of concerns; abstraction of underlying logic; and designing services that are reusable, loosely coupled, modular, composable, autonomous, stateless and discoverable.

2.2 Business Benefits of SOA Implementations

Regardless of its technical background, SOA is gaining a lot of attention in the business world, because its principles and concepts promise to provide a number of business benefits: flexible collaboration between business partners, better support to agile business strategies, and more effective alignment between business objectives and IT resources [Brown03, Sprott04].

When business partners collaborate via IT services, the company who acts as a service provider first exposes the service features and capabilities it offers by creating and publishing the service descriptions as a standardized interface. Companies who would like to consume such service can look up the interface from the service provider or from a service registry provided by a third party, and remotely invoke the service described by the service interface. Interoperability between disparate systems is possible by using service interfaces and messaging protocols that are based on open standards; hence, companies save the time and effort needed by traditional systems to customize connections between business partners. This also allows service providers and consumers to conduct business transactions across the Internet without the need to understand the details of each other's systems, benefiting from the principle of separation of concerns. Consequently, business collaboration can be accomplished with increased flexibility while reducing cost and complexity.

The great degree of flexibility offered by the SOA has a second advantage: to provide better support to agile business strategies, saving companies' time, cost and money to accommodate new business needs and adapt to changing market conditions [Brown03]. Not only can connections be automatically established, but because business activities are designed as a collection of interconnected services, and operations are

broken up into discrete business processes, companies can reuse their IT assets by reconfiguring their services and processes on demand in new business contexts.

In addition, the set of loosely-coupled and modular services in an SOA is defined to support business processes, such that each service performs a repeatable business activity, and each activity aims to achieve a specific business objective. Consequently, the focus of IT resource management is on the set of business-aligned IT services rather than on the specific applications or technologies, which allows IT resources to reflect a better alignment with business objectives and processes, as well as better fit with an organization's specific business model[1].

2.3 Relationship between Business Modeling and the SOA

A number of business benefits that SOA offers are discussed in the previous section, and as emphasized in [Bieberstein05], a major business driver in implementing an SOA is to achieve better alignment between business objectives and IT resources, because as companies are all striving to lower costs and improve responsiveness to market needs, it is important for them to justify the value of their IT investments and ensure such investments fulfill their business needs effectively. However, it is important to keep in mind that whether the resulting system will fulfill their needs heavily depends on whether those needs are properly analyzed, understood and transformed into technical specifications. This raises the need to build a sound business model[2] that captures the business needs and objectives, and use it as a basis for analyzing and expressing the business level concepts and strategic decisions before determining the technical design options. To achieve better alignment between the business model[2] and the technical design of an SOA, a systematic technique is necessary to recognize the relationship between the two and determine what services a company should make available.

In the following chapters, related work is discussed, and our approach to adopt a business modeling technique as well as a reference catalog to bridge the gap between business models and service-oriented design will be described in detail.

Chapter 3 Related Work

3.1 Business Models

As discussed earlier, the term business model has different meanings when used in the business and the IS engineering literature. The concept of business models[1], which generally refer to the actual design of business in the business literature, became popular in the late 1990's as businesses began to take advantage of the potential of the Internet to reach out to customers (B2C) and to transact with each other (B2B). These models are considered to be central in the discussion of e-business, as the success or failure of a firm is often attributed to the viability of its business model[1]. Despite its popular usage, there is no agreement on what the term should precisely encompass [Osterwalder05]. In the business literature, this term is often used broadly to refer to the unique ways a firm determines to conduct business. One of the earliest definitions was offered in [Timmers98], which defines a business model[1] as "*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 business actors; and a description of the sources of revenues*". [Rappa03], on the other hand, describes a business model[1] as *"the method of doing business by which a company can sustain itself -- that is, generate revenue"*, and it *"spells-out how a company makes money by specifying where it is positioned in the value chain*".

Over the past few years, the business models[1] literature has been actively debating what should be included in the concepts of a business model[1]. For instance, [Weill01] proposes that a business model[1] includes "*the roles and relationships among a firm's customers, allies, and supplier, the major flows of product, information, and money, and the major benefits to the participants*", which is similar to the set of components proposed by [Timmers98], whereas some other works focus more on business vision and goals [Alt01, Magretta02], and others emphasize on interactivity among business partners [Essler01]. A number of works also proposed taxonomies and characteristics of specific business models[1], such as various types of e-business models [Weill01, Rappa03, Straub04], and boundaryless business models that specify boundaryless information flow architectures for enterprises [Solomon03].

So far, the study on business models[1] in the business literature focuses on the descriptive aspects, such as what concepts can be expressed in them and how business practices from the real world can be captured as types of business models[1] with a name and textual descriptions. Thus, its focus is less so on the design and analytical powers of business modeling.

On the other hand, the notion of business models[2] in the IS engineering community is a tool for representing the business concepts in the real world, such that they can be properly expressed, designed and analyzed using various modeling techniques. Thus, the soundness of a business model[2] in this sense would relate to how accurately it reflects the reality; whereas soundness of a business model[1] in the other case would be measured by how well it helps a company to conduct its business and gain profit. A comprehensive survey regarding business models' origins, current status and future outlook can be found in [Osterwalder05].

3.2 Business Modeling Techniques

As discussed earlier, a number of business literature contribute to the study of business models[1], but their analytical and reasoning capabilities are yet to be explored and assessed. The IS community, in contrast, has made much greater use of models as representations of real world concepts, particularly in supporting analysis and design. In light of the need for design and analytical support in the business modeling process, a number of approaches have been developed in the IS engineering community, including: an extended version of Unified Modeling Language (UML) [Eriksson00], the Business Model Ontology (BMO) [Osterwalder04a,b], the Business Modeling Method (BMM) [Montilva04], the e3value framework [Gordijn01, Gordijn03], and a value network approach [Allee02].

UML is the *de facto* standard for modeling software systems. [Eriksson00] discusses how it can be extended for business modeling using concepts including business processes, goals, resources, activities and rules of a business system. It uses a process and object-oriented approach to build business architectures, and the resulting

process and use case diagrams are intended for identifying functional and non-functional requirements of the information system that supports the business architecture.

The BMO proposed in [Osterwalder04a] and [Osterwalder04b] focuses on four main areas: product innovation, customer relationship, infrastructure management, and financial issues. These four areas are further broken down into a set of nine building blocks for constructing business models[2], and relationships between them can be established. This approach adopts on the use of entity-relationship diagrams, and intends to drive the analysis and comparison of value propositions for businesses as future work with the aid of computer-based tools.

BMM is a method for modeling business concepts in the Enterprise Information System (EIS) application domain [Montilva04]. It expresses knowledge in terms of goals, technologies, business rules, business processes, business objects, actors, job structure, and events. The main objective of using this approach is to gain understanding of a business domain before initiating the requirements engineering process, and to elicit requirements using the models.

The *e*^{3}*value* framework [Gordijn03] is developed for defining, deriving, and analyzing multi-enterprise relationships from the business value viewpoint, and is suitable for value-based business modeling. Its modeling concepts include actors, value objects, value interface, value activities, and value exchanges. In general, this approach allows the modeling of economic value object creation, exchange and consumption among multiple actors. It supports the analysis and evaluation of economic feasibility by means of a profitability calculation technique, and allows comparisons among alternative business models[2] in terms of scenarios and quantitative characteristics.

Last but not least, a value network approach for business modeling and analysis is proposed in [Allee02], which focuses on modeling and measuring both tangible and intangible value exchanges. It views businesses as living networks rather than discrete organizations, in which knowledge and intangible values are also important elements to consider. It supports the analysis of the value network in three forms: patterns of exchange, impact assessment, and value creation analysis.

3.3 The *i** Modeling Framework

The *i** modeling framework [Yu97] is an agent and goal-oriented methodology for modeling and analyzing early requirements. This framework is of interest in this thesis, because as demonstrated in [Weiss05], objectives and goals are essential elements to be analyzed in business models[2], but such analysis is not addressed by the modeling techniques described in the previous section. Therefore, we turn to the *i** framework, which offers a set of goal-oriented notation and analysis techniques that are highly relevant for modeling business concepts and objectives.

The *i** framework consists of two main types of models [Yu99]: Strategic Dependency (SD) model, a graph which describes a network of actors and strategic dependency relationships among them in the organizational context; and Strategic Rationale (SR) model, a graph that extends an SD diagram to describe stakeholders' internal interests and concerns, and provides support for reasoning of their intentional relationships.

As described in [Yu97] and [Yu99], the *i** framework is built upon the fundamental concepts shown in figure 2 below, and some of the important ones are briefly described here:

Actor. It is an entity that may represent a human participant, a software or hardware system in the problem domain. It has its own strategic goals and can carry out tasks to fulfill the goals. An actor can be differentiated into an *agent*, *role* or *position* [Yu99], where an agent can take on different roles or positions within an organizational context. However, such distinction may not always be significant.

Goal. It represents an interest or intention of an actor. There are two types of goals: softgoals, which usually represent non-functional requirements that have no defined steps to achieve it and can only be *satisficed*; and hard goals, which are requirements that can be satisfied. In the following sections, goals refer to hard goals.

Dependency. It is a relationship between two actors where one actor, the *depender*, depends on the other actor, the *dependee*. A dependency can be in terms of a goal, a softgoal, a task, or a resource.

Contribution. It represents the type of contribution a goal or task has on a softgoal. The type of contribution can be one of make, help, hurt or break.

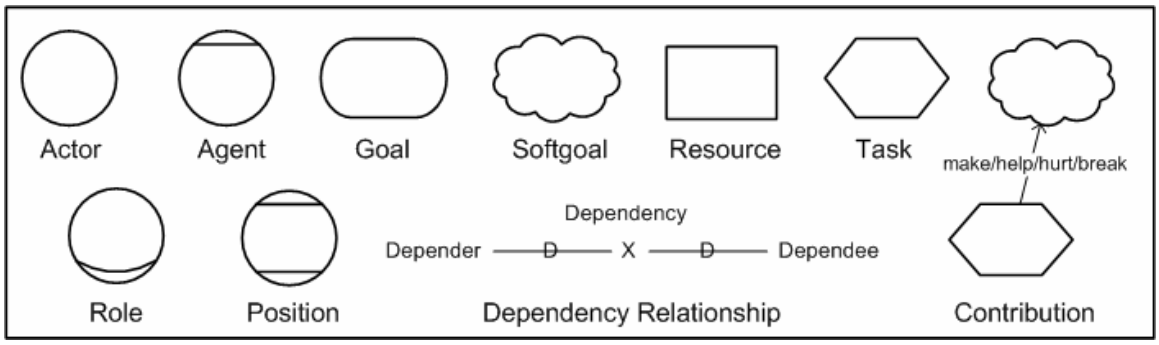

Figure 2. Major modeling concepts in the *i** framework

3.4 Tropos

Tropos is a methodology that supports all phases of the software analysis and design process, including: *early requirements*, *late requirements*, *architectural design*, *detailed design* and *implementation* [Bresciani04, Tropos]. It extends the *i** framework, which takes intentional elements such as stakeholder goals and strategic relationships into consideration, and intends to provide a seamless integration between early requirements models with the technical solution. This methodology has been adopted by [Lau04] to design Web services, and a later work by the same author extends this approach to generate business processes and BPEL specifications for Web services [Lau05].

Also, the framework proposed in [Kaz04] integrates business requirements and business processes using a modified version of Tropos. It makes business goals and strategies explicit during the course of building a business process model.

The Tropos design process offers an integrated set of design models that can be systematically derived from *i** models, which makes the *i** framework an even more favorable approach for aligning business level concepts with technical design models.

3.5 Service-Oriented Design Methodologies

At present, very little research has been done to bridge the gap between business models[2] design and service-oriented design. The works listed below advocate various ways to explore and design Web services from a business perspective, mostly started from business requirements or business processes.

For instance, [Terai03] proposes a unified framework for composing Web Services coordination based on business models[2]. It links business activities with Web service activities from a business process perspective, and helps achieve reusability by the use of object repositories and process templates.

Several technical papers from IBM, including [Zimmerman04] and [Arsanjani04], propose a service-oriented approach for modeling, analyzing and designing IT services. The methodology focuses on functional requirements derived from business scenarios and processes.

Finally, [van der Raadt05a,b] introduces an approach to explore Web service ideas from a business value perspective, which proposes the combined use of the goal-oriented *i** framework and the value-based *e*^{3}*value* approach to identify business requirements and evaluate various alternatives. It provides a preliminary investigation on using the *i** framework to represent alternate business models[2], but does not examine the business model concepts in depth.

3.6 Methods to Reuse Design Knowledge

Design knowledge may be reused at different stages throughout the design process. A common way to reuse existing knowledge is by means of patterns, where each pattern, as defined in [Alexander77], "*describes a problem that occurs over and over again in our environment and then describes the core of the solution to that problem in such a way that you can use this solution a million times over without ever doing it the same way twice*". Design patterns have been proposed and proven useful at various stages or levels of software design, such as in object-oriented software development [Gamma95], and from requirements models to design [Gross,Yu01]. A number of works have also been

focused on design patterns for service-oriented systems, including patterns at the IT service level [Arsanjani05, Evdemon05] and the message level [Chaterjee04].

However, there also exist recurring business patterns and models in the real world, such that patterns of best practices in business strategy repeat from time to time. Although the patterns and models vary from one another in different businesses, previous design knowledge can still be applied to common cases. Thus, to reduce model construction overheads and to increase reusability of existing models, it is beneficial to work towards a set of reference business models, in which business level components and design knowledge can be reused to solve similar problems.

Currently, some works proposed taxonomies of e-business models[1], such as in [Timmers98] and [Weill01], where characteristics and examples are given for a set of common business models[1]. To apply modeling techniques that facilitate analysis and reasoning for these types of common business models[1], our approach offers a graphical representation as well as analysis and reasoning techniques by using the *i** framework. We also propose a reference catalog approach to increase reusability of existing model components, such that pre-analyzed *i** models are organized in the reference catalog with associated technical design models. The rest of the thesis will further illustrate how the reference business models are constructed, and how their components found in the catalog can be reused and adapted for a particular case. The application of the goal- and agent-based *i** framework in our approach for business modeling is significant, because unlike other modeling approaches which are inherently not intentional, *i** models can capture the intentions and concerns of all stakeholders during the refinement process of the reference business models, allowing the adaptation of the general model into the user's specific case. As a result, the instantiated models not only consists of factual descriptions of good practices that are derived from the reference business models, but also includes design rationales and alternative selection based on the user's specific needs, which distinguishes our approach from other existing methods.

Chapter 4 *i** as a Business Modeling Technique

4.1 Requirements for Business Model Analysis and Design

Discussions in the business literature on business models are mainly focused on the purpose and descriptive aspect. There are very few guidelines as to how business models[2] should be designed and analyzed. To explore what constitutes a sound business modeling technique, first we surveyed the literature to identify the set of concepts considered to be key ingredients for business models in general. Then, we extract questions induced by these concepts in the literature and study the types of design and analytical support that are required to address them during the modeling process.

The business modeling concepts are organized into four categories along with their sources in table 1 below. Figure 3 illustrates these modeling concepts in a meta-model to indicate their interrelationships. It is an entity-relationship diagram in which rectangles represent the entities, and links represent the labeled relationships read in the direction of the arrows. Note that there is no assumption of SOA implementation in these concepts extracted from the literature. Also, the diagram can be simplified by using a parent role for the two children roles *business provider* and *consumer*, because they have identical relationships with the other model constructs; however, both sides are shown in the figure to indicate that there is usually two sides in a business partnership, and that business concepts such as goals and value creating activities should be identified and analyzed from both perspectives in a business model.

Table 1. Sources of the desired properties of a business modeling technique.

Category / Source	Actors and roles	Vision and goals	Interactivity and resource flows	Joint value creation
Timmers'98	Actors and roles		Product, service and information flows, sources of revenue	Actor's potential benefits
Alt'01	Structure (roles and agents)	Mission (overall vision and goals)	Customer coordination, sources of revenue	Value creation activities and processes
Essler'01		Goals of both the company and customers	Interactivity	Customer perspective in value creating process
Magretta'02	Identification of customers	Business vision	Reaching of customers, value delivery	Values desired by customers, value making activities
Straub'04	Stakeholders and relationships	Mission and strategic statements	Flows of resources, revenue model	
Osterwalder'05	Target customers, partnership	Value proposition (products and services intend to offer)	Distribution channels, value configuration, cost and revenue model	Value proposition and configuration, capabilities

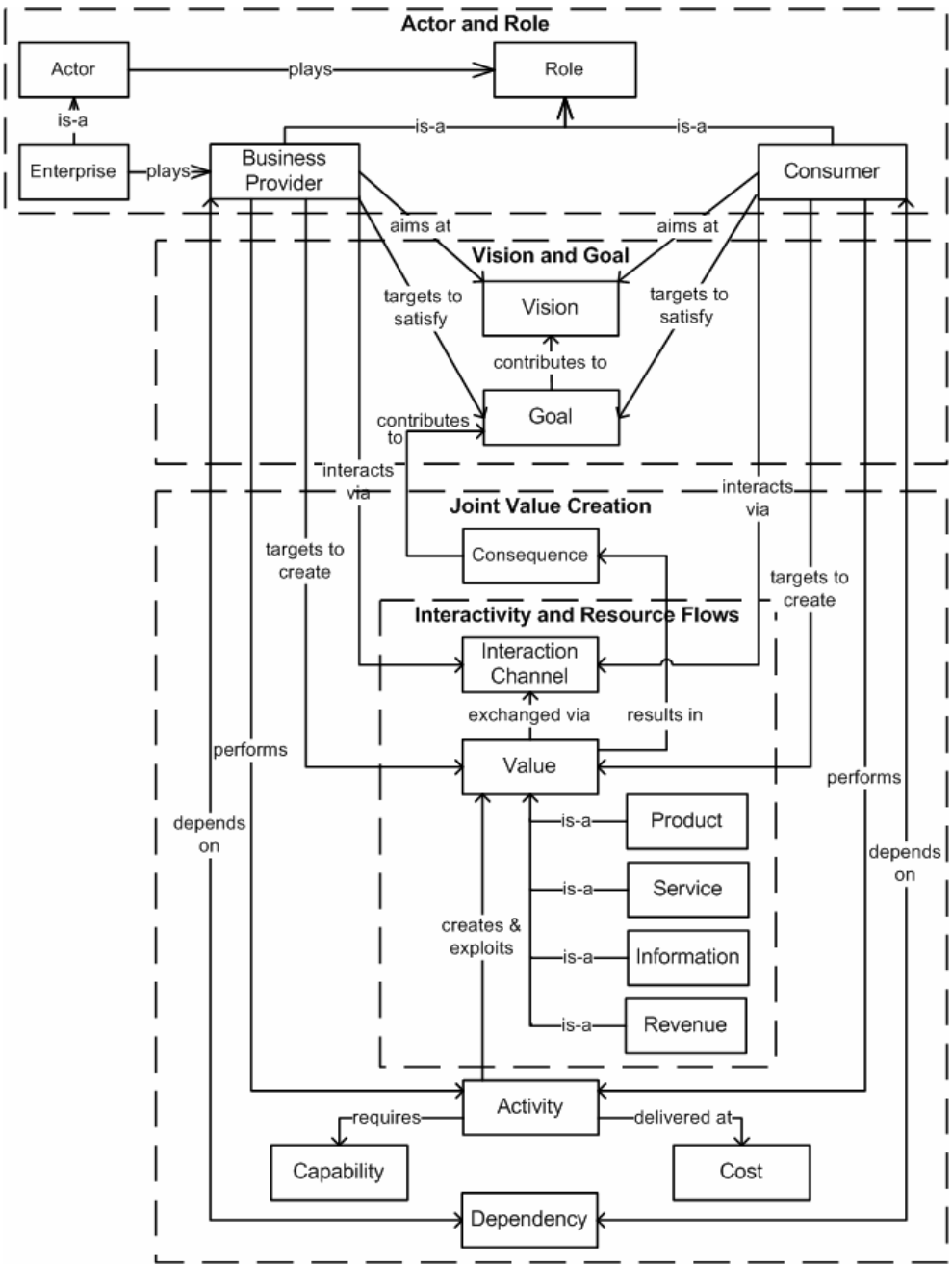

Figure 3. A meta-model showing the essential concepts of a business model and the relationships among them.

4.1.1 Actors and Roles

The concepts of business actors and roles are mentioned in most of the business model[1] literature, some explicitly [Timmers98, Alt01] and others implicitly [Magretta02,

Straub04, Osterwalder05]. Regardless of how they are referred, rather as actors and roles, stakeholders or target customers, there is a common agreement that business participants are essential elements in a business model. We generalized such concept from different literature and came up with the following definition: an *actor* represents a stakeholder or an organization in the business domain, whereas a *role* is a function or position that can be undertaken by an actor. The separation of actors from the roles they play is optional, but it allows capturing how each actor may play different organizational roles when performing different business activities. Furthermore, each role may represent a particular way for the organization to conduct business in alternate business models. For example, a company can play the role of a service provider, a service aggregator, or even a service consumer of its business partner during the course of a business process in an SOA [Stojanovic05].

In the meta-model shown in figure 3, we include the concepts actor and role as well as two general types of roles: business provider and consumer. Although we could define the two roles as subclasses inheriting the same set of properties, we show the symmetry in the model to make the two-sided relationships more visible.

To properly capture the concepts of business actors and roles in a business model, we would need to ask the following questions during the modeling process:

- What are stakeholders and business players that will make a difference to success of the business, and therefore should be captured in the business model?
- Who do we want to target as customers?
- What are the different roles that each participant can play?
- How should the organization position itself relative to its customers and business partners to distinguish its competitive advantage?

4.1.2 Vision and Goals

In general, business people intend to use business models[1] to capture and provide a high-level understanding of the overall vision and objectives of an organization, and it acts as a basis for communicating and aligning employees to the goals that the organization targets to achieve [Magretta02]. Hence, the organization's overall vision and

strategic goals are considered to be key elements of business models by many authors [Alt01, Magretta02, Straub04]. Moreover, [Essler01] and [Magretta02] emphasize the importance and benefits of exploring goals and values from the customer's perspective.

To build a sound business model[2] that effectively expresses and delivers the vision and objectives of an organization, the followings are essential concerns to be explored and analyzed in the business models[2] according to the authors [Magretta02, Mitchell03, Osterwalder05]:

- How to identify and express vision, business objectives, as well as new opportunities?
- What are the unmet needs of the customers? How can they be satisfied by the organization?
- How can the organization foster innovation and create stronger competitive advantage?

4.1.3 Interactivity and Flows of Resources

In addition to identifying actors and their objectives, there seems to be a common agreement among authors regarding the importance to model actor relationships, such as by means of resource flows [Timmers98, Straub04] and interactivity [Essler01].

Many authors emphasize the value in determining how to find and reach other business participants as well as what each of them would offer in exchange, especially the offering of revenue [Timmers98, Alt01, Magretta02, Straub04]. Meanwhile, [Essler01] proposes modeling actor relationships by interactivity, because in the real world consumers and other partners are actively co-producing values with the organization through various interactions; hence, this approach is more practical and flexible than the conventional one-way 'value chain' business model.

To combine the two concepts, the meta-model in figure 3 illustrates the notion of interaction channels between actors to describe the interactivity between them, and via the channels actors can exchange various types of values, such as product, service, information and revenue.

Moreover, because the ways an organization determines to handle its relationship with its customers and business partners have direct impact on its performance, the following concerns are raised in the literature regarding actor interactivity and the flow of resources, and are expected to be addressed by the business models:

- What kinds of engagement do the company has with its customers and business partners? For what objective are they serving?
- Where are the sources of revenue?
- How to explore alternate ways for an organization to interact with its customers and business partners? What values are exchanged in these interactions and what are their benefits?
- How to evaluate alternatives based on various attributes?

4.1.4 Joint Value Creation

Value creating activities are also essential information to be captured by business models according to a number of business literatures [Alt01, Essler01, Magretta02]. These activities indicate how business participants intend to create values and act to satisfy their goals, which enables the alignment between goals and activities in an integrated view through the resulting values and consequences. Several additional constructs are proposed from the authors and are introduced in the meta-model in figure 3: activities; values created by the activities; consequences of the created values [Alt01, Osterwalder05]; dependencies, such as possible risks that one is dependent on another [Magretta02]; as well as costs [Magretta02] and capabilities [Essler01] that are required to carry out the activities.

As shown in the meta-model, value creating activities have direct impact on all other parts of the business model[1], including from where the values come, what consequences follow, and whether objectives of the actors are covered in the model by created or exchanged values that contribute to their satisfaction.

To design a business model[2] that effectively captures and helps evaluate the joint value creation activities, a number of analytical questions need to be addressed in the business modeling process:

- What activities is the organization capable of performing? How do they contribute to the organization's goals?
- What are the activities customers agree to carry out for joint value creation? How do they affect the organization's other activities?
- How can value creating activities be designed or reconfigured in various ways to explore different model alternatives?
- How to compare between models? How to select the most optimal model among available alternatives?
- How can the feasibility of the business model be analyzed?
- Having modeled the organization's business objectives, how can alignment between business objectives and value creation activities be improved?
- How can the business model[2] be used to design a technical system that supports its business activities efficiently and effectively?

4.2 *i**'s Analytical and Reasoning Capabilities for Business Modeling

Based on our research, currently no existing modeling technique can address all the descriptive and analytical needs for designing and assessing business models[2] described in the previous section. We introduce the *i** framework here and explore the potential in extending this framework to accommodate the business level concepts, because as studied in [Weiss05], the goal-oriented modeling and reasoning language GRL (another name for the *i** framework) is highly suitable for expressing and supporting the analysis of business models[2]. Although the analytical and reasoning capabilities in *i** are tailored for early-phase requirements engineering, they also apply to business modeling in addressing the following types of questions:

- Why is the business model[2] designed this way?
- How would the intended business model[1] meet organizational objectives?
- How might the actors' interests and concerns be addressed?
- What alternatives exist?
- What are the implications of the alternatives for various actors?

To demonstrate the techniques *i** offers that are of interest to business modeling, we use the *Value Chain Integrator* business model as an example and explains the design and analysis process below. The *Value Chain Integrator* business model, adapted from the *Value-Chain Integrator* business model in [Timmers99] and the *Value Net Integrator* model in [Weill01] and [Straub04], is an interesting business model to study because value chain collaboration is one of the top challenges for suppliers based on a survey in 2005, and value chain integration management is becoming a good business opportunity and a strategic competitive advantage tool [IC]. Also, this model is adopted by successful companies like UPS and FedEx, who offers services to integrate the value chain between suppliers, complementors and customers.

4.2.1 Goal Analysis

One way to start the *i** modeling process is by identifying the significant business actors and representing their interests as goals and softgoals. In the *Value Chain Integrator* business model, significant participants in the value chain are: product supplier, customer who purchases the products, complementor who carries out the actual value chain tasks such as shipping and delivery, and value chain integrator who provides integration services for value chain management. Since the goal of the value chain integrator is mainly to support the needs of the customer and supplier, hence we begin by analyzing the goals of the customer and supplier. For instance, goals can be explored from the customer's perspective by asking questions such as "what does the customer want?". This follows by the objective of the customer to *own products*, as shown by the high level goal in figure 4. Also, for customers to be satisfied, they would generally like to purchase products with a *low cost* but *good quality*, and they prefer the products to be *delivered reliably* and *efficiently*. These are abstract goals and thus modeled as *i** softgoals in figure 4. Some of the goals can later be decomposed into subgoals and tasks, such as the softgoal of *reliable delivery* can be contributed by ensuring the products are on-the-way to the right address; whereas others, such as *low cost* and *quality of product*, are dependent on other actors. On the other hand, the business objective of the supplier is to *sell products*, and its success is measured by how well it *maximizes profit* by *retaining*

clients and *reducing costs*. The goal hierarchy, as shown in the internal view of the supplier in figure 4, shows how *i** allows high level abstract softgoals to be decomposed by more specific subgoals, so that ways to fulfill high level business objectives can be explored. Also, the analysis of the goal dependencies allows us to identify unmet needs and business opportunities. For instance, figure 4 indicates that the supplier has accommodated the customer's need of *good quality* products by *providing quality control*, but the need of providing *low cost* products might have been neglected.

In summary, goal analysis enables the model designer to explore overall business opportunities and vulnerabilities based on the strategic goals and relationships of various business participants. Also, high-level goals can be broken down into more specific goals to further explore and analyze how they can be achieved.

4.2.2 Task Decomposition and Means-Ends Reasoning

With *i** goals and softgoals to specify and help analyze the actor's business objectives and vision, together they provide the "why" aspect for business considerations and strategies. The next set of questions is: how business activities may be designed to achieve those goals and softgoals? Means-ends and decomposition links, as shown in the actor's internal views in figure 4, are used to discover and indicate tasks that are possible solutions to achieving the goals. This offers the reasoning of how goals are designed to be achieved, why certain business activities are introduced in the business model[2], as well as how can general business activities be decomposed into more specific tasks to guide the design of business processes. For instance, the *sell products* goal of the supplier requires several operations, including *produce products*, *handle order* and *deliver products*. However, to focus on the first two core operations, it is a common practice for a supplier to *outsource value chain operations* to *ensure fast and reliable product delivery* and *reduce cost*. These task decomposition and means-ends reasoning techniques offered by *i** enable the analysis of the implications of various alternatives, and indicate tasks that are possible solutions to achieving the goals. Furthermore, contribution links between tasks and softgoals expresses the tasks' impact on the softgoals, which help recognizing trade-offs and further guide the decision-making process.

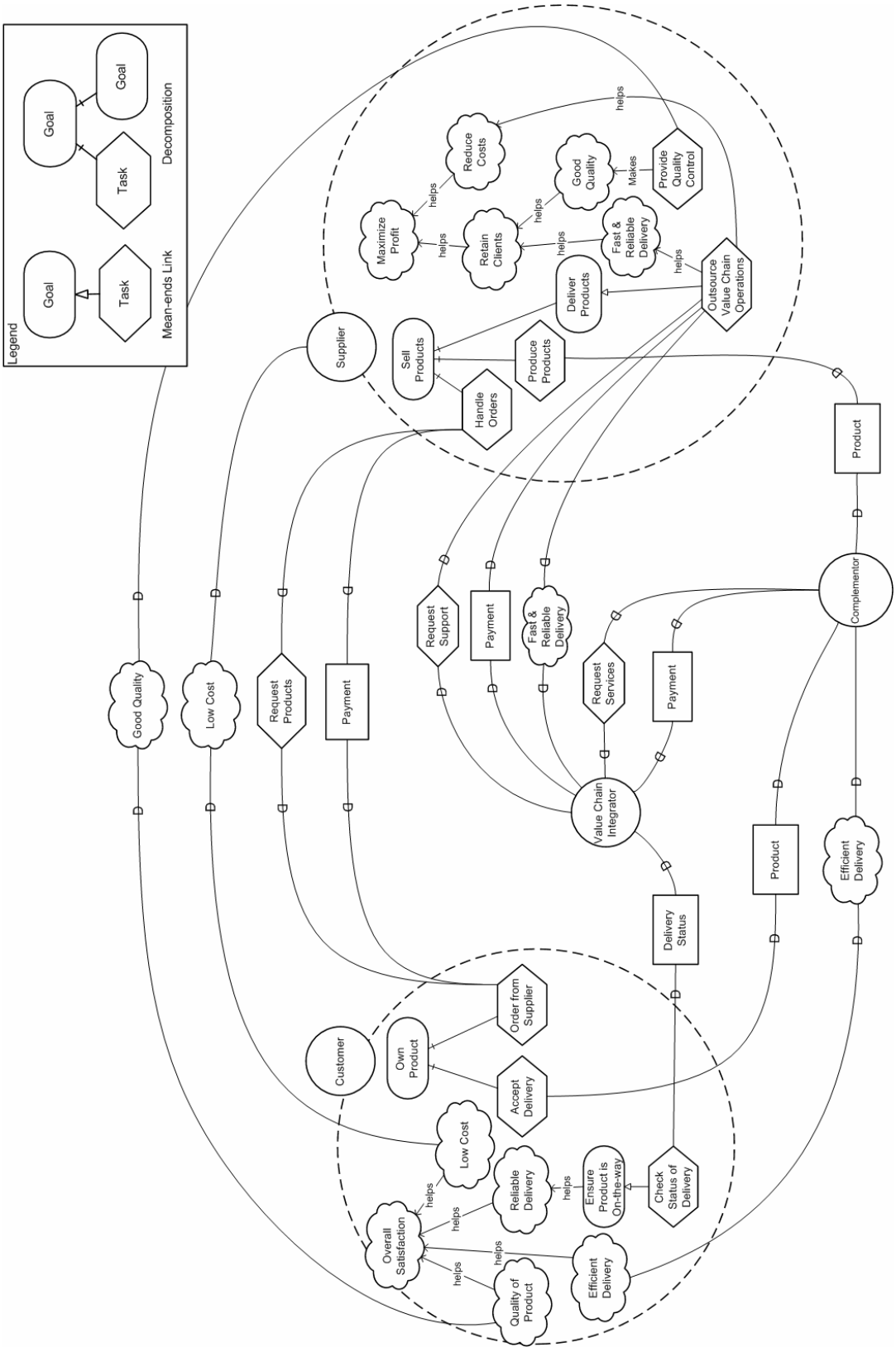

Figure 4. A conventional *i** SR model for the *Value Chain Integrator* business model.

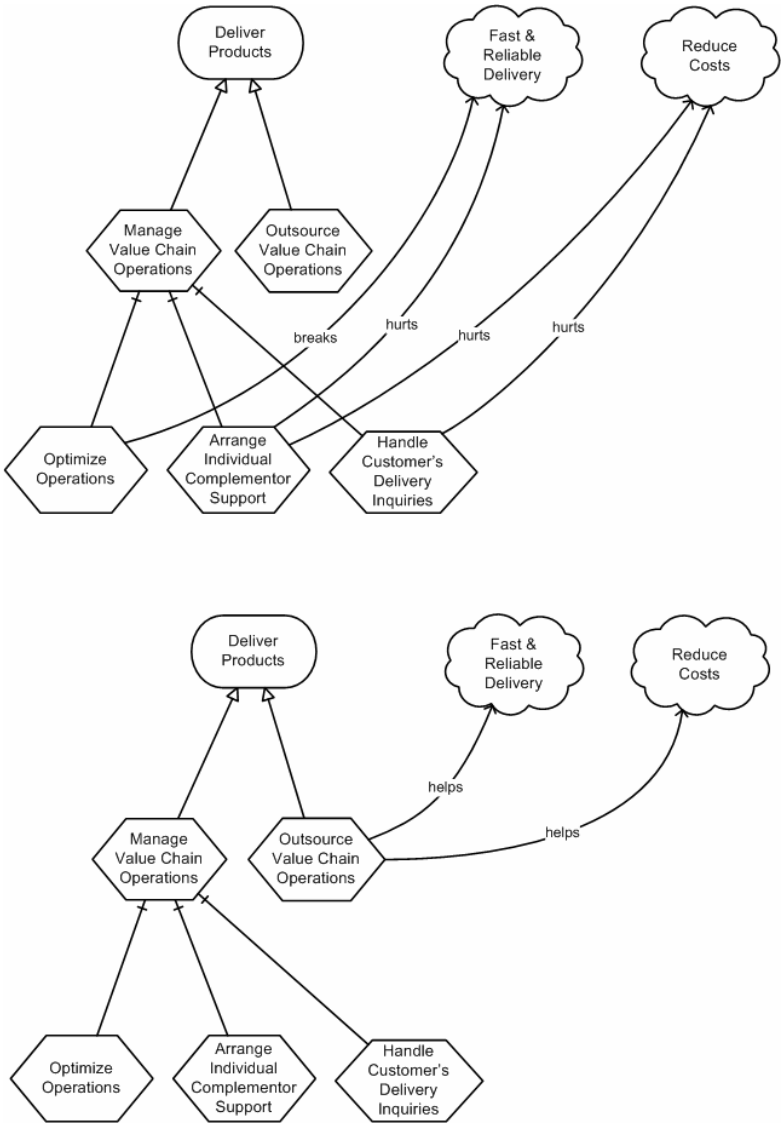

Figure 5. Exploration and evaluation of design options.

4.2.3 Alternatives Exploration and Evaluation

When analyzing the business activities, we would naturally ask: "are there other ways to satisfy a certain need?" and "which one would be a better solution?" These questions raise the need to explore various options, which is addressed by *i**'s alternatives exploration and evaluation technique using means-ends and contribution links. With means-ends links, we can illustrate the different options of achieving a goal

within the same view. In our example in figure 5, the supplier has two different choices of product delivery: managing the value chain operations itself or outsourcing. Then, using the contribution links between goals, softgoals and tasks as qualitative criteria, alternative means for achieving ends can be compared and evaluated, because an optimal solution would be one that satisfies the greatest number of goals and balances out the interests of all stakeholders. In our example in figure 5, the better choice would obviously be outsourcing the value chain operations, because the supplier lacks the expertise to optimize these operations, and extra costs would be needed to make arrangements with individual complementors and handle customers' inquiries regarding the delivery status. Later, these rationales can be used to justify why one alternative is chosen over another.

4.2.4 Feasibility Analysis

After applying the above techniques, the modeling process results with the model in figure 4, but we also need to determine whether it is feasible or not. The *i** SR model allow us to raise ability, workability and viability as issues that need to be addressed to assess the model's feasibility. If in the model an actor has a task to perform a certain routine, that means the actor has the *ability* to carry out such routine. To determine *workability* of the routine, each sub-task must be looked at and be workable for the routine to be workable. For instance, if a business intends to implement the *Value Chain Integrator* business model as a value chain integrator, it needs some system in place for handling service requests from suppliers, making service requests to complementors, as well as responding delivery status to customer inquiries. If the business does not have the ability to handle these tasks or the underlying routines are not workable, the business model will not be feasible. Moreover, workable solutions are not necessarily *viable*, but that can be analyzed in terms of *enforceability*, *assurance* and *insurance*, which are explained with details in [Yu99].

4.3 *i**'s Coverage on the Requirements for Designing Business Models

In addition to the analytical and reasoning support that *i** offers for business analysis and design, this section examines how *i** may or may not cover the four sets of requirements discussed in section 4.1, and the SR model to demonstrate this coverage is in figure 6.

Note that the *i** framework does not provide the constructs to model interactivity nor interaction channels, but these concepts are important in modeling actor relationships as explained in section 4.1.3 and [Essler01]; hence, this results in an extension of *i** that is illustrated in the legend in figure 6 where task and resource dependencies are bundled into an interaction channel to indicate the possible interactions via the channel. There is one direction for each dependency within the bundle, and one overall direction for the entire bundle that is illustrated outside of the dotted boundary line. The overall direction indicates the dependency of this interaction channel, whereas the individual directions within the bundle indicate the dependency direction for each associated task or resource. For example, the *request products* and *payment* dependencies between the customer and supplier shown in the conventional *i** model in figure 4 are modeled separately, but can also be bundled into the *place order service* as shown in figure 6. The latter case indicates that the customer is dependent on the supplier to be able to place order on the products, such as to have a phone number to call or a website to place orders online, otherwise the interaction cannot happen at all. In the bundle there are three sub-dependencies: the supplier depends the customer to *create the order*, the customer depends on the supplier to *process the order*, and at the end the supplier depends on the customer to *make the payment*. The significance of this extension is to show the overall dependency of interactivity, which helps the propagation of goal evaluation process to examine what interaction may or may not be established, and consequently determine what goals may or may not be fulfilled. The ability to bundle dependencies together also allows interaction channels to represent business services, because grouping business activities and value exchanges into business services, such that it is provided by one side and consumed by the other, better reflects business collaborations in the real world. This extension has no special requirement on the direction or the number of dependencies in

each bundle, and exchanged values are not required in either direction. Nevertheless, in cases where detailed information is not required, the bundling can be simplified by using a single task dependency as the primary dependency between the two actors, such as a task dependency *place orders* for our example, in which the sub-dependencies, such as *create order*, *process ord*er and *payment*, are implied.

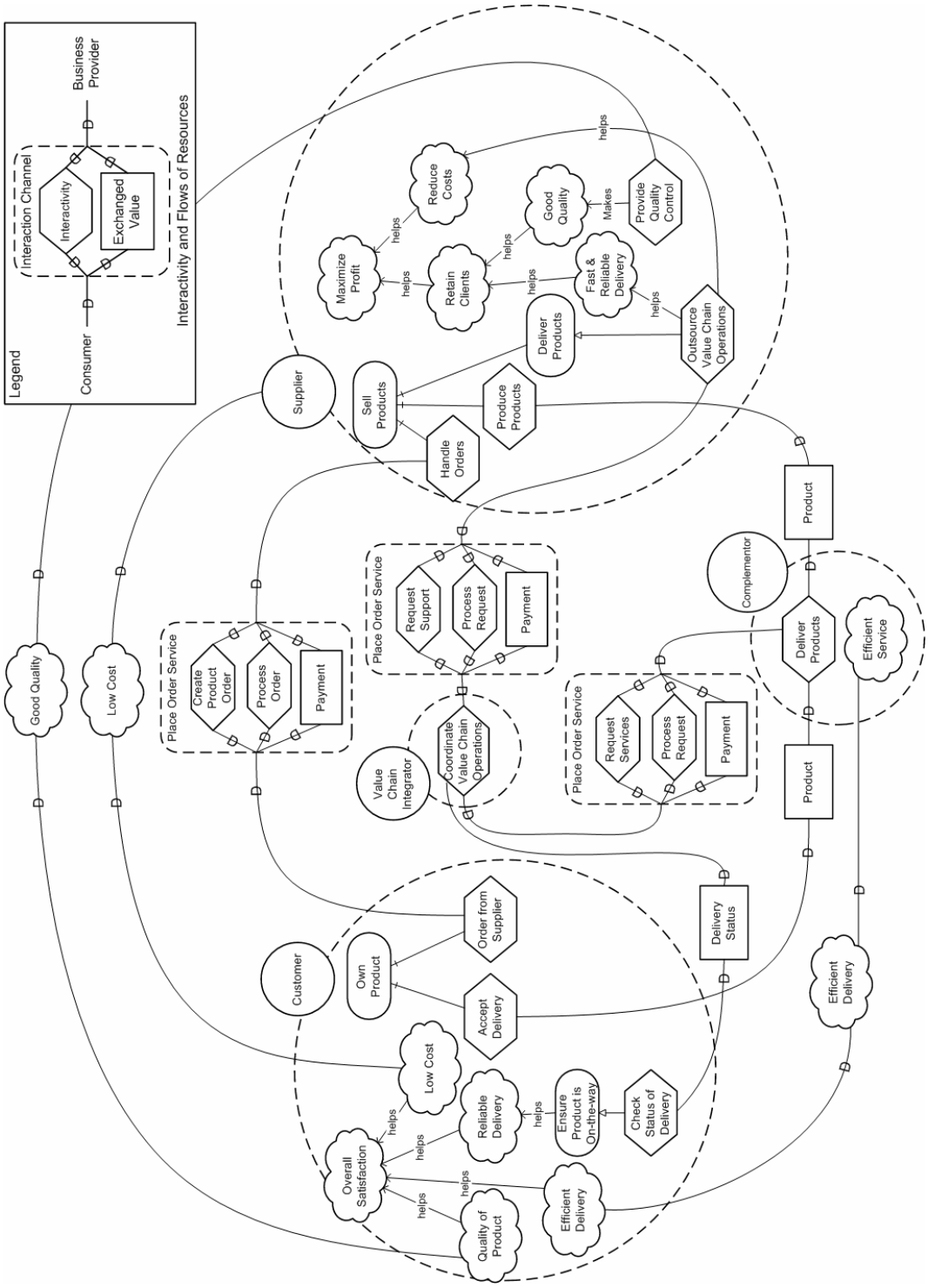

Figure 6. A modified version of *i** SR model for the *Value Chain Integrator* business model.

4.3.1 Actors and Roles

The *i** framework is well-established for modeling organizational settings with multiple participants, with modeling components including actors, agents, roles, and positions [Yu99]. Hence, actors and roles in business modeling can be appropriately represented using *i** agents and roles respectively. The relationship between a business actor and role in business models[2] is the same as that between an *i** agent and role. In the example illustrated in figure 6, because the distinction between actors and roles is not necessary, hence the business participants are modeled as *i** actors.

4.3.2 Vision and Goals

The overall vision and strategic goals of an organization can be illustrated in the internal view of the corresponding actor in an *i** SR model. Figure 6 is an example SR model that expresses the vision and business objectives of the supplier and customer as softgoals and goals. The top level softgoal and goal can be viewed as their overall vision, while the goals and softgoals in the lower levels are its strategic goals to pursue this vision. For instance, a supplier generally has a business vision of maintaining profitability by selling its products, and this vision may be broken down into sub-goals *retain clients* and *reduce costs*, as shown in the figure. Furthermore, the *i** models not only show the vision and strategic goals, but also illustrates the relationships and contributions between one another.

4.3.3 Interactivity and Flows of Resources

The relationships among actors in *i** are modeled using dependency links, and each can be expressed in terms of a goal, softgoal, task or resource dependency. An extended version of *i**, as shown in figure 6, is used to express interactive channels as business services, because businesses are turning toward decomposing their operations into *business services* to build agility and reusability into their business models as described in [Erl05], and grouping business collaborations and value exchanges into business

services better reflects business collaborations and transactions in the real world. Therefore, we view each interaction channel as a business service that is provided by one side and consumed by the other.

In addition, although *i** only offers qualitative description for the flows of revenue, and does not support a detailed revenue model, this limitation can be resolved through the combined use of the *i** and *e*^{3}*value* frameworks as studied in [van der Raadt05a,b].

4.3.4 Joint Value Creation

Since value creation activities are carried out by individual actors, they can be represented by *i** tasks in the internal views of actors in an SR model. These *i** tasks may lead to various tasks or resources that are exchanged with business partners via the interaction channels, which consequently illustrates how business activities create and exchange values between one another. Although the *i** framework does not provide constructs to model the consequences as a result of the created values, this concept is implied using the positive or negative contributions of tasks to goals and softgoals. Dependencies, such as opportunities and vulnerabilities, can be modeled as goal or softgoal dependencies as shown in figure 6.

4.4 Discussion

The purpose of this section is to explore the potentiality of the *i** framework in addressing the needs illustrated in 4.1 as a technique for modeling business models[2]. This work is significant because in order to further analyze the effectiveness of business modeling in guiding technical system design, first we need a sound modeling technique to design and analyze business models[2], as well as a clear representation to express business level concepts which will later be used for aligning with technical design components and composing a reference catalog.

The evaluation in the previous sections shows that *i** offers several analytical and reasoning techniques that are relevant for business models analysis and design, including: goal analysis, means-ends reasoning, task decomposition, alternatives exploration and

qualitative evaluation, and feasibility analysis. Also, it has well-established notation to model organizational actors and roles, strategic goals, and relationships among the network of domain participants, which are all essential components of a business model[1].

The evaluation results are organized in table 2, in which the *i** framework is compared with other existing business modeling techniques. The requirements on the first column are extracted from section 4.1, and the modeling techniques are the ones introduced in section 3.2. As shown in the table, the *i** framework provides a relatively complete set of model constructs required by business models, especially the intentional elements that are needed for designing and analyzing the business vision and goals. The comparison also indicates that only the *i** framework offers support to most of the analysis and evaluation needs of business models.

One limitation of *i** in business modeling is that it does not support a detailed revenue model with quantitative cost/benefit analysis, but this is addressed by a research on combining the *i** and *e*^{3}*value* frameworks to explore alternatives from a business perspective [van der Raadt05a,b].

Results from this chapter indicate that a lot of the design and analysis needs in business modeling are not addressed by existing modeling techniques, while the *i** framework appears to respond to many of those needs. In the next chapter, we will use this framework to build and analyze our business models, and explore how these models can help guide the design of a service-oriented IT solution.

Table 2. Comparison among existing business modeling approaches.

Modeling approaches / **Requirements**	UML	BMO	BMM	*e³value*	Value Network Approach	*i**
Descriptive concepts						
Actors and roles						
• Business participants	✓	✓	✓	✓	✓	✓
• Target customer		✓		i	✓	i
• Multiple actors in the same view				✓	✓	✓
• Distinction between an actor and its roles	✓		✓			✓
Vision and goals						
• Business vision	✓		i			✓
• Stakeholder goals	✓		✓			✓
• Customer goals						✓
Interactivity						
• Flow of resources	✓	✓		✓	✓	✓
• Stakeholder interactions						✓
• Flow of revenue		✓		✓	✓	✓
Joint Value Creation						
• Business activities	✓		✓	✓	✓	✓
• Created values	✓	✓		✓	✓	i
• Consequences				i	✓	i
• Dependencies						✓
• Costs of activities		✓		i	i	
• Capabilities		✓				✓
Design and analysis capabilities						
Vision and goals						
• Achievement of goals	✓					✓
• Exploration of unmet needs/new opportunities						✓
Interactivity						
• Analysis of interactivity						i
• Revenue model analysis		✓		✓	i	
• Alternative exploration and evaluation						✓
Joint Value Creation						
• Objective coverage	i					✓
• Capability analysis						✓
• Alternative exploration and evaluation				✓	✓	✓
• Alignment between objectives and activities	✓					✓
• Support for technical system design	✓		✓			✓

✓ - Supported i - Implicit representation

Chapter 5 Toward an Expandable Reference Catalog

5.1 Objective and Approach

To maintain the alignment of IT solutions with the business level concepts, while being able to respond quickly to new business strategies, is considered to be an ongoing top priority to enterprises, especially to those who relies on technology to remain competitive in the market.

To address this need, people from both the business and IT communities have proposed using the principles of SOA to analyze and design business operations as a set of discrete processes and services. However, to improve the design and analysis process over time, it is important to capture repeatable solutions and be able to apply them to similar problems in the future [Endrei04].

In section 2.3, we have already indicated the importance of business modeling to service-oriented system design. In this chapter, we will look at how alignment between the two can be realized by maintaining an expandable set of reference business models, and how the reusable components associated with these models can provide design suggestions and rationales for the technical design process. The technical design methodology used here is Tropos [Bresciani04, Tropos], because it is an extension of *i** and provides systematic transformation techniques from *i** models to architectural and detailed design models. Also, it has been adopted for designing Web services [Lau04] and deriving business processes [Kaz04, Lau05].

Our approach is to express and capture recurring business models[2] and patterns in an expandable reference catalog, which consists of two parts: a set of reference business models and a set of business service patterns. The purpose of this separation between reference business models and business service patterns is that business service patterns often recur in business models[2]; hence this separation will avoid duplicate entries of business service patterns.

The following sections will further describe the set of reusable, structured and connected model components that are provided in the proposed reference catalog. A sample catalog can be found in the appendix of this thesis.

5.2 Reference Business Models

A reference business model, as defined in [Alt01], is a model that provides a generalized representation of a business model[1]. It can be referenced or used as a basis for adaptation to the business of a specific company.

Table 3 below shows an expandable set of reference business models that can be included in the reference catalog. Each of them represents a particular way of conducting business, so that companies wishing to implement a particular business model[1] similar to the ones expressed in the catalog can retrieve the reusable model components from it to aid its business and technical system design process. An example reference catalog containing the details of these reference business models can be found in the appendix. These models are adapted from the set of e-business models proposed in [Weill01] and [Straub04], but are revised so that there are neither assumptions nor restrictions in the use of e-business technologies. This is only a sample set of reference business models, which is not intended to be complete and is expected to evolve over time as more data is collected from empirical research in the industry. Some other works, including [Timmers99] and [Rappa03], also defined taxonomies of e-business models, but since limited information is provided in the literature, those are currently not included in the sample catalog. Nevertheless, we believe people in the business community who has expertise in business models[1] would have no problem in adding those required details, therefore our approach would not be limited to the models proposed in [Weill01] and [Straub04]. The information required to construct a reference business model in our catalog is listed later in this section.

To maintain a scalable catalog as the number of reference business models grows, while preserving its ease to navigate, one suggestion is to organize the models into a hierarchical tree, such that users can traverse the tree to search for appropriate models based on common model attributes. This strategy can be applied when we have more entries in the catalog in the future.

Table 3. A sample set of reference business models.

No.	Reference Business Models
1	Direct-to-Consumer
2	Full-Service Provider
3	Intermediary
4	Shared Infrastructure
5	Value Chain Integrator

5.2.1 Reference Model Template

In the reference catalog, each reference business model is introduced by a set of general descriptions listed and described in table 4, of which some are required and others are optional as indicated by the last column. The required information, such as the business drivers, solution, advantages, key business actors and strategic dependencies, is necessary to construct the *i** business models[2] and to analyze the model components properly. This set of general descriptions also help users to find reference business models from the catalog that best fit their purpose by providing essential information such as business drivers that motivate the use of the reference business model, potential advantages, challenges and limitations. For instance, the *Value Chain Integrator* reference model would have the descriptions as shown in figure 7.

Table 4. Attribute names and descriptions for the business models.

No.	Attribute Name	Attribute Description	Required
1	Name	A unique name to identify the model in the reference catalog.	X
2	Summary	A brief description of the reference business model.	X
3	Key business drivers	The major issues that motivate the use of this model.	X
4	Solution	Description of how this model solves the issues listed as the key business drivers.	X
5	Potential advantages	A list of potential advantages that this model targets to deliver.	X
6	Challenges and limitations	A list of challenges and limitations that might be caused by the implementation of this model.	
7	Key business actors	A list of key business actors that are involved in this model, and their roles.	X
8	Strategic dependencies	Strategic dependencies between the different business partners.	X
9	Revenue model	A description of how business participants can	

		generate revenue by participating in this model.	
10	Related model(s)	Other reference business models that is similar to this model.	
11	Source(s)	The source where this model is defined or proposed.	X
12	Example(s)	Examples of model usage in the real world.	

1. **Name:** The *Value Chain Integrator* Reference Model

2. **Summary:** This model involves four types of actors: supplier, customer, complementor, and the value chain integrator. It enables the supplier to focus on its core competence by outsourcing its value chain operations. It also allows the value chain integrator to take advantage of its central position among the suppliers, customers and complementors, and coordinates tasks in the value chain operations.

3. **Key business drivers:**
   - Increasing complexity in coordinating of value chain operations
   - Financial/cost pressure on suppliers/manufacturers
   - Increasing speed and reliability expectations from customers

4. **Solution:** Physical actions are performed by the suppliers and complementors, but the coordination tasks are outsourced to the value chain integrator. Suppliers and complementors can focus on their core competences, while the value chain integrator specializes in managing information and the flow of goods and services.

5. **Potential advantages:**
   - Reduced costs in handling value chain operations
   - Streamlined and accelerated value chain
   - Enhanced visibility throughout the value chain
   - Fast and reliable delivery
   - Improved customer satisfaction

6. **Challenges and limitations:** Increased need of technology for facilitating efficient communication and information management.

7. **Key business actors:**
   - Supplier – The product supplier who out-sources its value chain operations to the value chain integrator.
   - Customer – The customer who orders products from the supplier.
   - Value chain integrator – The agent who helps the supplier to coordinate tasks in the value chain operations and manage information and resource flows among the supplier, complementor and customer.
   - Complementor – The agent who carries out the actual tasks that are out-

sourced by supplier, including the shipping or delivery of products.

8. **Strategic dependencies:** The supplier is dependent on the customer to create product orders. The value chain integrator depends on the supplier to request value chain operation support. The complementors depend on the value chain integrator to request its services. The customer is dependent on supplier to offer products with good quality and a low cost, but the actual delivery would come from one of the complementors.

9. **Revenue model:** Revenue flows from customer to supplier, from supplier to value chain integrator, and from value chain integrator to the complementors.

10. **Related model(s):** *Intermediary*

11. **Source(s):** Adapted from the *Value-Chain Integrator* model proposed in [Timmers99] and the *Value Net Integrator* model in [Weill01] and [Straub04].

12. **Example:** UPS Trade Direct℠, which acts as a value chain integrator that arranges transportation and freights for product delivery for consumer product manufacturers such as Adidas and Nikon.

Figure 7. General descriptions for the *Value Chain Integrator* reference business model.

Furthermore, each reference business model is composed of the following model components:

- an ***i** SD business model**;
- an ***i** SR business model**;
- a set of **business services** identified in the SR business model, each associated with a business service pattern; and
- an **extended actor diagram** showing the architectural structure of the set of IT services and other subsystems.

These model components are pre-analyzed and generic, which are effective tools for the representation and analysis of business concepts. The associated business services and design models are also useful in the later stages of the technical design and development process. In the following sections, we will describe in more detail each type of these model components by using the *Value Chain Integrator* example.

5.2.2 *i** SD Business Model

The *i** SD business model provides a graphical representation of the reference business model, indicating the business actors, business goal dependencies, business collaborations and value exchanges. An example SD model for the *Value Chain Integrator* reference model is shown in figure 8 below. Note that this can be generated from the *i** SR business model by simply hiding the internal views of each business actor. For in-depth analysis, it is better to use the SR view; however, for business model designers to choose a suitable reference business model to start with, this SD view is easier to compare by hiding extra details.

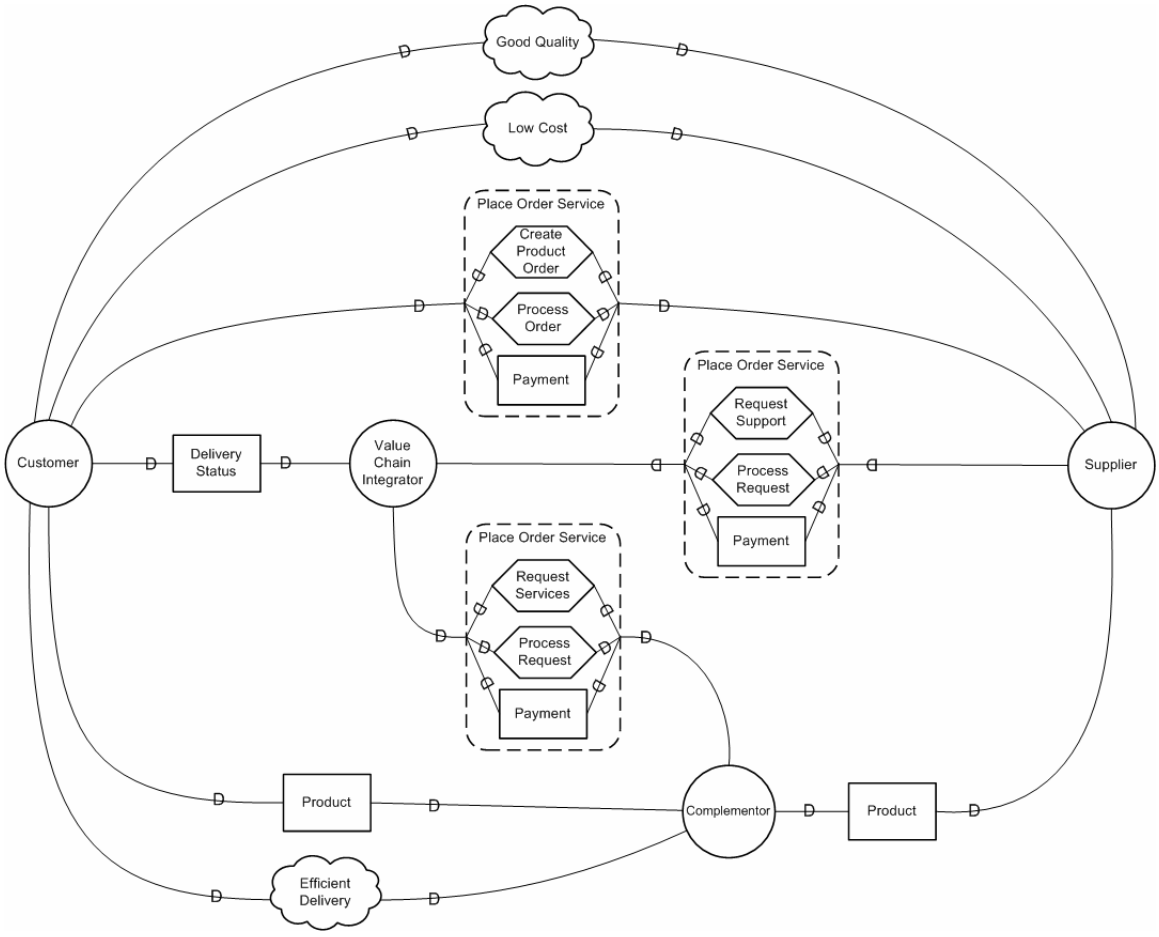

Figure 8. An example SD model for the *Value Chain Integrator* reference business model

5.2.3 *i** SR Business Model

The *i** SR business model provides a more comprehensive graphical representation of the reference business model, indicating the internal business objectives and activities of business actors. As illustrated in chapter 4, this model can be designed and analyzed using techniques offered by the *i** framework. Therefore, business model designers can refine a reference model for a particular business under question by modifying goals, tasks and dependency relationships, and analyze it more extensively using *i** techniques to explore and evaluate various design options. An example SR model for the *Value Chain Integrator* reference business model, which is the model pre-analyzed in chapter 4, is shown in figure 9.

5.2.4 Business Services

Each reference business model also comes with a set of business services, which are identified from the SR business model. They are organized in a table as shown below, in which each row links to a business service pattern in the second part of the catalog. As explained earlier, the purpose of this separation between reference business models and business service patterns is that business service patterns often recur in business models[2], such as the *Place Order Service* listed below, hence referencing to patterns in a separate section will avoid duplicate entries and increase reusability of model components.

Then, for each business service that is identified from the SR models, model designers may use the corresponding business service pattern and associated collaboration diagrams to further analyze and design how their specific service will be carried out, while guided by design options and rationales that are collected from previous experience or other experts. More details on business service patterns will be provided in section 5.3.

Table 5. Business services found in the *Value Chain Integrator* reference business model.

Service in SR model	**Requester**	**Provider**	**Business Service Pattern**
Place (Product) Order	Customer	Supplier	Place Order Service
Place (Service) Order	Supplier	Value Chain Integrator	Place Order Service
Place (Service) Order	Value Chain Integrator	Complementor	Place Order Service
Request Status	Customer	Value Chain Integrator	Obtain Data Service

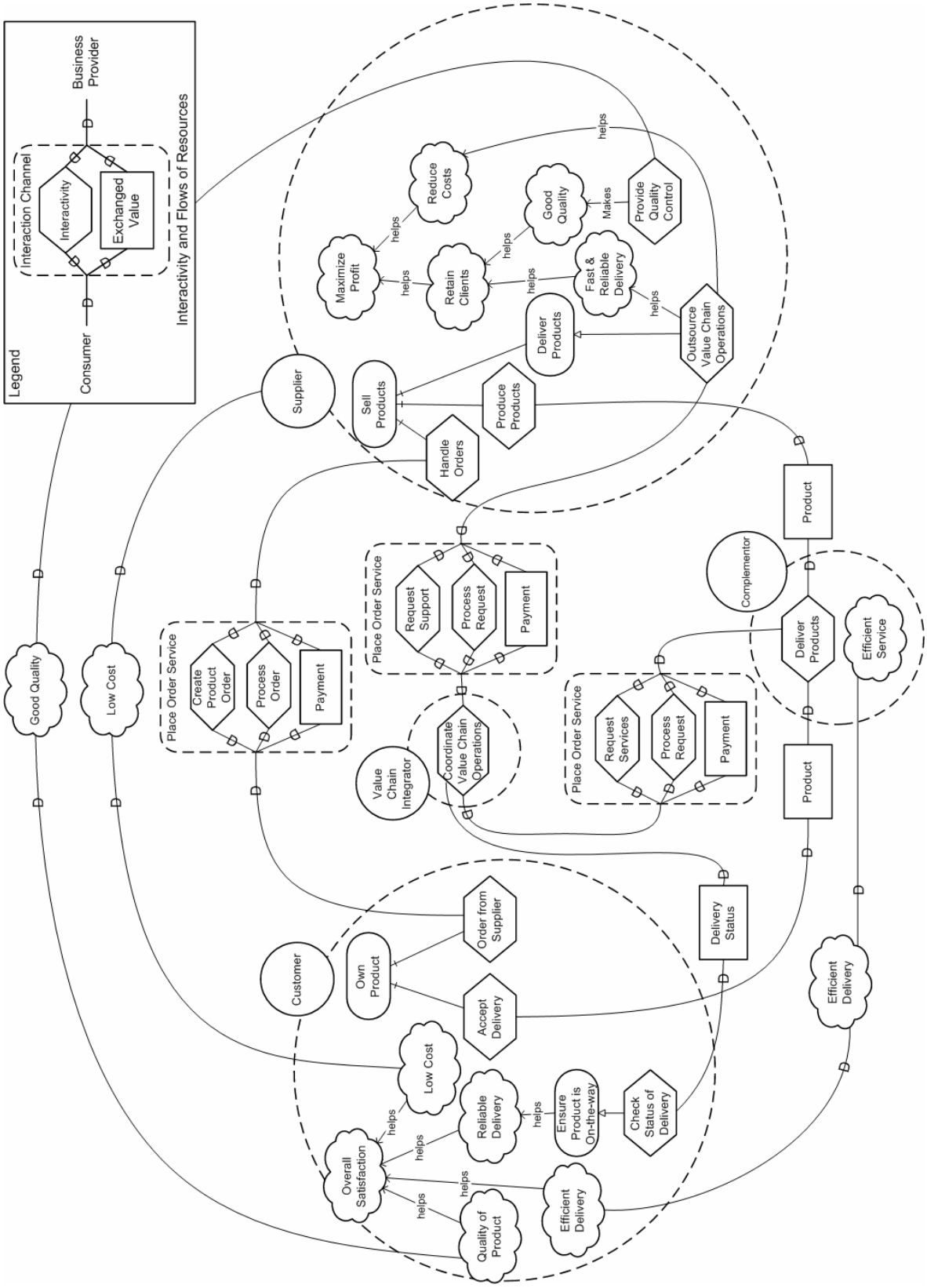

Figure 9. An example SR model for the *Value Chain Integrator* reference model.

5.2.5 Extended Actor Diagrams

We then use an extended actor diagram to illustrate the IT services or subsystems that each business actor needs for the business model to work. This diagram can be generated using the Tropos methodology as described in [Lau04]. As shown in figure 10 below, the actor diagram illustrates the architectural structure of the technical system that needs to be implemented by the business actor *Supplier*. It also guides the identification of IT services that it should provide, i.e. the *Place (Product) Order* service. Examples of extended actor diagrams for the other business actors can be found in the appendix.

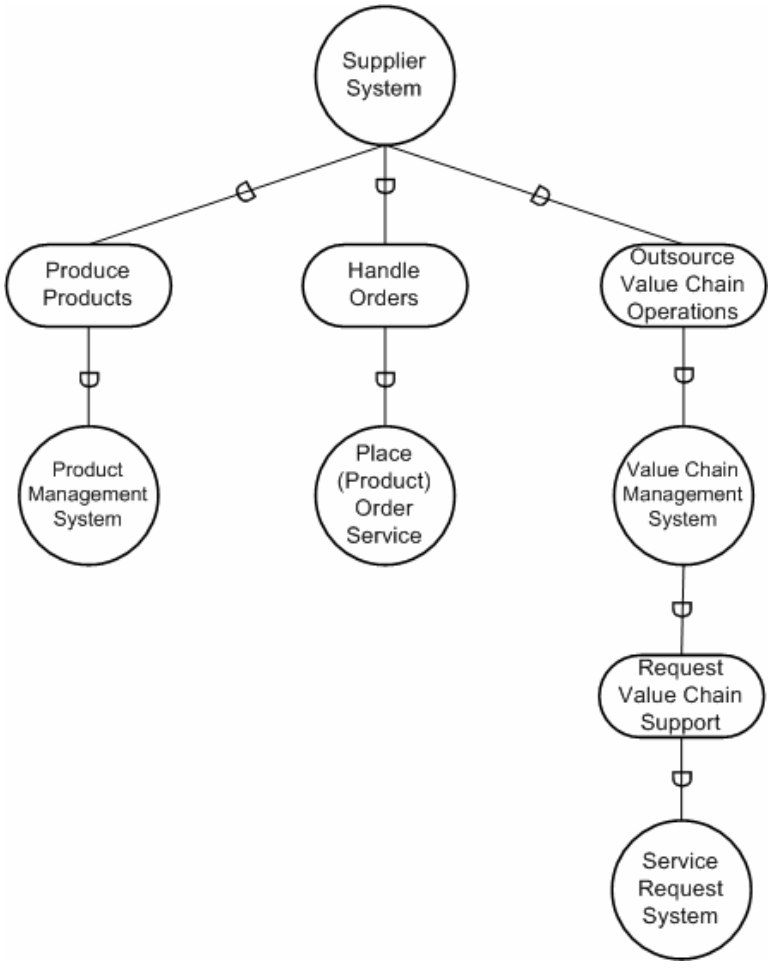

Figure 10. An extended actor diagram for the *Supplier* actor.

5.3 Business Service Patterns

The second part of the reference catalog contains a set of business service patterns, and each business service pattern comes with the following components:

1. A diagram illustrating the recurring business service
2. Design rationales, if any
3. One or more derived business collaboration diagram
4. One or more business process model that corresponds to the business collaboration diagram, if such collaboration can be automated using IT services

These components capture common patterns of dependencies and collaborations between business partners, as well as provide design alternatives and reasoning to help analysts design strategic business services that will benefit them in their specific case. These components are described more in detail in the following sections.

5.3.1 Business Service Pattern Diagram

When a recurring business service is found in the *i** business models, it is captured and added to the reference catalog as a business service pattern in terms of generic business actors, such as service consumer and provider, and generic dependency relationships. For instance, the *Place Order Service* recurred several times in the *Value Chain Integrator* model, and therefore is specified as a service pattern in the catalog with the diagram in figure 11 below. This diagram captures the business actors that are generally involved in the business service, as well as the high-level collaborations between them.

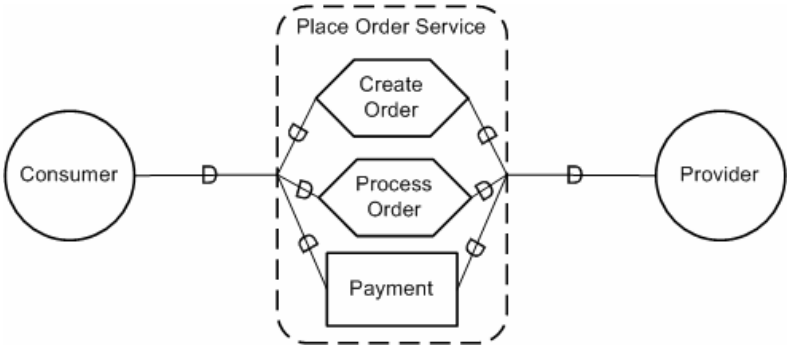

Figure 11. A recurring service pattern found in the *i** business models.

5.3.2 Design Rationales

Design options may also be recorded in the *design rationale* section under the *service pattern* section, because each business service can be designed in a variety of ways, thus entries of the design options and their rationales will be helpful when designing the same or a similar business service again in the future. One of the design options we have in our example is consumer's payment method, and they are listed in table 6 below.

Table 6. The payment options that are available for the *Place Order* service pattern.

	Design options	Intentions or concerns
1	*Pay-per-use* (immediate payment)	Fees are incurred according to the usage rates, and payment must be made at the time of usage.
2	*Pay-per-use* (periodic invoice)	Fees are incurred according to the usage rates, and fee statements are sent to the user periodically.
3	*Subscription-based*	Users of the service are charged periodically, such as daily, monthly or annually, and the subscription fees are incurred irrespective of actual usage rates.

5.3.3 Business Collaboration Diagrams

There is at least one business collaboration diagram for each business service pattern to illustrate the sequence of business activities and resource exchanges involved in the service. Each one of them can be generated based on the method described in [Kaz04], where the task originating or receiving the service request is decomposed into more specific tasks performed in sequential order, and the interactions between business partners are shown as resources or transaction messages being transferred between them.

Note that the Business Process Modeling Notation (BPMN) can replace the approach we use here, because BPMN also supports the modeling of activity sequence flow and the generation of executable BPEL processes [White05]. However, we use the method proposed in [Kaz04] here, because it is based upon the Tropos methodology and shares the notation used in our *i** models and service pattern diagrams. Also, as explained in the original work, this method allows intentional elements to be shown in the same

view as the business collaboration activities for analysis, and supports verification of the business processes using the T-Tool [Kaz04].

Given the recurring *Place Order* service pattern shown in figure 11, for example, we can derive a business collaboration diagram by elaborating on the *create order* and *process order* tasks. As shown in figure 12, the *Place Order* service is invoked when the consumer creates an order request and sends the order details to the provider. Then, the provider would process the order by performing common tasks such as validating the request, processing payment information, and finally delivering the requested goods or services. This business collaboration diagram assumes consumers are charged on a pay-per-use basis, but another diagram can be added to the catalog to illustrate the subscription-based scenario.

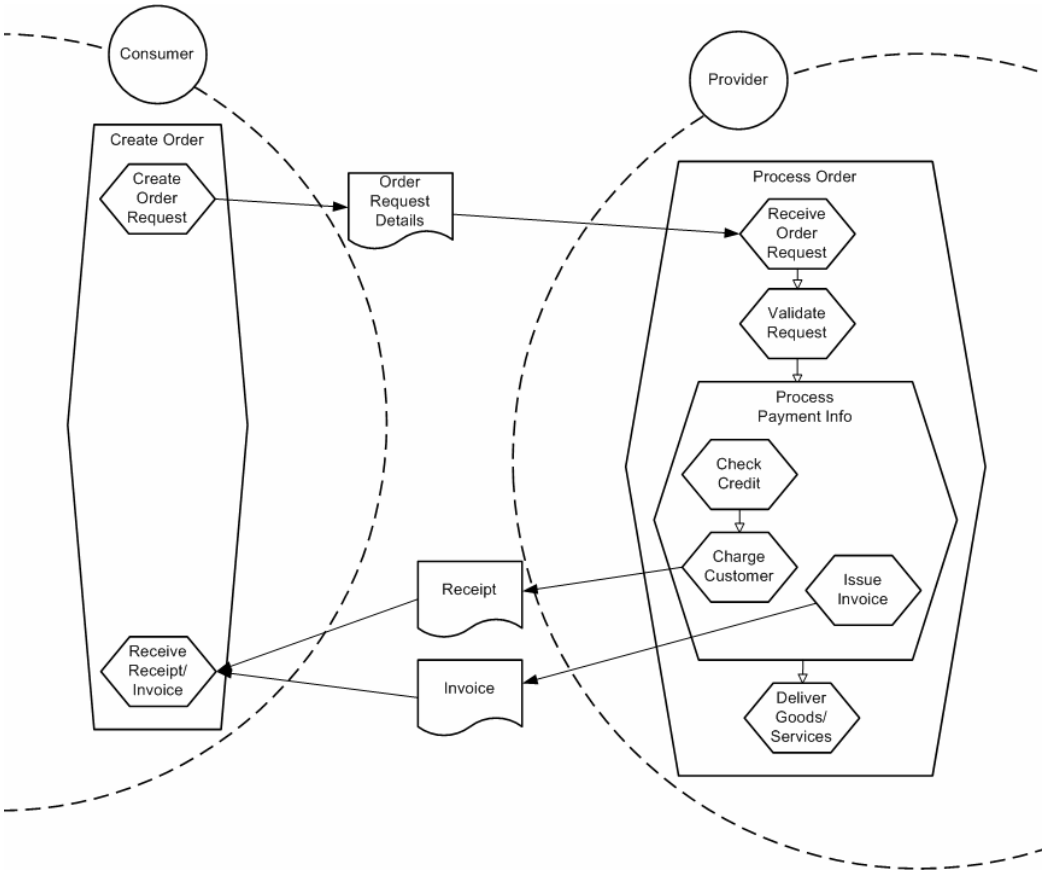

Figure 12. A business collaboration diagram for the *Place Order* service pattern.

5.3.4 Business Process Models

The business collaboration diagrams described in the previous section are useful for analyzing the activities and exchanged values involved in specific business collaborations, whereas the business process models in this section are useful for generating process definitions that can be implemented and executed via IT service orchestration engines. Also, since IT services are defined to support business processes, understanding the business processes is essential.

The mapping between a business collaboration diagram and a business process model depends on whether such business collaboration is appropriate for automation via IT services, because some collaboration activities, such as the delivery of products, can only be done manually. In our example, since order details can be defined, stored, and delivered electronically, the *Place Order* process can be automated using IT services, and its process model is illustrated in figure 13. These UML process models can later be transformed into standard definitions (e.g. WS-BPEL) using a UML to BPEL translator such as the one introduced in [Mantell05].

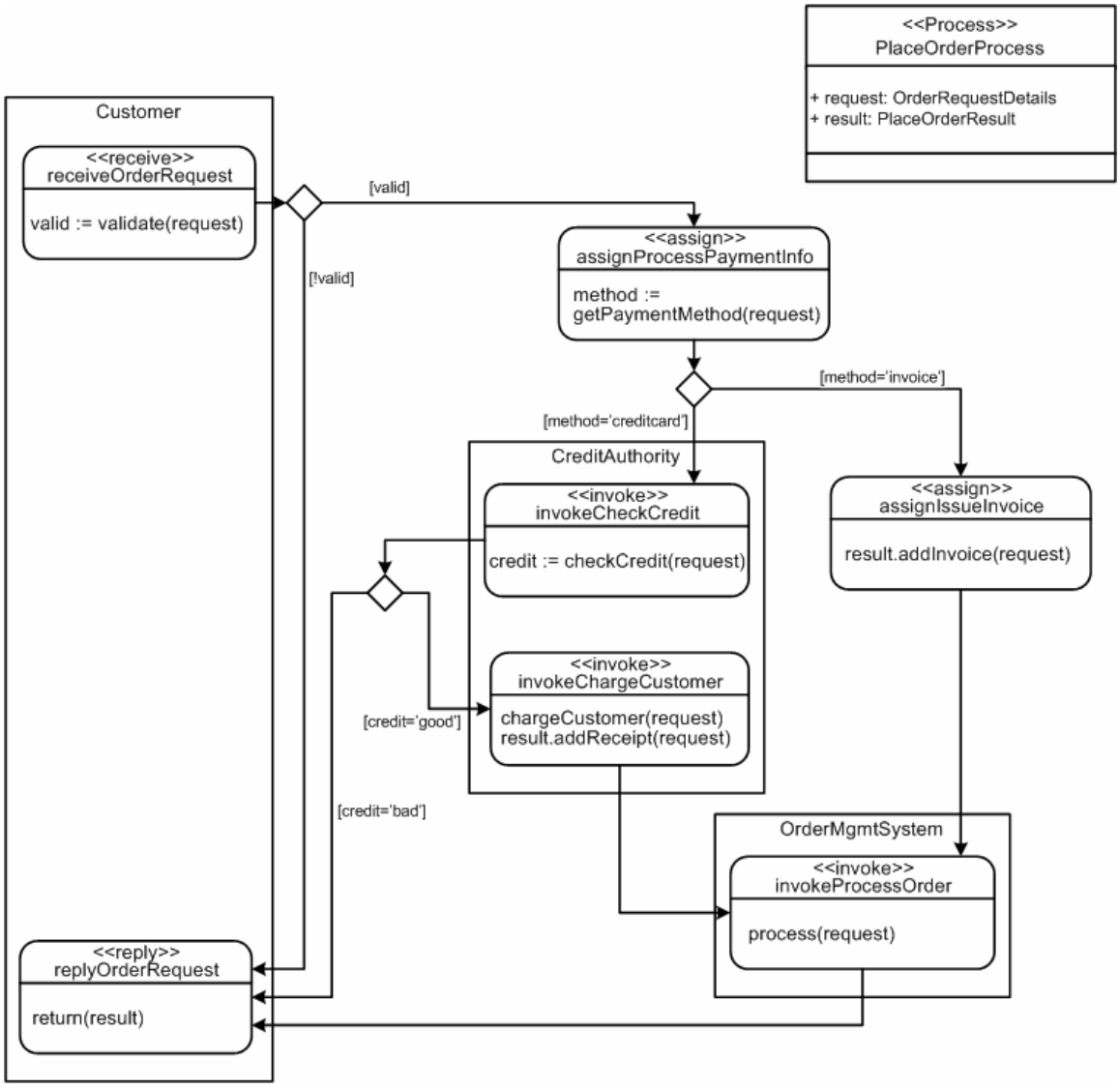

Figure 13. A business process model for the *Place Order* process.

5.4 Quality Control Guidelines

The reference catalog proposed in this thesis is intended to be expandable and will evolve over time, therefore it would be beneficial to keep it public and allow other business model users to add and modify the catalog entries. However, to keep a public catalog, we need some guidelines to help users to evaluate and maintain the quality of the reference business models.

Here we propose a set of guidelines that would assist users to assess and control the quality of the models in terms of traceability and completeness:

1. Reliable sources, e.g. some business literature on business models[1], must be provided for each model entry as indicated in the reference model template, so that users can check where the business model[1] is originally proposed.
2. Information should be traceable between the set of general descriptions and elements in the *i** models. For example, the business actors and strategic dependencies listed in the text descriptions should be found in the *i** models. However, more information is likely to be found in the *i** models as a result of the analysis and design process.
3. The services listed in the business services section for each model entry should be identical to the ones generated from the analysis process in the *i** SR models.
4. Recurring business services that are listed in the reference business model section should be found in the business service patterns section, so that users can look up the corresponding diagrams to guide their business collaboration and technical design.

These are the suggestions we have so far, and they can be used as the criteria to perform quality checking and to evaluate the completeness of the reference business model components.

Chapter 6 Application of Approach to a Real World Case Study

6.1 Overview of Procedure

In this chapter, we will look at a real world case study and use our approach to analyze its business problems. We will then design a technical solution for the company in question by reusing design knowledge from the reference catalog.

Figure 14 summarizes the procedure of adapting a reference business model from the reference catalog to a specific case. The process begins by selecting a reference business model from the reference catalog based on business drivers that relate to the company's specific needs. Then, to decide whether a reference business model is an appropriate one to start with, we assess the potential advantages of implementing the model as well as the challenges and limitations it may bring. Once a reference business model is selected, we instantiate *i** SD and SR models from the reference models, and refine them based on the company's characteristics and design decisions. The refinement process can be guided by design rationales recorded in the reference catalog from previous cases. Next, business service patterns are extracted from the *i** models. They are further designed and analyzed using business collaboration diagrams, either to be created or derived from the existing ones in the reference catalog. Then, potential IT services are identified from the set of business services, and for each of them, business process models are designed. The set of IT services, described in an extended actor diagram, along with the corresponding business process models will then be passed to the technical design and development process. Lastly, new model components and design rationales generated during the process will be added back to the catalog for future reference.

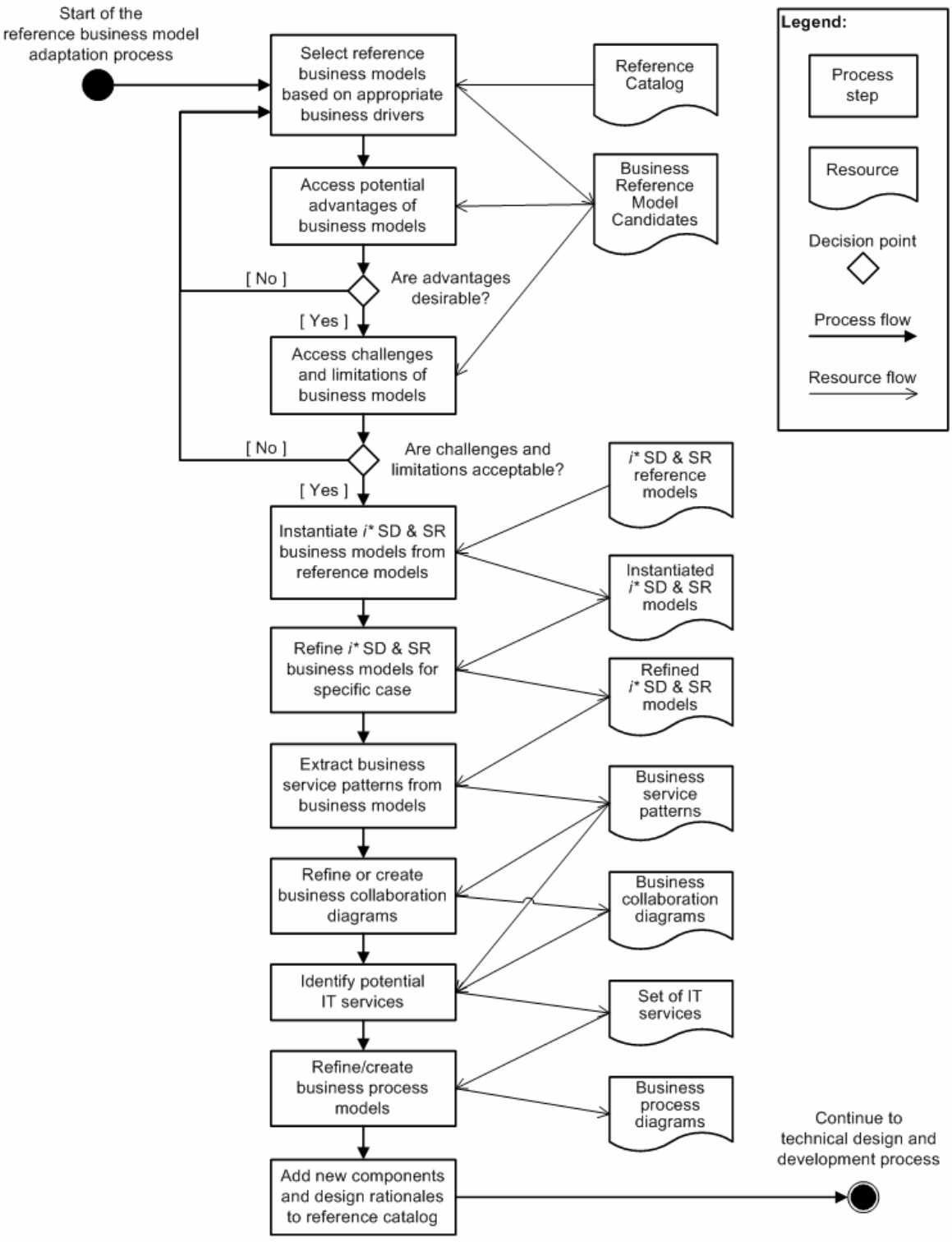

Figure 14. Flowchart showing the procedure to adapt reference business model components to a specific case.

6.2 Overview of Case Study

The case study we use in this chapter originates from [Chong05], which studies the design process of a real-life solution that solves the business problems of a company named Northern Electronics. The main objective of the company is to improve its product shipping process in terms of efficiency and reliability. This includes being able to communicate with transport consolidators to coordinate activities and handle problems more effectively and efficiently through the use of information technology, but without having to agree on the vendor technology with the transport consolidators. Also, the executives prefer to have a solution that is reusable and able to establish flexible connections, so that it can coordinate with more transport consolidators in the future without incurring extra costs. A natural solution to meeting these needs is to implement the SOA with Web services.

In the following sections, we will look at how our approach aids the analysis and design of the company's business model and the aligning technical solution. Then, we will evaluate the effectiveness of our approach by comparing with the design process and resulting solution proposed in [Chong05].

6.3 Potential of Guided Design via Reference Model Components

6.3.1 Business Model Instantiation

Our approach begins with the selection of a reference business model that is similar to the business model implemented by Northern Electronics. Since the shipping process of Northern Electronics is outsourced and managed by a transport consolidator, it needs a business model that involves a business actor who coordinates the value chain operations for the supplier and customer. In addition, the company's major business goals in the case study include improving the efficiency and reliability of the shipping process. Since only the *Value Chain Integrator* business model matches these two criteria, it is chosen as the reference model for this company.

The next step is to instantiate *i** SD and SR business models for this specific case. Figures 15 and 16 are showing the original SD and SR models of the reference business

model, whereas figures 17 and 18 illustrate the refined SD and SR models for the case study. The refinement process of these models requires the application of the *i** analysis and reasoning techniques described in section 4.2:

1. Goal analysis: This involves the addition of missing business goals that are relevant to our specific case, as well as the removal of goals that are irrelevant but given in the original model. Once the high-level goals are determined, they can be decomposed into more specific subgoals as appropriate.

2. Task decomposition and means-ends reasoning: Tasks in the original models are examined to see whether they are relevant to the business goals of our specific case. Irrelevant tasks are removed, and new tasks are added for goals that have not been addressed. Also, given more details in our scenario, some tasks can be decomposed into more specific subtasks. For instance, Northern Electronics separates its *outsource shipping* task into three different processes: *request shipping support*, *get products ready*, and *confirm pickup*. Therefore, this *outsource shipping* task is decomposed accordingly in the SR model. To further illustrate the current task and resource dependencies among the three departments of the company, we added three roles that the company plays: sales/shipping agent, warehouse, and loading dock.

3. Alternative exploration and evaluation: As described in section 4.2.3, the *i** framework supports the exploration and evaluation of various design alternatives in achieving the same set of business goals. Since the goal of Northern Electronics is to improve its product shipping process, which requires more efficient and effective communication with its business partners, we will explore design options for it at the business and IT services level in the next section on *Service Identification and Design*.

4. Feasibility analysis: To verify that the instantiated business models are feasible, we analyze the refined SR model using the evaluation propagation rules defined in [Horkoff06]. It not only offers the checking of capability issues, semantic errors or inconsistencies, but also allows the designer to discover any unintentional omissions or misrepresentations of important business concepts after refining the business models. Figure 19 shows the refined SR model with qualitative evaluation labels, indicating evaluation results such as satisficed, conflict, unknown or denied. For example, from the figure we realized there are unknown attributes in the model such as the satisfaction of

the wholesaler's goals *low cost* and *efficient delivery*. This kind of information guides Northern Electronics to explore more on how can it better serve its customers, and select alternatives that offer more effective tradeoffs among the goals of its business partners. In this case, for instance, the supplier needs to develop strategies to maintain lower costs and select a transport consolidator that hires efficient transporters in order to increase the wholesaler's overall satisfaction.

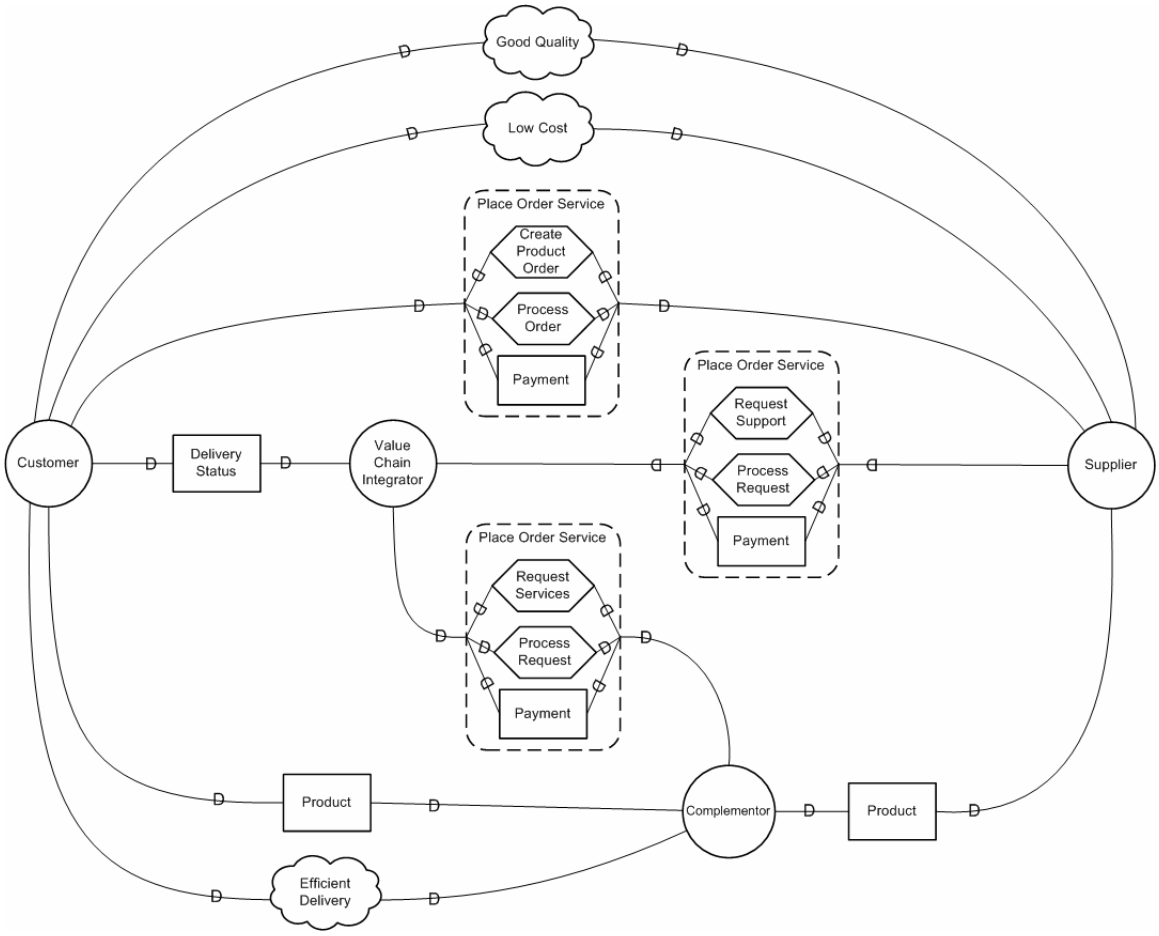

Figure 15. The original SD model of the *Value Chain Integrator* reference business model.

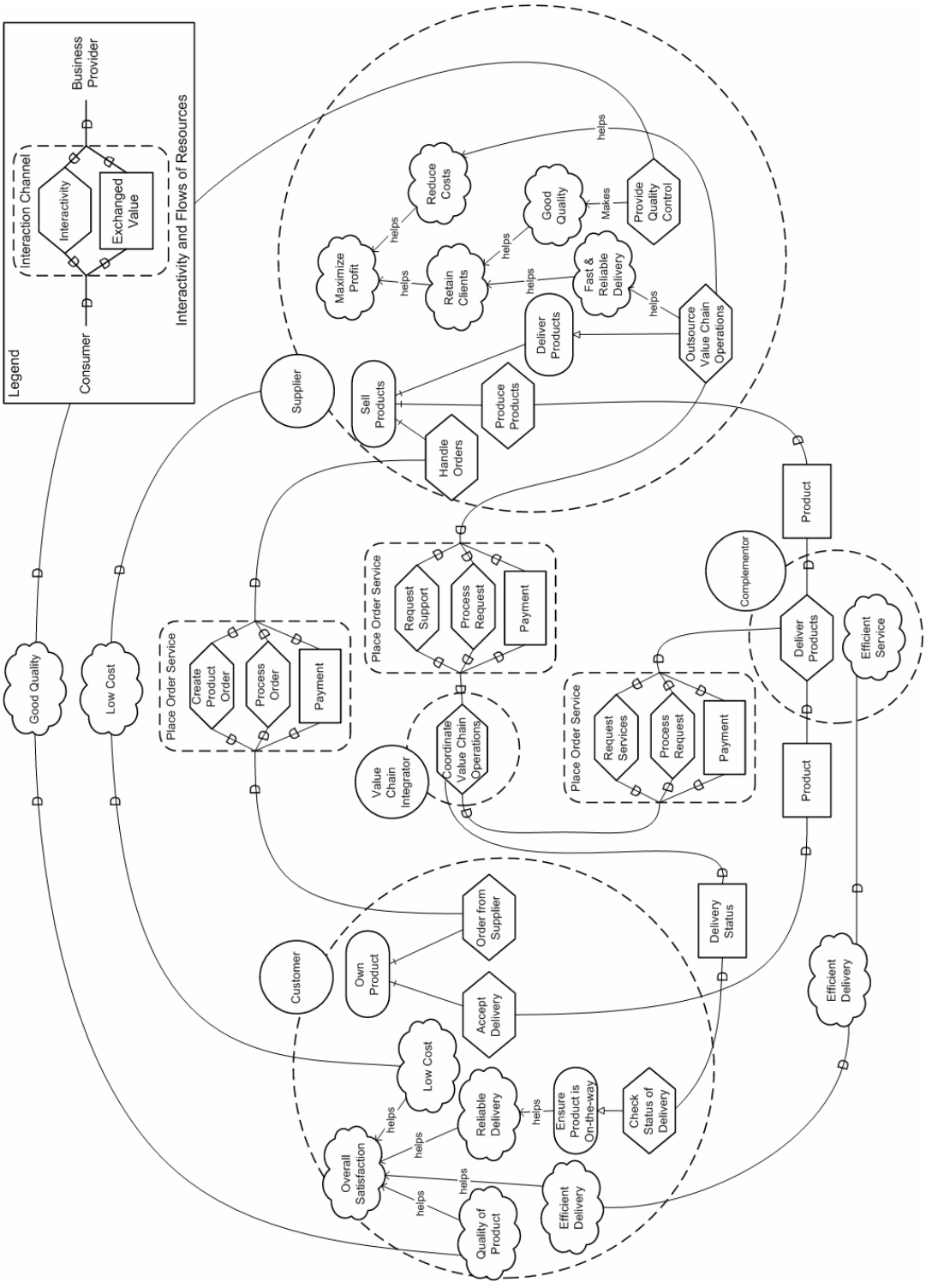

Figure 16. The original SR model of the *Value Chain Integrator* reference business model.

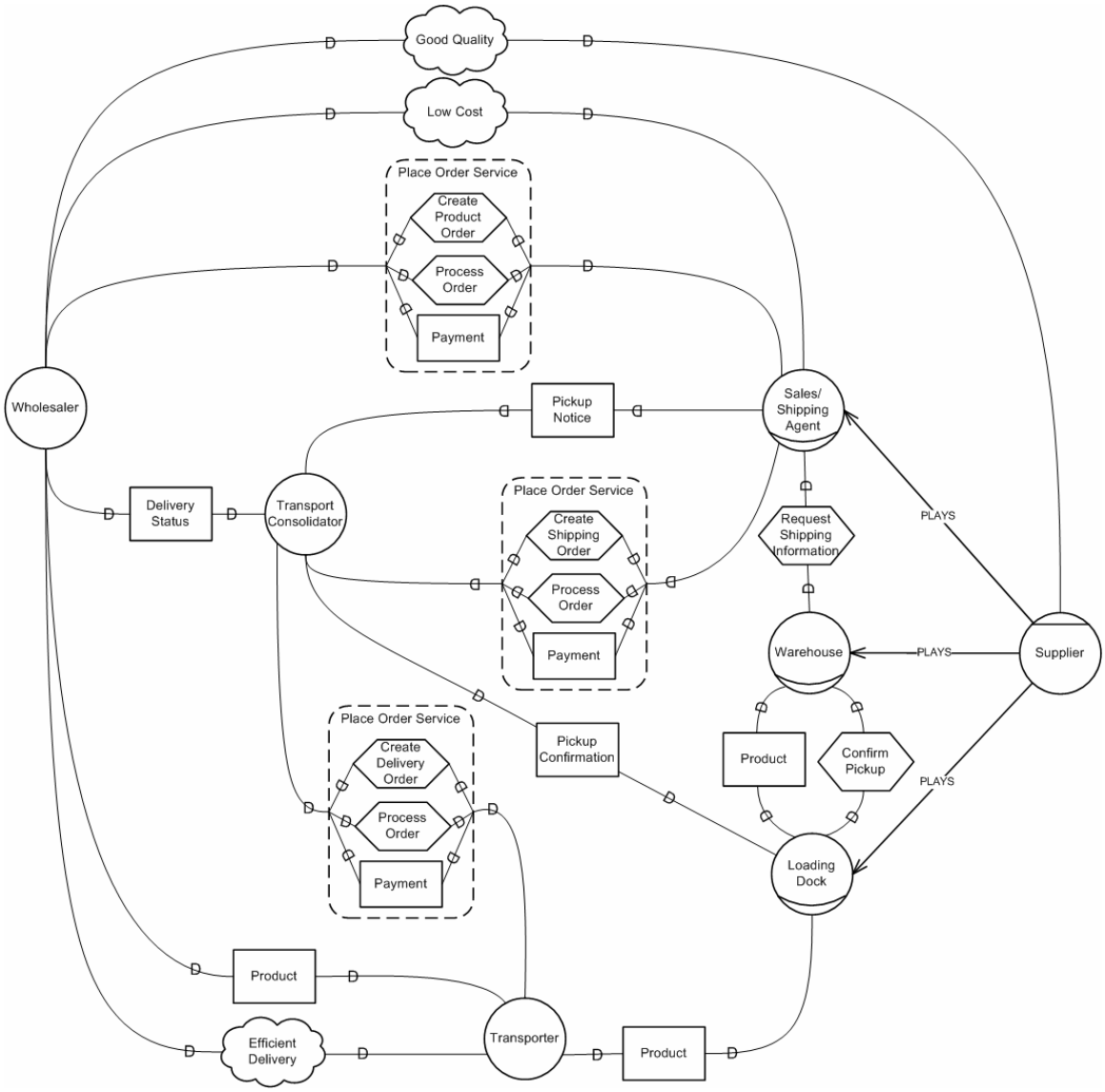

Figure 17. The refined SD model for the Northern Electronics case study.

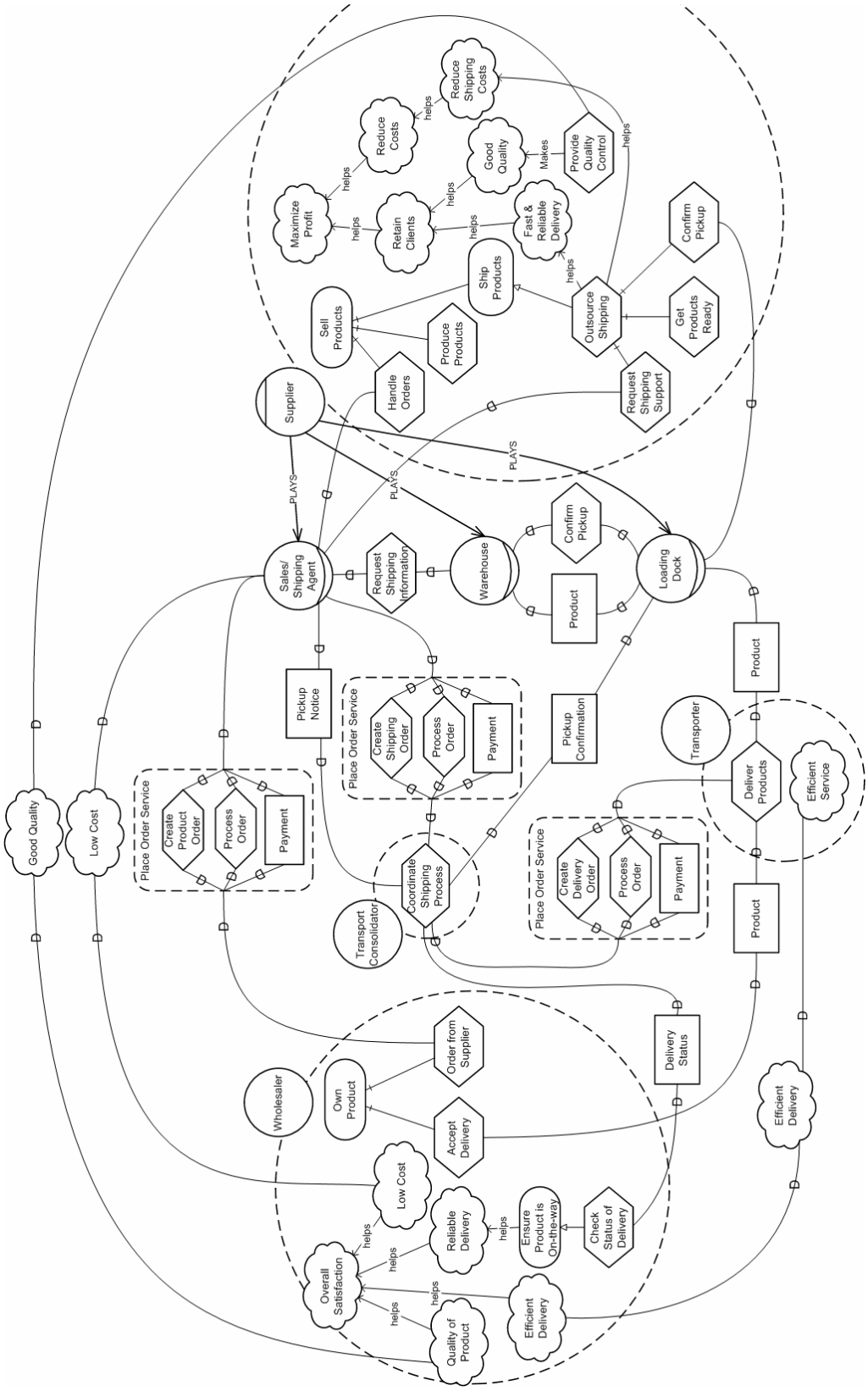

Figure 18. The refined SR model for the Northern Electronics case study.

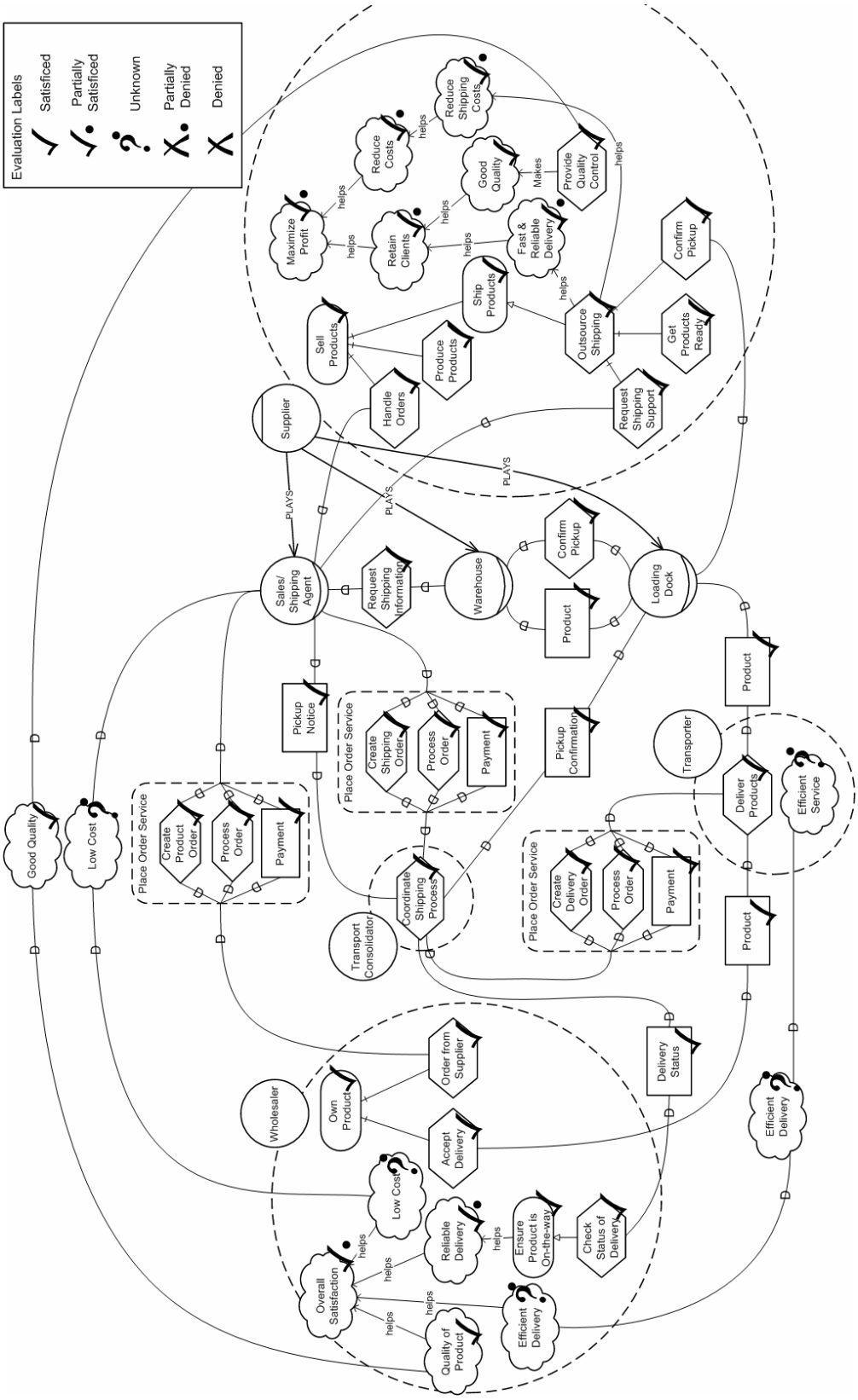

Figure 19. The refined SR model with qualitative evaluation labels.

6.3.2 Service Identification and Design

After the business models are analyzed and refined, the next step is to use these models to guide service identification and design. Although there are a number of business services identified in the business models, not all of them can be implemented by IT services. For instance, the negotiation of purchase between the wholesaler and the sales agent at the company cannot be automated as indicated by the program manager in the case study. On the other hand, interaction between the supplier and transport consolidator can be automated, because shipping request can be stored and sent electronically. This is similar for processing request and generating acceptance on the transport consolidator's side.

As shown in figure 18, shipping requests can be made by the shipping agent via a *Place Order* service, and this IT service can be defined by the design components from the reference catalog, which are modeled and analyzed in sections 5.3.1 to 5.3.3.

To support the tasks *request shipping information* and *confirm pickup*, we can apply the *Obtain Data* service pattern shown in figure 20, because these tasks basically require a request and delivery of data, which are similar to the resource dependencies of *pickup notice* and *pickup confirmation*. We explored this pattern using an *i** SR model in figure 21, and found two basic alternatives: (1) *request on demand* or (2) *receive when data is available*. These alternatives can be evaluated based on objectives of the data sender and data recipient, such as depending on who is willing to implement and provide the service, as well as who would like to gain more control over the collaboration. Design rationales, business collaboration diagrams and business process models for both options are captured in the reference catalog. Hence, if Northern Electronics prefers to provide its data using the *request on demand* option, then it can implement the services based on the business collaboration diagram and the business process model described in figures 22 and 23 respectively, which are extracted from the reference catalog.

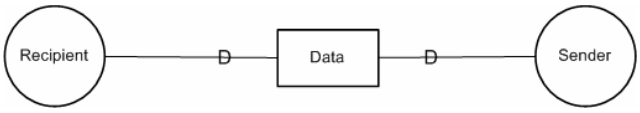

Figure 20. The recurring *Obtain Data* service pattern.

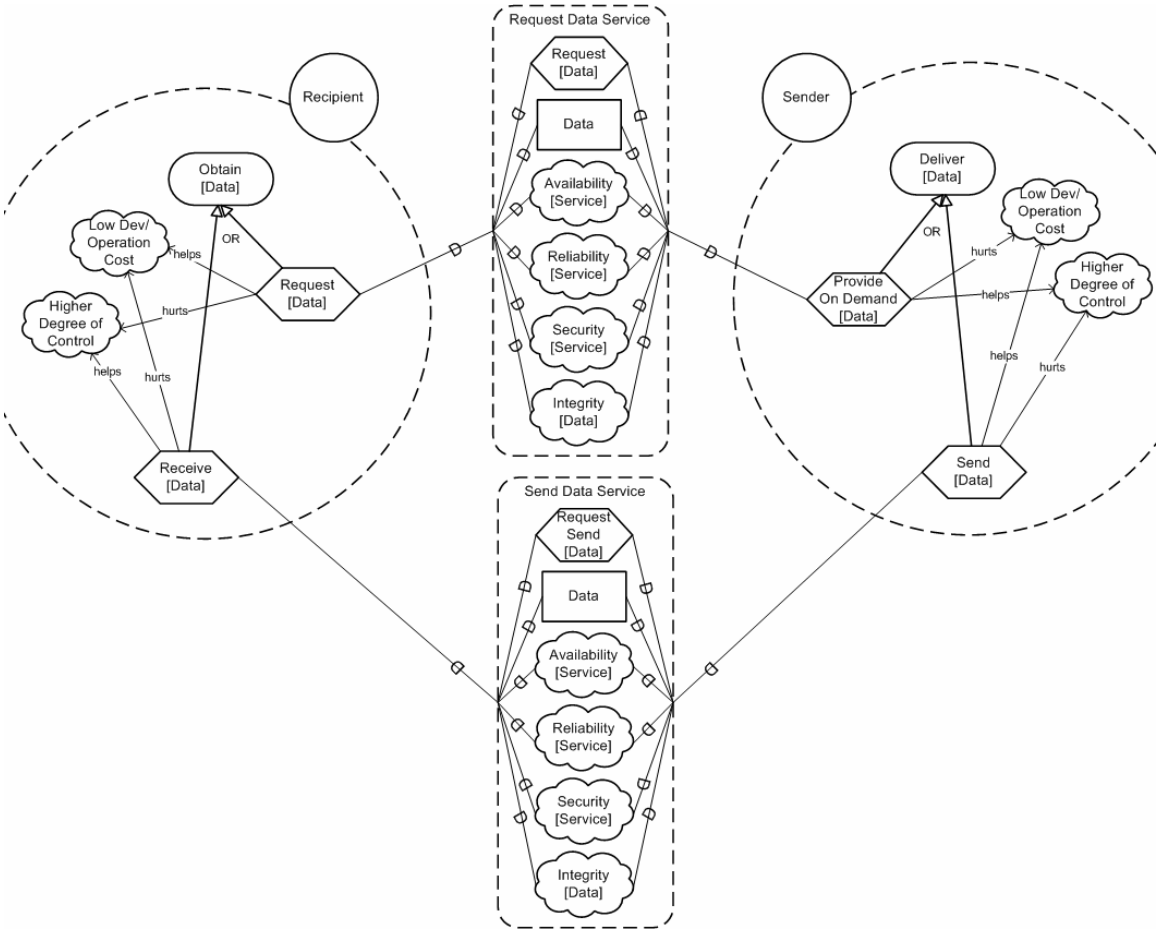

Figure 21. An *i** SR model showing two options for the *Obtain Data* service pattern.

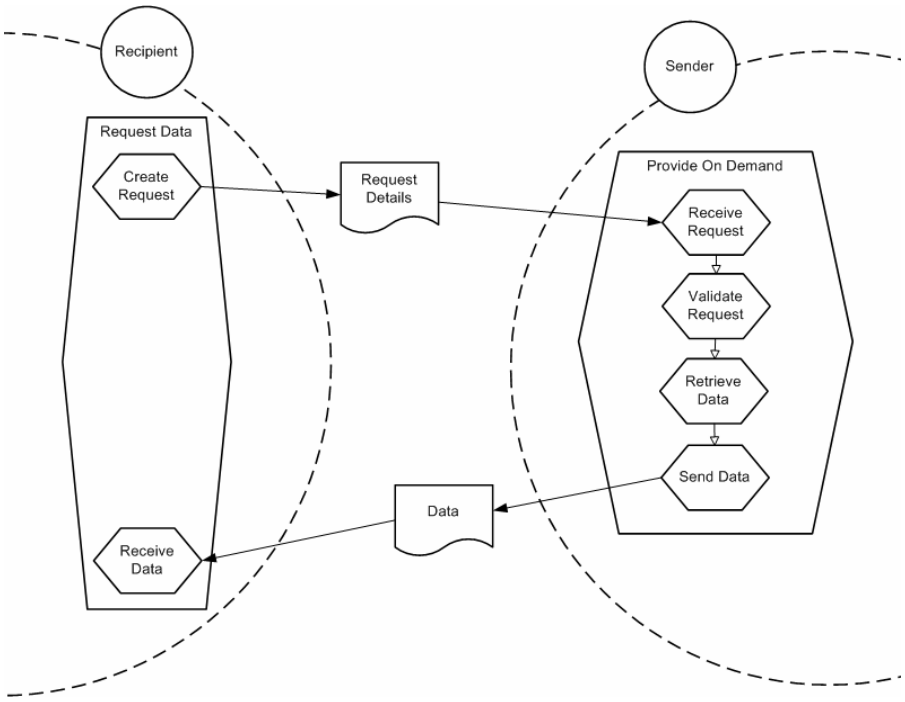

Figure 22. The business collaboration diagram for the *request on demand* option.

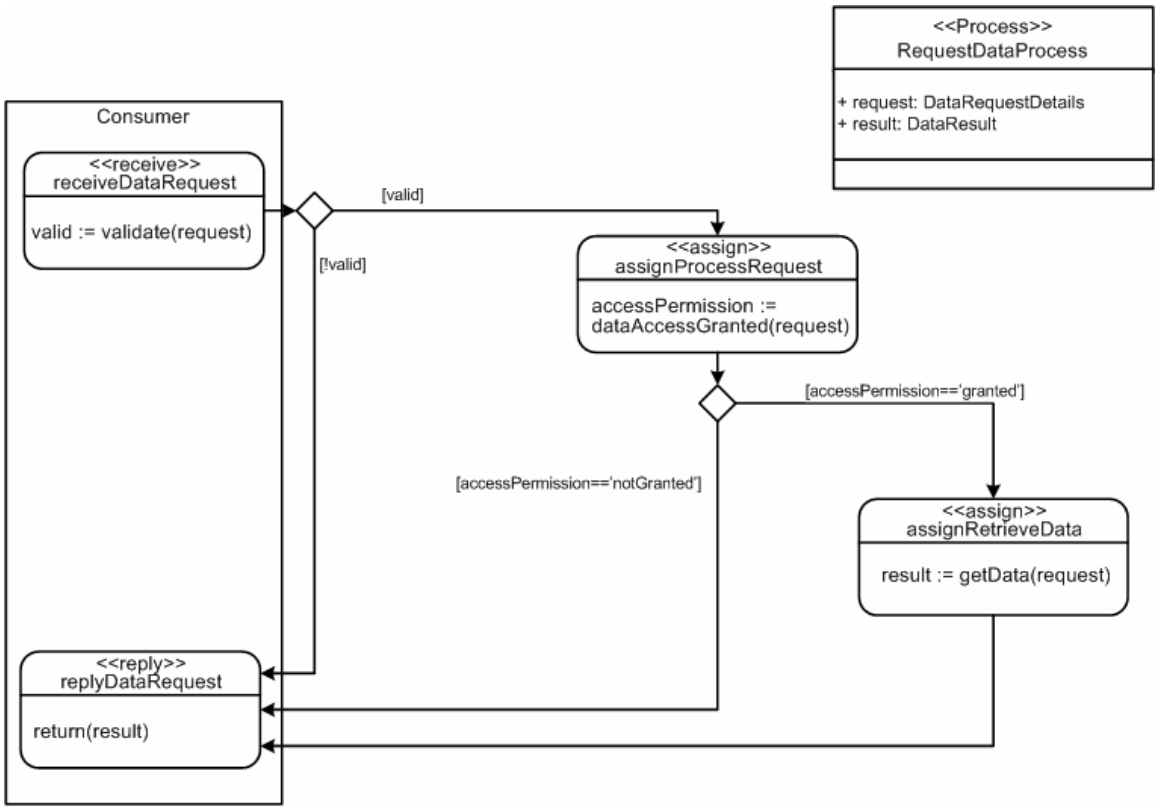

Figure 23. The business process model for the *request on demand* option.

6.4 Discussion

Although the literature that studies the same case study has designed a number of services and business processes to improve the shipping process using a different method, there are a number of advantages offered by our approach that has been overlooked in the method used in the literature:

1. Our approach offers the reuse of business model and service design components, which are valuable design knowledge that are accumulated and validated from previous experience. As a result, it is more efficient than developing ad hoc solutions, and provides more knowledgeable guidance than relying solely on the experience and skills of individual solution designers for each problem.

2. The *i** models support extensive analysis with business goals of business participants and alternative exploration, which are not captured in the case study, because the method used in the literature begins with business collaboration design and analysis. Therefore, the non-functional objectives which are important elements to making design decision and choosing between different options might be overlooked in the other approach. For example, if the supplier prefers to have a Web service to support the delivery of *pickup notice* from it to the transport consolidator, then according to the *i** SR model in figure 21, it has the option of either providing the Web service itself or letting its business partner to provide it, and the choice depends on preferences or conflicting goals such as a reduction in implementation costs versus a higher degree of control over the transaction. However, the design of the original case study, as shown in figure 24, chooses the transport consolidator as the service provider without considering intentional elements that might affect the design decisions. As a result, their approach delimits the design choices and the flexibility of implementing such an open architecture.

3. Our approach provides traceable rationales for future evolution of the implemented system. This is a benefit from the intentional elements captured in the *i** business models, because they indicate the business rationales behind the system design, and the linkage between goals and tasks supports the traceability between each task and its objective. As the system evolves, these traceable rationales can help system designers to better analyze the system and make more informed design decisions.

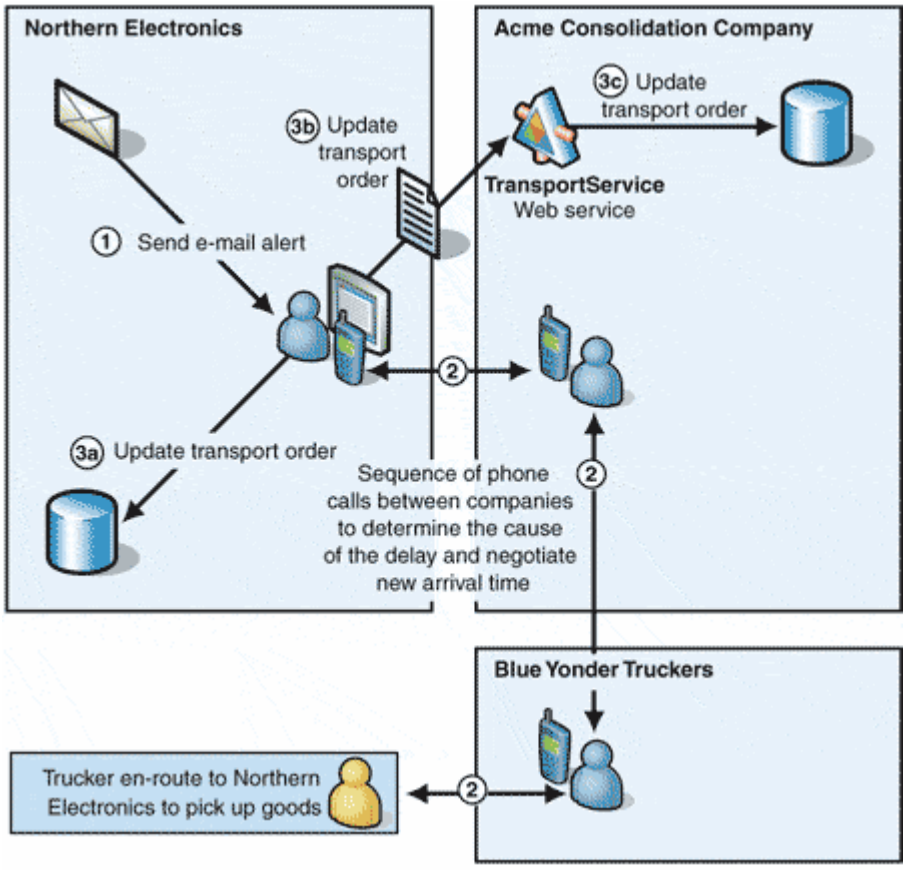

Figure 24. Design of the transport Web service in the original case study [Chong05].

Chapter 7 Conclusions

7.1 Summary and Contributions

In this thesis, we have reviewed relevant work that individually focuses on the various aspects of business models, business modeling techniques, as well as SOA design methodologies. Despite the divergence in understanding and usages of business models, we realized there is a common agreement that a business model[2] is important in expressing and analyzing strategic concepts and goals for a specific firm, because the success or failure of its business is often attributed to the viability of its business model[1]. However, there are a few issues that had not been addressed.

First of all, there is still no general agreement on what concepts should be included in a business model[1], and the focus so far has been on the descriptive aspects of business models[1], and less so on the analytical powers. As we expect that the design of new generations of information technology systems will need to be guided much more closely by business considerations, we developed a systematic technique to design and analyze business models[2] using an extended version of the *i** framework.

Secondly, we discussed the importance in using business models[2] to guide service-oriented design, and also established the relationship between business model components and IT services. Then, to take advantage of the property that business models[1] do recur in the real world, to increase reusability of model components and to create better strategic alignment between the business models[2] and the SOA, we proposed the idea of working toward an expandable set of reference business models, which includes details of the construction and analysis process of reusable components for each reference model, as well as the reusable components' relationship with later technical design and process models. We then tested the effectiveness of these reference business models with a real-world case study, and compared our approach with the method used in the original literature.

7.2 Lessons Learned

There are a number of lessons learned from the work of this thesis. First, we know that business modeling is a good approach to capture, design and analyze business level concepts, but a sound modeling technique is yet to be developed. Second, we know that further extension of the *i** framework is needed to accommodate all the business level concepts we found in the literature.

We also confirmed, using our case study, that even though variations of business models[1] exist for each company or business scenario, we can still learn from common cases and apply previous design knowledge acquired from common business models[1].

There are certain limitations to our approach. To apply the reference business model and its associated components to a specific case, training on using the *i** modeling framework is required, especially on the techniques for performing analysis and reasoning on the refined model components. Nevertheless, it is an improvement from existing works where reference business models are merely used as factual description of successful or common business models, in which adaptation techniques to specific cases is neither supported nor studied.

7.3 Future work

7.3.1 Tool Support

Tool support is essential for assisting model designers to construct and analyze business models efficiently and effectively. Also, a storage and retrieval tool is necessary for storing and accessing the catalog of reference business models, as well as refining them for a specific business problem or firm. A number of software tools, such as OpenOME [OpenOME] and TAOM4E [TAOM4E], have been developed for constructing *i** models. Therefore, one way to provide tool support for our approach is to extend these tools to accommodate the business level concepts and techniques introduced in this thesis, including the modeling of business services, storage and access of the model catalog, as well as business model instantiation.

7.3.2 Service Composition

There are existing work being done on designing and modeling service composition, such as [Skogan04] and [Colombo05], and they are mainly focused on the system requirements and technical levels. To leverage the strength of SOA in supporting complex business collaboration and processes, the design and analysis of service composition and its alignment with business level concepts are critical aspects to designing SOA solutions. Hence, it will be helpful to explore how business models and collaboration patterns can help guide such design and analysis.

7.3.3 Ongoing Expansion of the Reference Catalog

Our approach proposes the idea of creating and maintaining a reference catalog that consists of reference business models and reusable design components. The sample catalog included in the appendix is expected to be preliminary and incomplete. To make the idea of the reference catalog practical, in the future we will need to keep refining and adding new models and components to the catalog as the business models and strategies evolve in the real world, as well as inviting other experts to join the effort, so that workable solutions to recurring business problems and best practices can be shared among members in the community. An effective tool for this kind of collaborative authoring of the reference catalog is the Wiki system, thus a new section can be created on the *i** Wiki website [*i** Wiki] to allow researchers and catalog users to add, modify and rate the quality of each reference business model.

7.3.4 Reference Model Template

To demonstrate our reference catalog approach, we have proposed a reference model template that defines the set of descriptions and components of which a reference business model consists in the catalog. However, the current template is proposed for the sample catalog, and more work would be necessary to examine whether the set of elements it includes is relevant and sufficient. For instance, in case some users are not

familiar with *i** models, it may help to include a non-intentional flow model as part of the template, so it is easier for the users to understand the *i** models after they have seen the flow model.

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Appendices

Appendix A - Sample Catalog of Reference Business Models

Model No. 1: The *Direct-to-Consumer* Reference Model

1. **Name:** The *Direct-to-Consumer* Reference Model

2. **Summary:** In this model, the direct-to-consumer provider interacts and provides its goods and services to its consumers directly, and does not involve any third party.

3. **Key business drivers:**
   - Need to lower business exchange costs
   - Demand strong relationship with consumers

4. **Solution:** All interactions, including the exchange of information, money, products and services, are performed directly between the firm and its consumers, so that extra costs incurred to pay for third parties such as distributors and retailers may be reduced, and the firm owns both the data and relationship with the consumers.

5. **Potential advantages:**
   - Reduces business exchange costs for both suppliers and consumers
   - Establishes stronger connection with consumers
   - May eliminate physical costs of retail stores if replacing them by electronic interactions

6. **Key business actors:**
   - Direct-to-consumer provider – The provider of goods or services that interacts with its consumers directly.
   - Consumer – The target consumer of the direct-to-consumer provider.

7. **Challenges and limitations:**
   - All transactions and business processes are handled by the provider, which may distract the provider from focusing on its core competences
   - May be problematic if the provider lacks expertise in handling some of the responsibilities

8. **Strategic dependencies:** The provider is dependent on the consumer to request its goods or services and make payments; while the consumers are dependent on the provider to offer and deliver the products or services.

9. **Revenue model:** Revenue flows directly from consumers to providers.

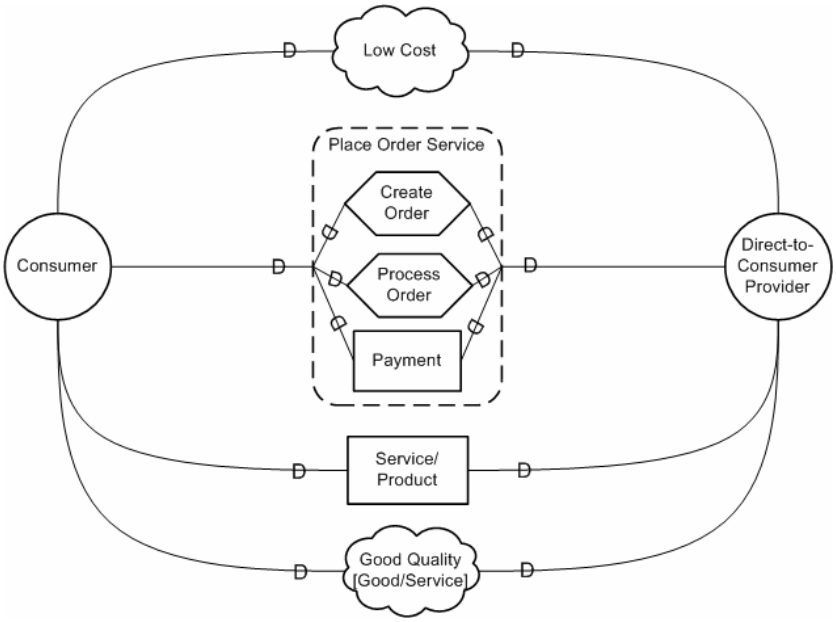
10. **Related model(s):** *Full Service Provider*

11. Source(s): Adapted from the *Direct-to-Consumer* model defined in [Weill01] and [Staub04].

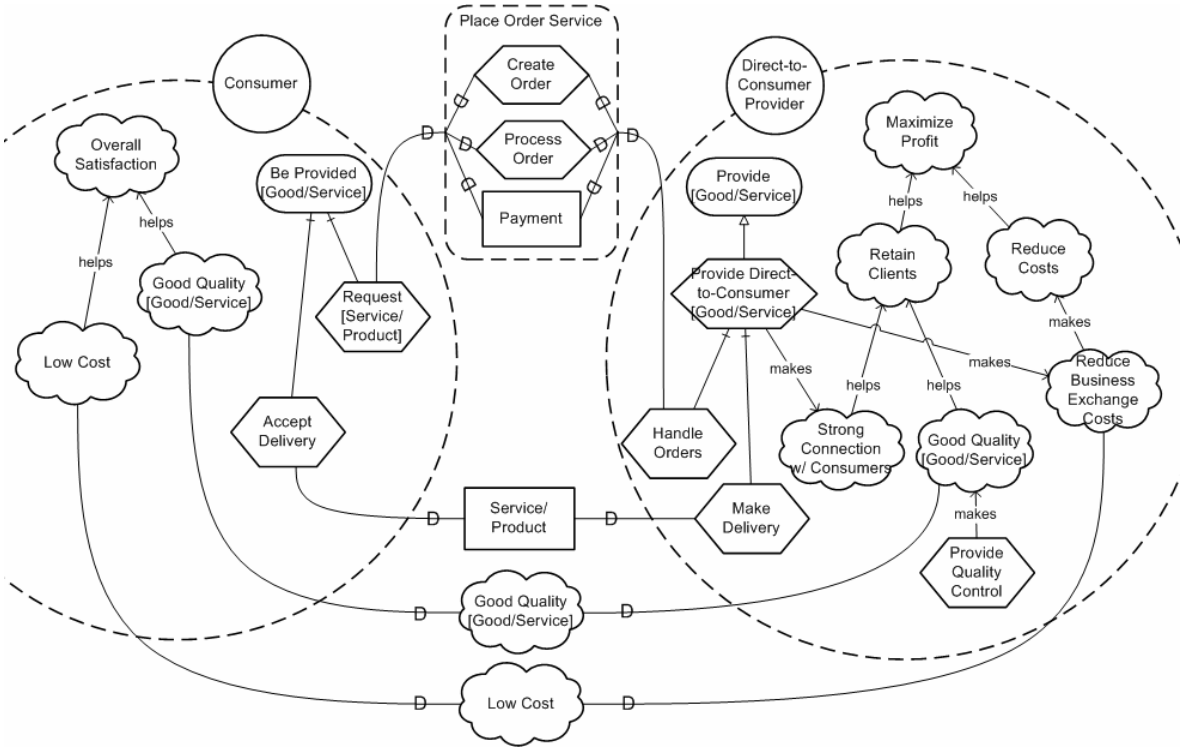
12. Example: Dell is one of the most successful examples that generated great profits by its unique way of selling computers directly to its consumers.

13. Business design rationale(s): N/A

14. The *i SD model:**



15. The *i SR model:**

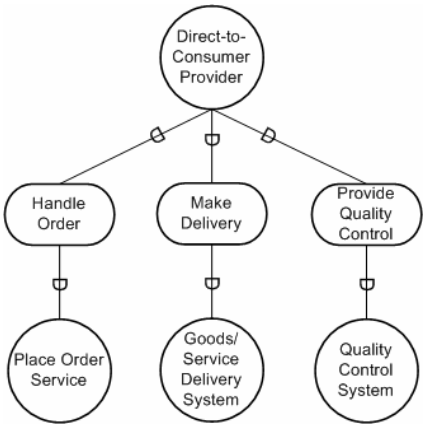


16. Business service pattern(s):

Service in SR model	**Requester**	**Provider**	**Business Service Pattern**
Place Order	Consumer	Direct-to-Consumer Provider	Place Order Service
Deliver Service/Product	Consumer	Direct-to-Consumer Provider	N/A

17. Extended actor models:

For direct-to-consumer provider:



Model No. 2: The *Full-Service Provider* Reference Model

1. **Name:** The *Full-Service Provider* Reference Model

2. **Summary:** This model focuses on two major types of business actors: the full-service provider and its targeted customers in a particular business domain. Third-party service providers may be introduced to the model by the full-service provider to integrate all the service offerings.

3. **Key business drivers:**
   - Aim to fulfill complete needs of customers in a particular domain
   - Desire maximum ownership of customer relationship, transaction and data, while partnering with third-party providers

4. **Solution:** The basic strategy of the full-service provider is to offer as many services to its customers as possible in a particular domain, becoming a single point of contact in this area, usually with the help of third-party service providers.

5. **Potential advantages:**
   - Adds value for customers since it consolidates a wide range of products and services, either its own or from third-party providers
   - Becomes single point of contact for its customers, resulting in the ownership of a large customer base
   - Becomes more profitable as it offers more products and services
   - Reduces business transaction costs for customers

6. **Challenges and limitations:**
   - To be a full-service provider, success is highly dependent on the firm's relationship management with its customers and partners
   - Since a single firm is unlikely to provide all products or services that are needed in a business domain, full-service providers often need a strong and comprehensive set of third-party providers, while require to manage competitions between those external offerings and its own offerings
   - Need to prevent third-party providers from attracting customers away, e.g. by limiting data flow to third-party providers
   - Need some infrastructure, such as a database, to maintain information of customers and products they own; otherwise, will be difficult to consolidate information for them
   - Require effective co-operations between individual business units within the firm

7. **Key business actors:**
   - Full-service provider – A service provider that aims to offer a full set of services in a particular business domain.
   - Consumer – The target consumer of the full-service provider.

- Third-party service providers – A service provider that offers its services to consumer through the full-service provider.

8. **Strategic dependencies:** Since the full-service providers own the relationship with the customers, the customers are dependent on the full-service providers on the set of services provided, and the quality as well as the cost structure of the services. Third-party service providers depend on full-service providers for service referrals, whereas the full-service providers will depend on both or either customers and third-party service providers to generate revenue.

9. **Revenue model:** Revenue flows from consumers to full-service providers in exchange for products and services. Full-service providers may also gain revenue from third-party providers, often in terms of commissions, membership fees, transaction fees, management fees or listing fees.

10. **Related model(s):** *Direct-to-Consumer*

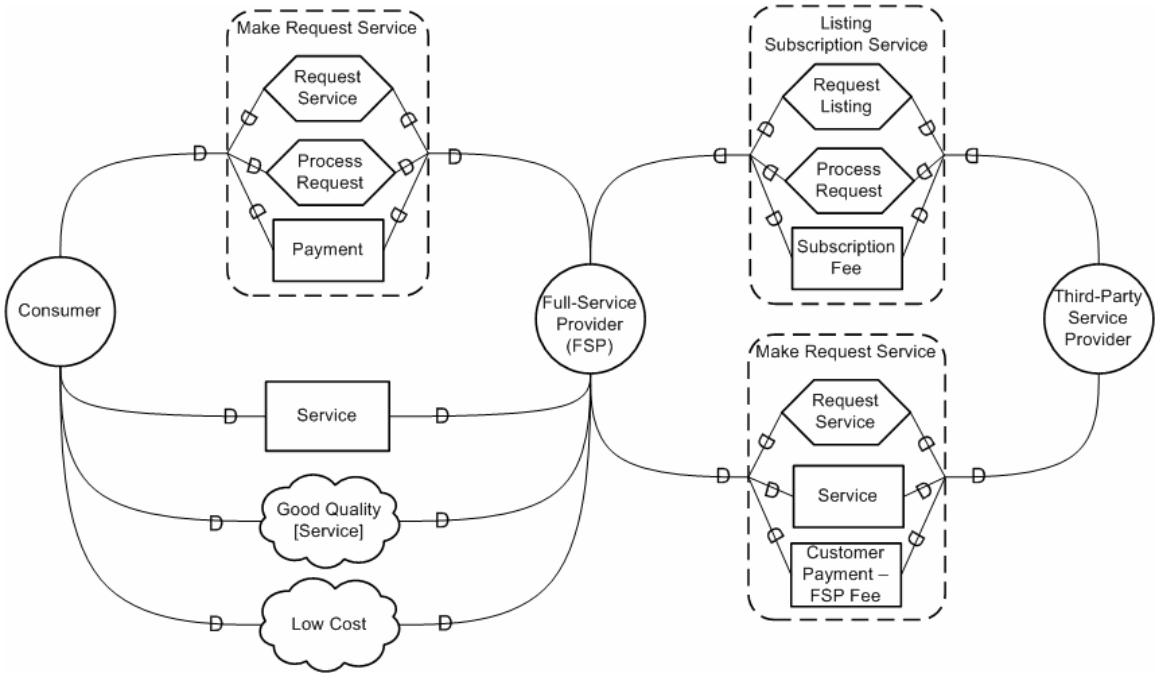
11. **Source(s):** Adapted from the *Full-Service Provider* model proposed in [Weill01] and [Staub04].

12. **Example:** Prudential Insurance Company of America is a full service provider in the financial industry that offers everything its customers could need, including: all kinds of investment products, insurance plans, financial accounts, credit cards, home mortgages, financial advices, and other services.

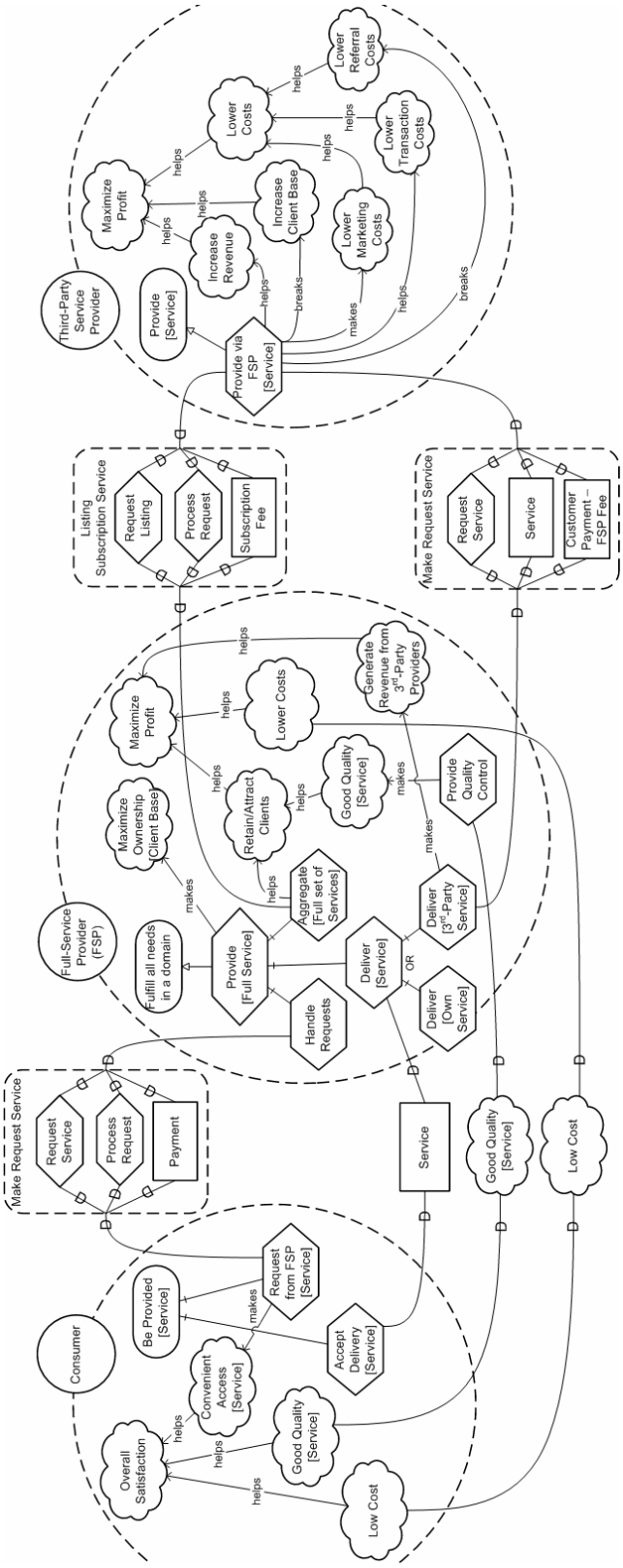
13. **Business design rationale(s):** A full-service provider has, but not limited to, the following options to generate revenue from third-party service providers:

	Fee option	Fee type
1	Commissions	Pay-per-use
2	Membership fees	Subscription-based
3	Transaction fees	Pay-per-use
4	Management fees	Subscription-based
5	Listing fees	Subscription-based
6	No extra fee	N/A

14. The *i SD model:**



15. The *i SR model:**

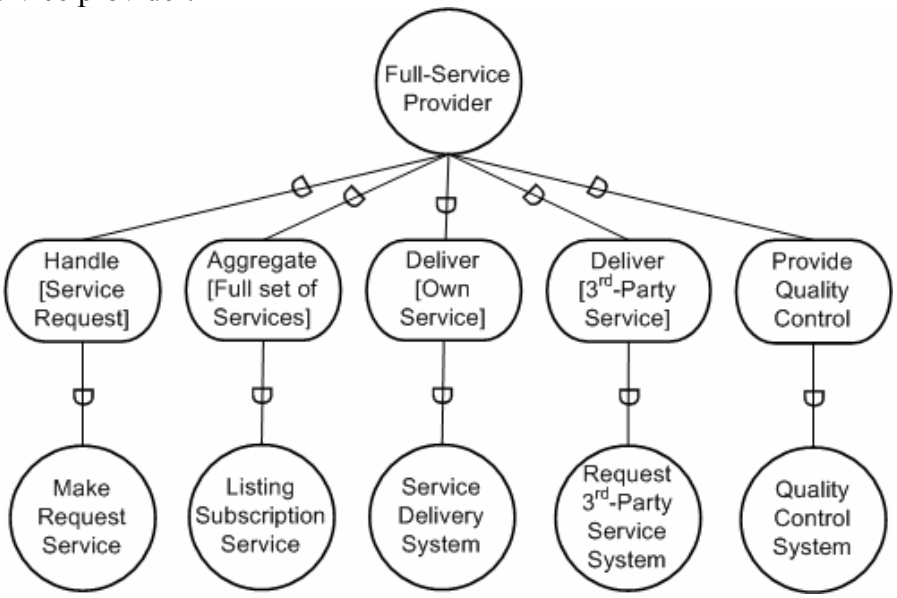


16. List of business services:

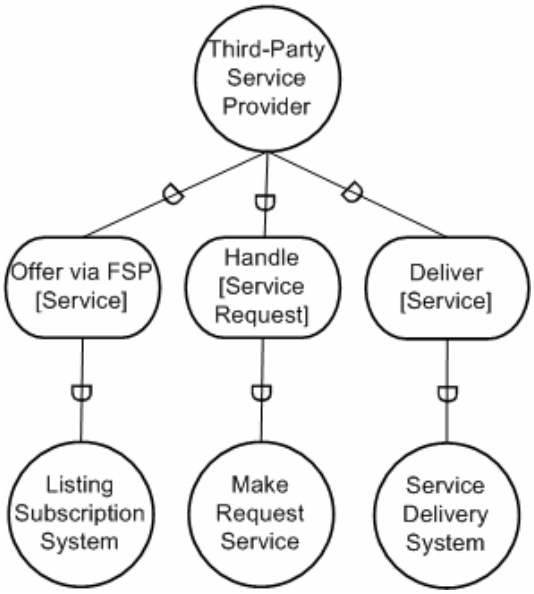
Service in SR model	Requester	Provider	Business Service Pattern
Listing Subscription	Third-Party Service Provider	Full-Service Provider	Place Order Service
Make Service Request	Customer	Full-Service Provider	Place Order Service
Make Service Request	Full-Service Provider	Third-Party Service Provider	Place Order Service
Deliver Service	Full-Service Provider	Customer	N/A

17. Extended actor models:

For full-service provider:



For third-party service provider:



Model No. 3: The *Intermediary* Reference Model

1. **Name:** The *Intermediary* Reference Model

2. **Summary:** The intermediary business model is common to both traditional physical systems and the electronic market. Traditional intermediaries include travel agents and brokers, who now also offer their services via the Internet. Intermediaries form the primary relationship with its customers, and refer them to suppliers or service providers. A detailed comparison between different kinds of intermediaries can be found in [Weill01].

3. **Key business drivers:**
   - Target a business domain with a large number of suppliers and customers
   - Intend to bring together suppliers and customers
   - Intend to sell aggregated information of customers to suppliers and advertisers
   - Not responsible for transactions between suppliers and customers

4. **Solution:** The business strategy of an intermediary is to bridge the gap between suppliers and customers within a business domain, and deliver various potential choices to them via its search or directory services. The intermediary earns revenues from suppliers, customers or both by providing such services. Then, suppliers and customers will carry out the actual business transaction directly.

5. **Potential advantages:**
   - Promising basis of revenue for intermediaries
   - Lower search costs for customers
   - Lower marketing costs for suppliers

6. **Challenges and limitations:**
   - Difficult to establish baseline
   - Require sufficient volume of usage to survive
   - Require strategy to attract and retain critical mass of clients
   - Require ability to collect and synthesize market information on behalf of their clients, such as products, prices and other market factors
   - Require ability to store and keep information secure, such as by means of an IT infrastructure

7. **Key business actors:**
   - Intermediary – A business actor that brings customers and suppliers/service providers together in a particular business domain.
   - Customer – The customer that the intermediary intends to serve.
   - Supplier/service provider – The supplier/service provider that the intermediary intends to refer to its customers.

8. **Strategic dependencies:** An intermediary serves as the initial connection between the customers and suppliers/service providers, hence customers are dependent on

the intermediary in finding the providers of goods or services that they want, whereas the suppliers are dependent on the intermediary in having their goods or services to be listed and searched. In return, the intermediary is dependent on either or both customers and suppliers in generating its profit.

9. **Revenue model:** Some type of payments is paid to the intermediary for the service, such as listing fees and sales commissions from advertisers and suppliers, or service fees from customers.

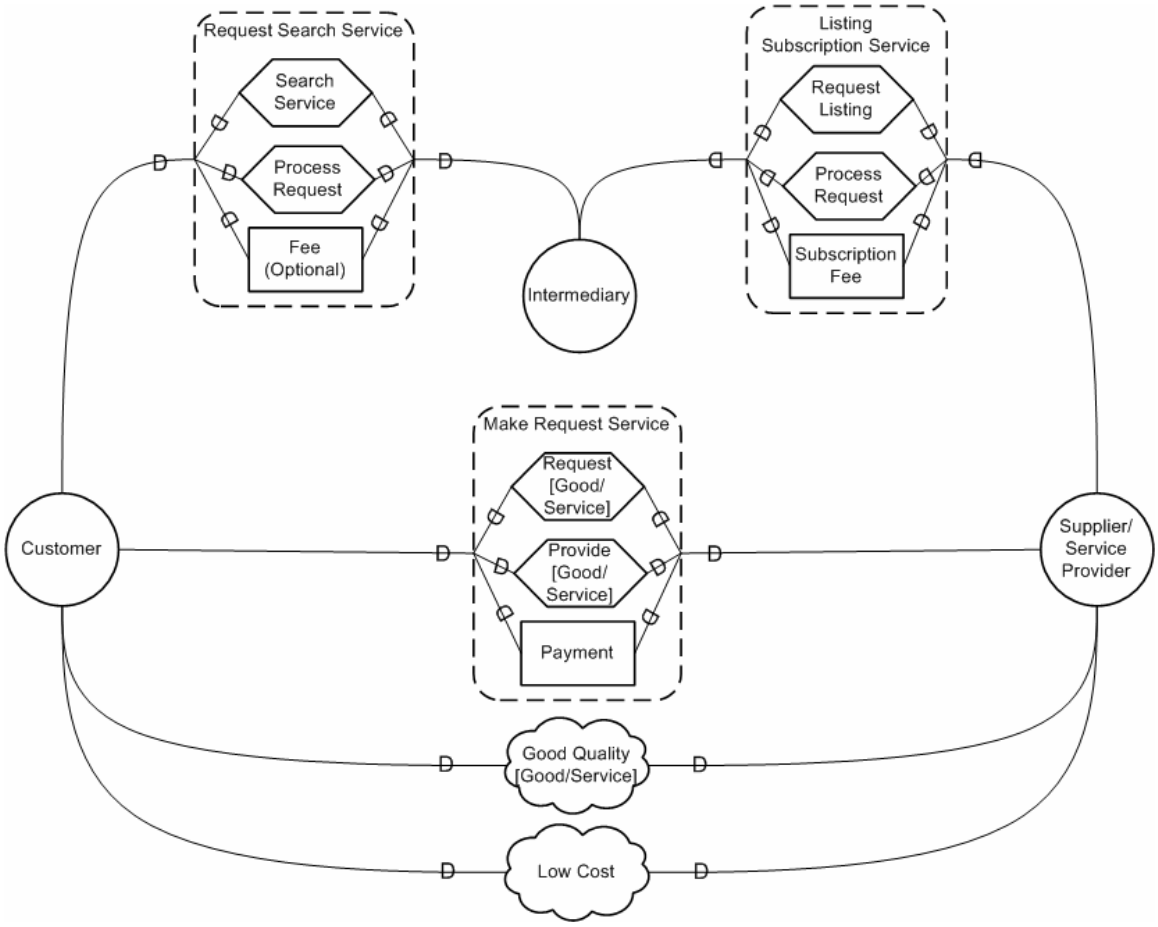
10. **Related model(s):** *Shared Infrastructure* and *Value Chain Integrator*

11. **Source(s):** Adapted from the *Intermediary* business model proposed in [Weill01] and [Straub04].

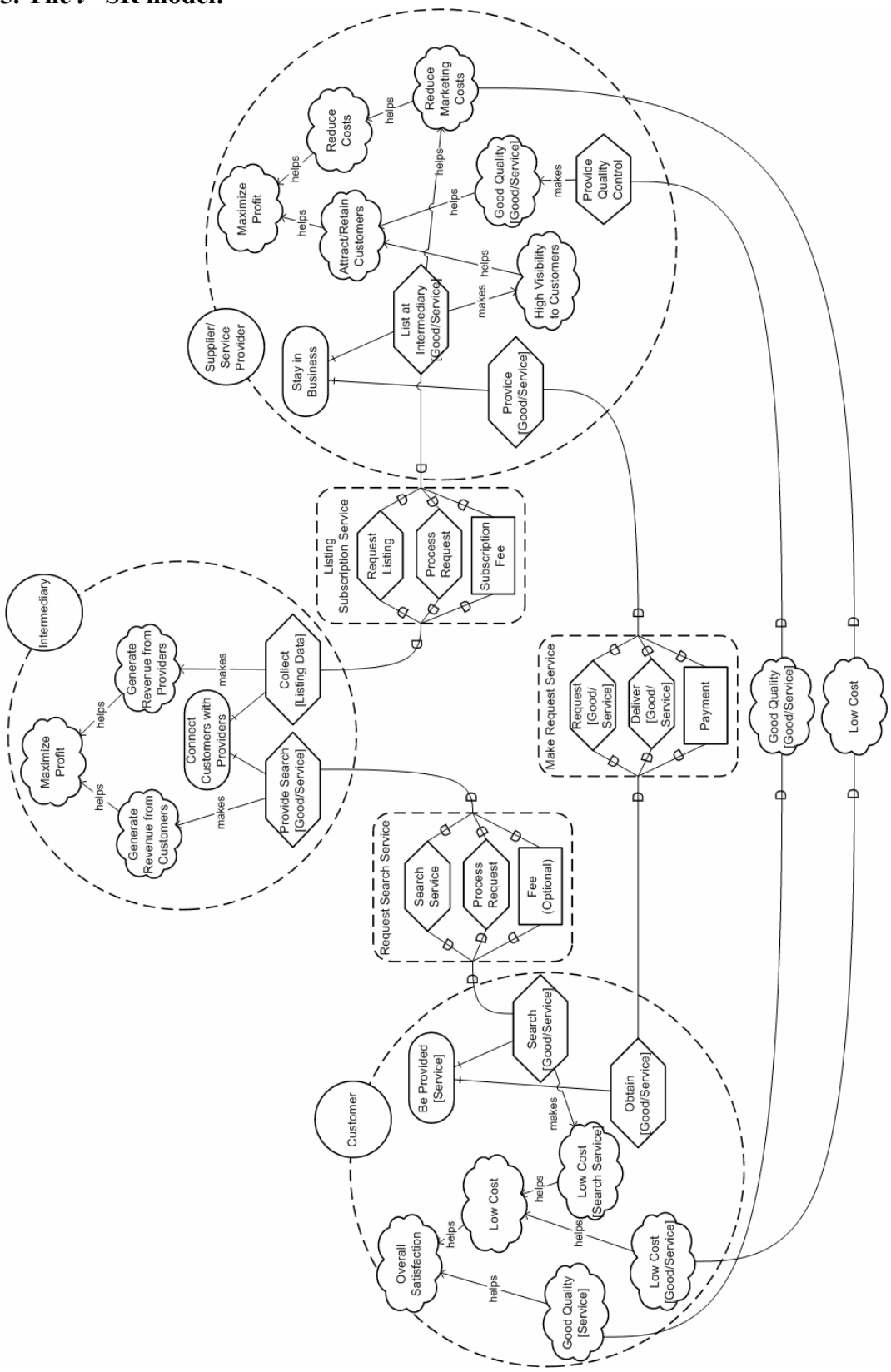
12. **Example:** Intermediaries long exist in the physical business market, including traditional travel agents and real estate brokers. Nowadays, increasing number of intermediaries make use of the Internet to deliver its services, which also known as cybermediaries. Successful examples include the online auction Web site eBay.com and the online travel agency Expedia.com.

13. **Business design rationale(s):**
    1. There are numerous types of intermediaries, including agents, brokers, portals, auctions and electronic malls. Each of them differs slightly on a number of business strategies, such as the set of services they provide, the price structure, as well as the group or number of buyers and sellers they serve. A general business model for intermediaries is illustrated in the following sections. For more details on the specific types of intermediaries, please refer to [Weill01].
    2. The search service offered by intermediaries to customers may or may not come with a service fee, and therefore it can be mapped to either *Place Order Service* (charged service) or *Obtain Data Service* (free service), as shown in the *Business Services* table.

14. The *i SD model:**



15. The *i SR model:**

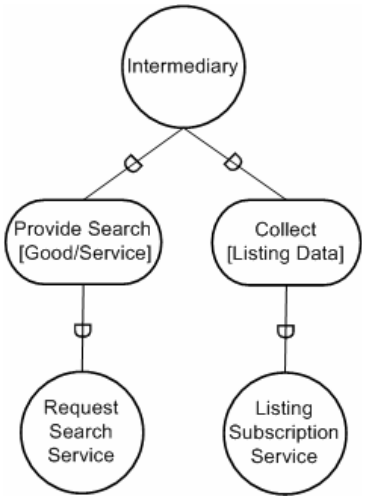


16. List of business services:

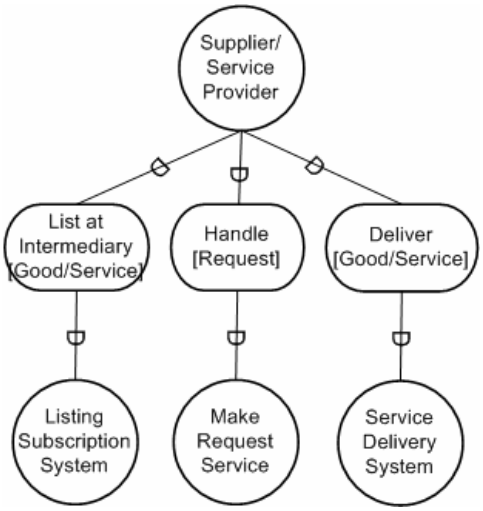
Service in SR model	Requester	Provider	Business Service Pattern
Subscribe Listing	Supplier/Service Provider	Intermediary	Place Order Service
Search	Customer	Intermediary	Place Order Service / Obtain Data Service
Make Request	Customer	Supplier/Service Provider	Place Order Service
Deliver Good/Service	Supplier/Service Provider	Customer	N/A

17. Extended actor models:

For intermediary:



For supplier/service provider:



Model No. 4: The *Shared Infrastructure* Reference Model

1. **Name:** The *Shared Infrastructure* Reference Model

2. **Summary:** Similar to the *Intermediary* model, this *Shared Infrastructure* reference model is not entirely new, and has been seen in the airlines, automobile and liquor industries. It starts when an opportunity emerged to set up and share an infrastructure among competitors for some mutual benefits, such as to reduce costs or provide a single-point-of-contact for customers.

3. **Key business drivers:**
   - Need to reduce the massive costs of setting up individual systems
   - Demand by customers for a single infrastructure to access multiple service providers
   - Has common cause to set up alliance to compete with another group of competitors (e.g. new entrants to their market)

4. **Solution:** This business model requires competitors to cooperate by sharing a common infrastructure, with agreements on terms such as the system architecture, operational standards, and technology used. This infrastructure will provide a set of generic services and serve as a single-point-of-contact for customers in their particular business domain.

5. **Potential advantages:**
   - Lower cost to provide generic services by sharing costs with alliance partners
   - Removed cost of implementing and maintaining individual systems
   - Increased service visibility to customers

6. **Challenges and limitations:**
   - Difficult to cooperate with competitors
   - Lots of decisions to be negotiated (e.g. fee structure, ownership of data, distribution of profit etc.)
   - Effectiveness of infrastructure is dependent on the enforcement of agreed terms among alliance partners
   - Requires an unbiased presentation of product and service information
   - Requires efficient operations and maintenance of complex IT infrastructure to attract participants

7. **Key business actors:**
   - Shared infrastructure – A business actor that provides an infrastructure that is shared among competitors in a particular business domain, it provides a set of generic services and serves as a single-point-of-contact for the customers.
   - Consumer – The target customer of the service providers that the shared infrastructure intends to serve.
   - Service provider – A business provider of services (or goods) that use the shared infrastructure to attract and interact with its target customers.

8. **Strategic dependencies:** Customers in a specific business domain are dependent on the shared infrastructure to have convenient access to multiple service providers, while service providers are dependent on the shared infrastructure to offer a generic set of services, such as the coordination of service listings and the transactions with customers. Also, since customers are well aware of the service provider when accessing the shared infrastructure, their overall satisfaction of the service is largely dependent on the service provider rather than on the infrastructure.

9. **Revenue model:** Although the main objective of a shared infrastructure is not to generate revenue for itself, profits might be generated from membership fees from companies using the infrastructure or transaction fees from customers. The profits are usually distributed back to its owners.

10. **Related model(s):** *Intermediary*

11. **Source(s):** Adapted from the *Shared Infrastructure* business model proposed in [Weill01] and [Straub04].

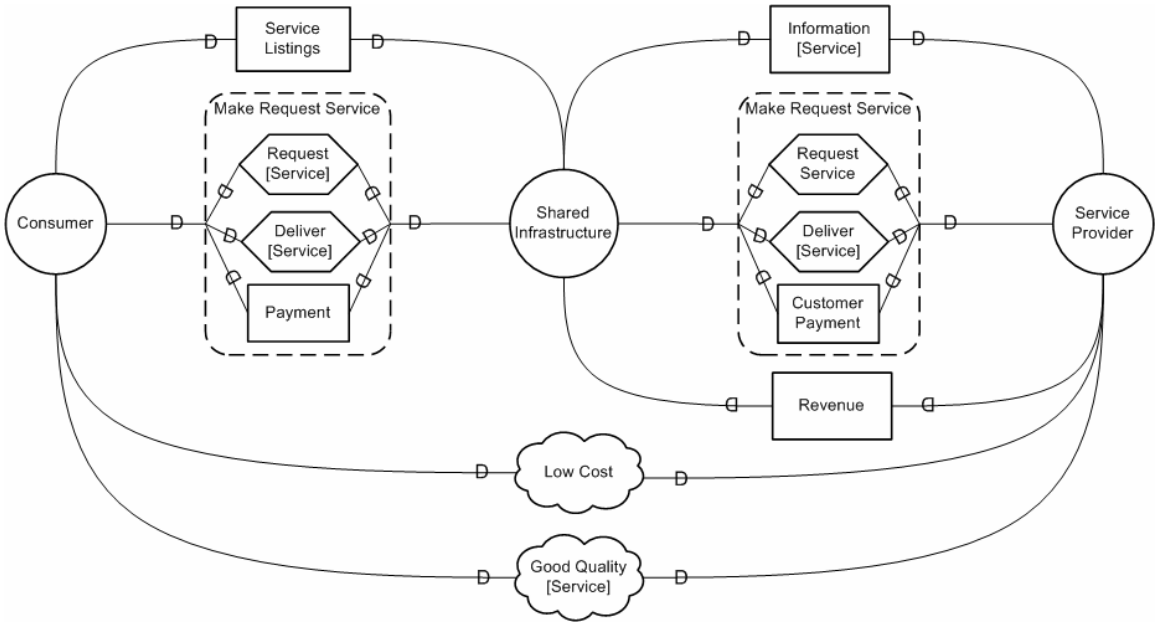
12. **Example:** There are examples of *Shared Infrastructure* business model in different industries, for instance, there are airline reservation systems such as ABACUS the Asian Airline Computer Reservation System, and joint ventures in the liquor industry such as the Artesian Innovation group.

13. **Business design rationale(s):**

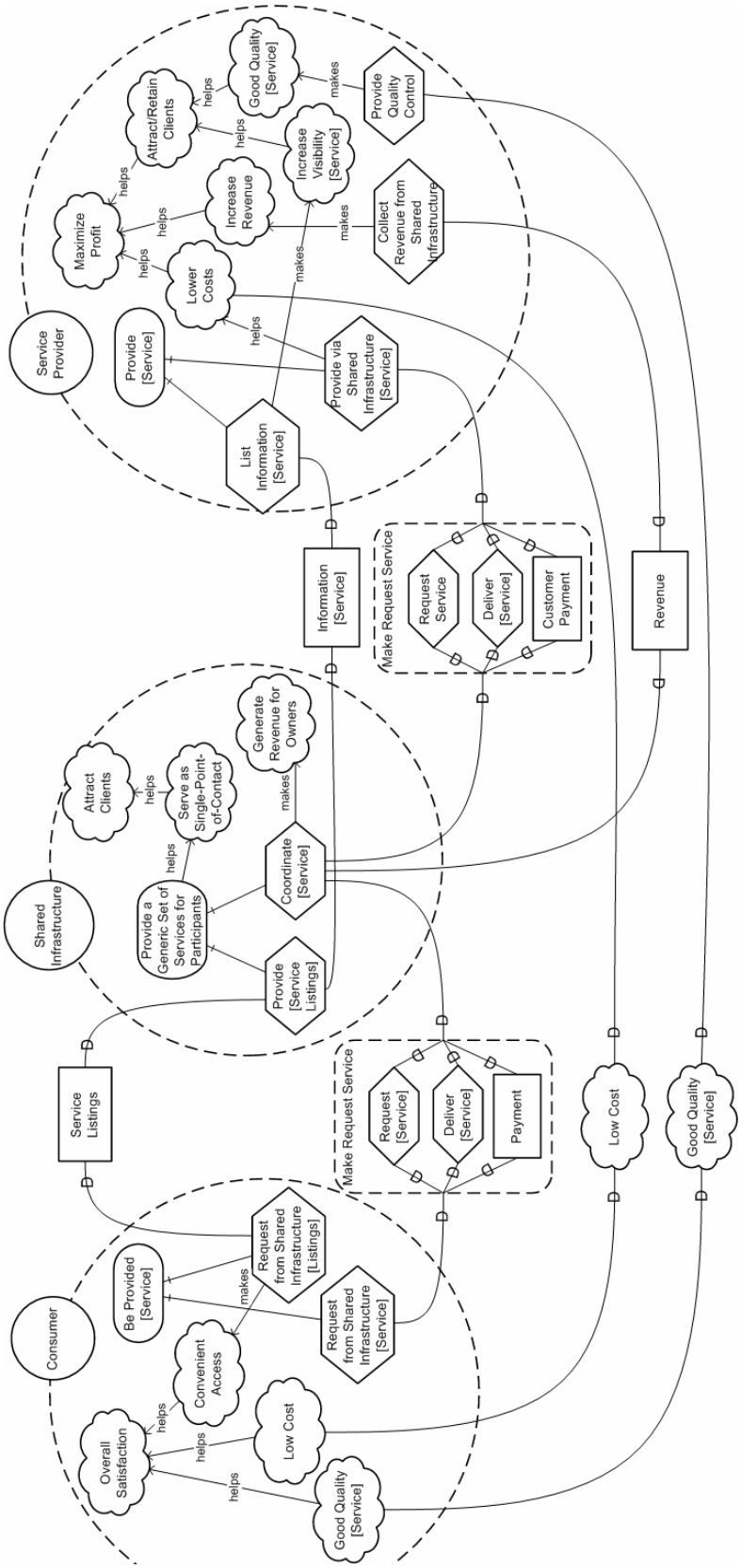
Service providers and customers have different ownership options:

Ownership options	Intentions or concerns
Service Provider as Owner	• Have access to customer data stored in the shared infrastructure • Own data of their own activities • May collect revenue from shared infrastructure, if any
Service Provider as Non-Owner	• May or may not have access to customer or activity data stored in the shared infrastructure • May have lower priority in presenting its services compared to owner's services
Customer as Owner	• Reduce bargaining power of suppliers • Possible to drive down prices
Customer as Non-Owner	• Less influence on the shared infrastructure, but still benefit from the combined view of available services

14. The *i SD model:**



15. The *i SR model:**

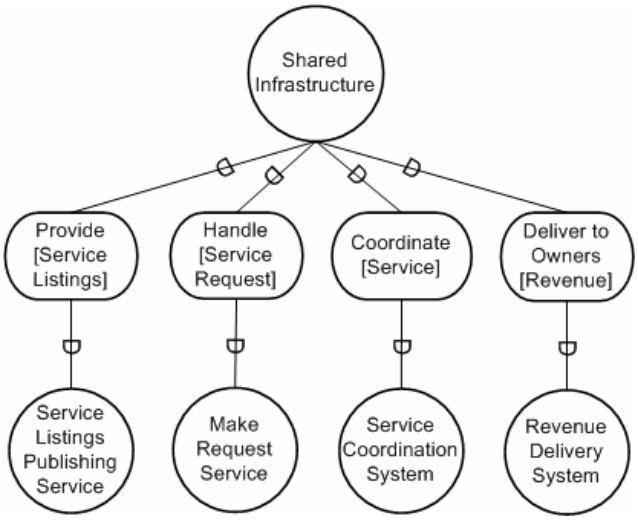


16. List of business services:

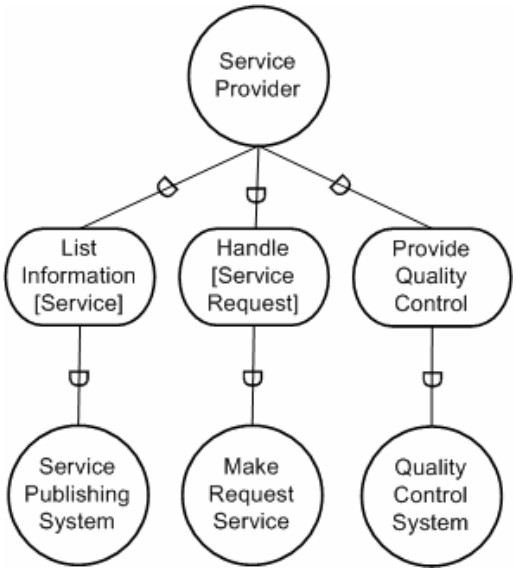
Service in SR model	Requester	Provider	Business Service Pattern
Service Listings	Shared Infrastructure	Service Provider	Obtain Data Service (Push from provider)
Service Listings	Customer	Shared Infrastructure	Obtain Data Service (Pull from requester)
Make Request	Customer	Shared Infrastructure	Place Order Service
Make Request	Shared Infrastructure	Service Provider	Place Order Service
Distribute Revenue	Shared Infrastructure	Service Provider (owners only)	N/A

17. Extended actor models:

For shared infrastructure:



For service provider:



Model No. 5: The *Value Chain Integrator* Reference Model

1. **Name:** The *Value Chain Integrator* Reference Model

2. **Summary:** This model involves four types of actors: supplier, customer, complementor, and the value chain integrator. It enables the supplier to focus on its core competence by outsourcing its value chain operations. It also allows the value chain integrator to take advantage of its central position among the suppliers, customers and complementors, and coordinates tasks in the value chain operations.

3. **Key business drivers:**
   - Increasing complexity in coordinating of value chain operations
   - Financial/cost pressure on suppliers/manufacturers
   - Increasing speed and reliability expectations from customers

4. **Solution:** Physical actions are performed by the suppliers and complementors, but the coordination tasks are outsourced to the value chain integrator. Suppliers and complementors can focus on their core competences, while the value chain integrator specializes in managing information and the flow of goods and services.

5. **Potential advantages:**
   - Reduced costs in handling value chain operations
   - Streamlined and accelerated value chain
   - Enhanced visibility throughout the value chain
   - Fast and reliable delivery
   - Improved customer satisfaction

6. **Challenges and limitations:** Increased need of technology for facilitating efficient communication and information management.

7. **Key business actors:**
   - Supplier – The product supplier who outsources its value chain operations to the value chain integrator.
   - Customer – The customer who orders products from the supplier.
   - Value chain integrator – The agent who helps the supplier to coordinate tasks in the value chain operations and manage information and resource flows among the supplier, complementor and customer.
   - Complementor – The agent who carries out the actual tasks that are outsourced by supplier, including the shipping or delivery of products.

8. **Strategic dependencies:** The supplier is dependent on the customer to create product orders. The value chain integrator depends on the supplier to request value chain operation support. The complementors depend on the value chain integrator to request its services. The customer is dependent on supplier to offer products with good quality and a low cost, but the actual delivery would come from one of the complementors.

9. **Revenue model:** Revenue flows from customer to supplier, from supplier to value chain integrator, and from value chain integrator to the complementors.

10. **Related model(s):** *Intermediary*

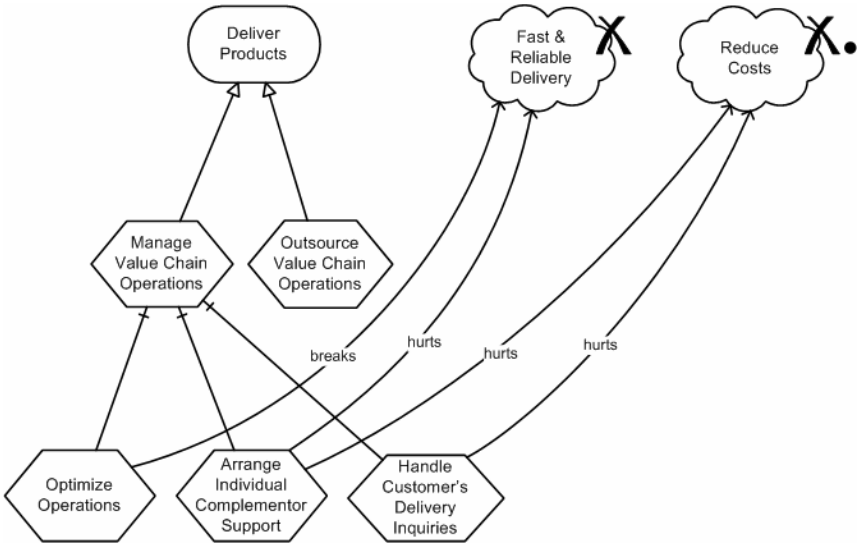
11. **Source(s):** Adapted from the *Value-Chain Integrator* model proposed in [Timmers99] and the *Value Net Integrator* model in [Weill01] and [Straub04].

12. **Example:** UPS Trade Direct℠, which acts as a value chain integrator that arranges transportation and freights for product delivery for consumer product manufacturers such as Adidas and Nikon.

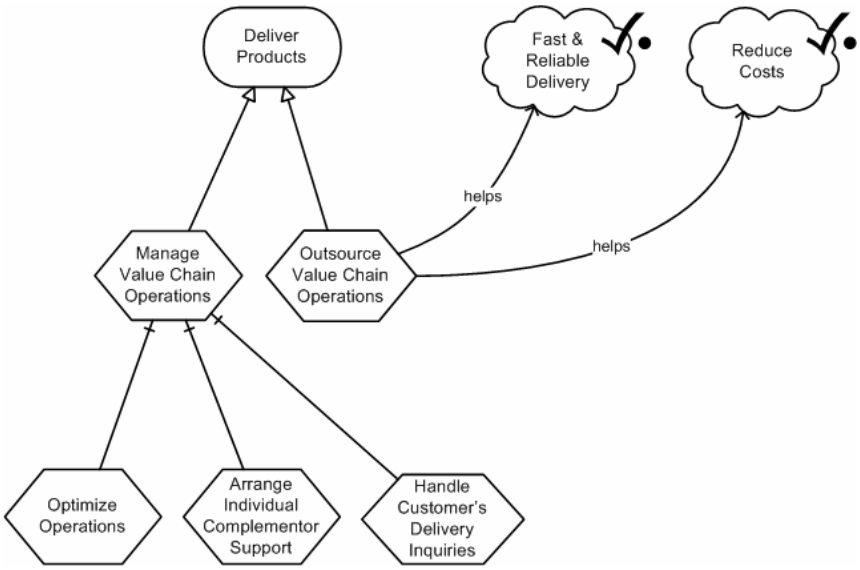
13. **Business design rationale(s):**

1. Suppliers have two options for handling its value chain operations:

	Design options	Intentions or concerns
1	self-manage the value chain operations	This option is usually less desirable since operation costs, delivery speed and reliability are often important objectives of the suppliers (see goal models below)
2	outsource the value chain operations	If operation costs, delivery speed and reliability are important objectives of the suppliers, then outsourcing is a better option (see goal models below)



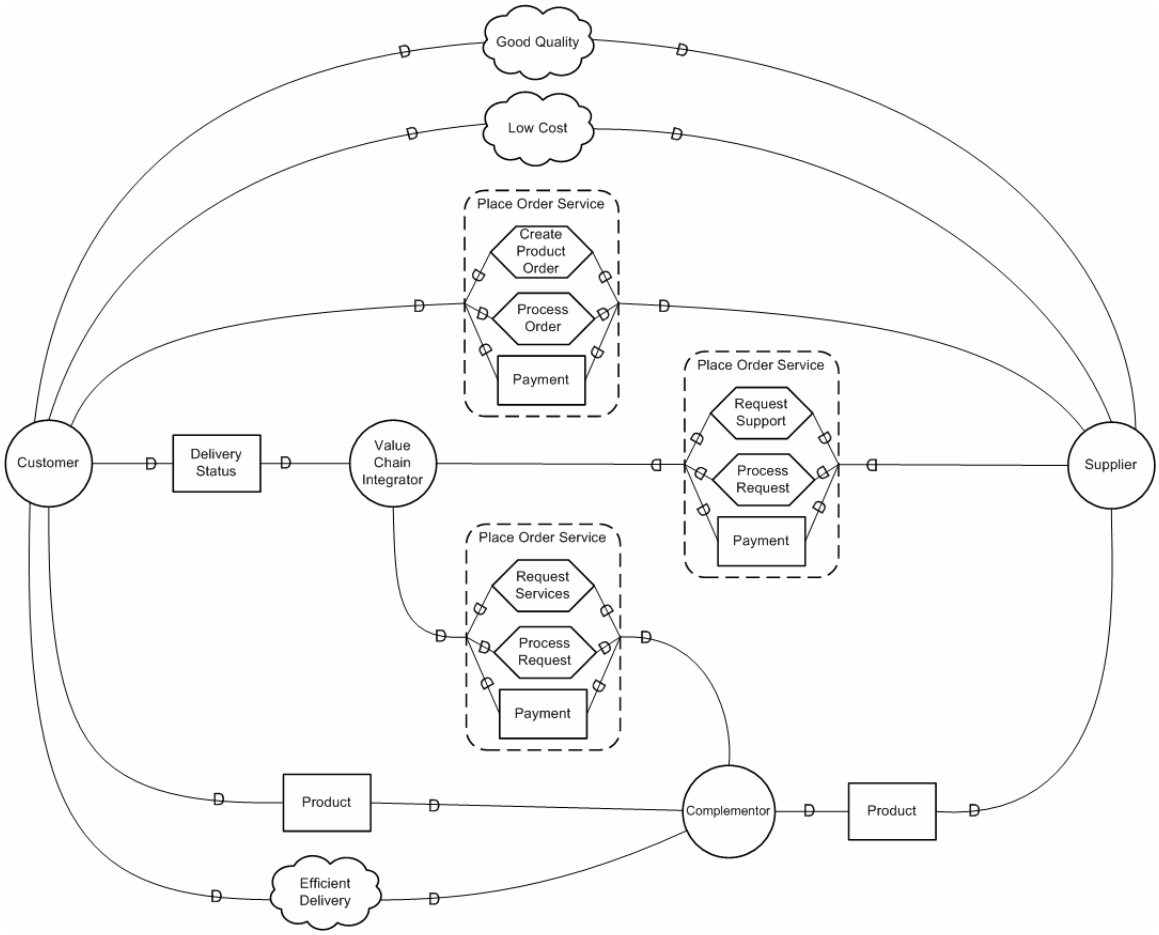
Supplier's contributions to business goals by self-managing the value chain operations



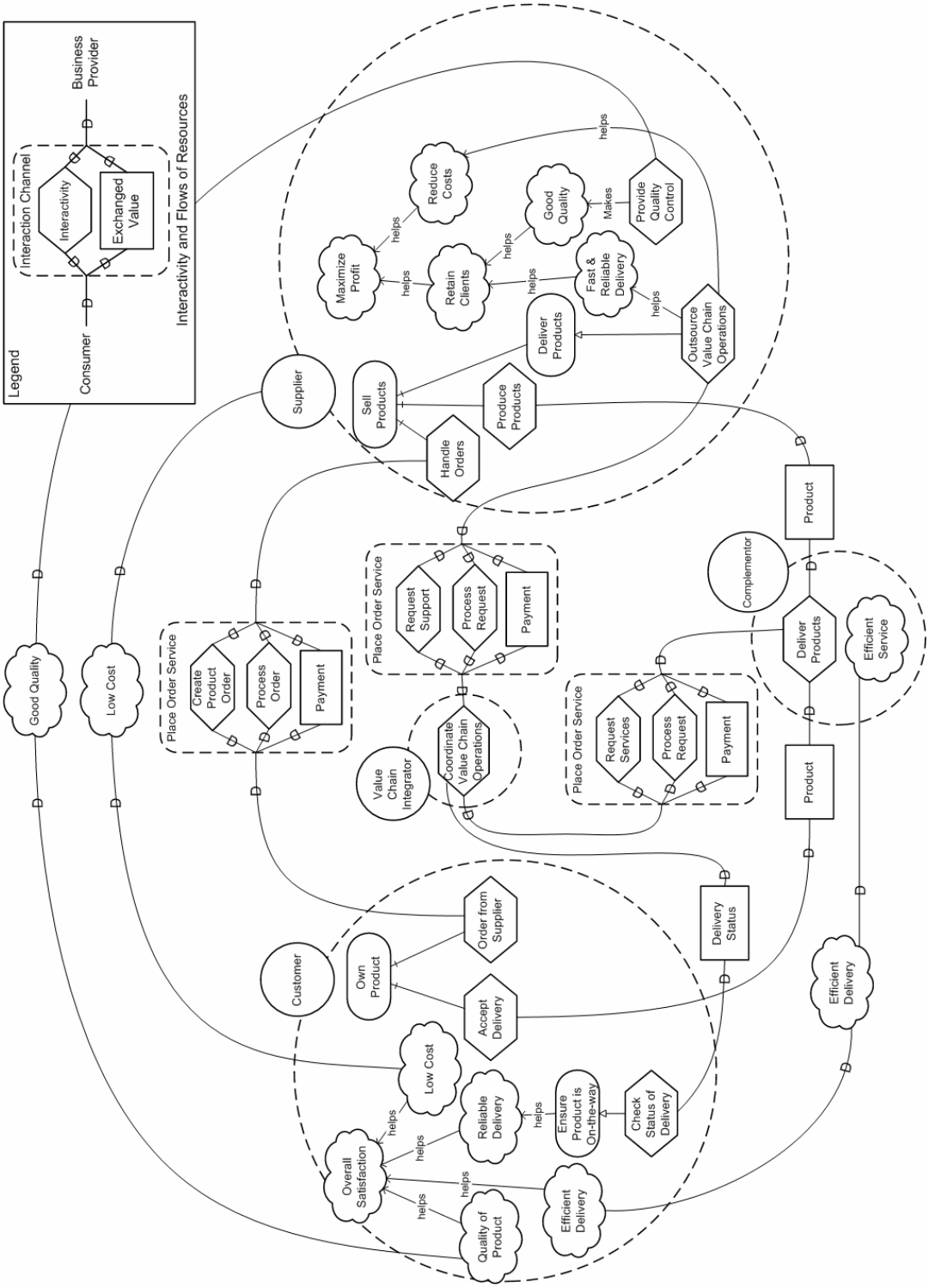
Supplier's contributions to business goals by outsourcing the value chain operations

2. The exchange of resources may be performed by either of *pulling on demand* or *pushing once available*, which are two options described more in detail in the *Obtain Data Service* section. In the case of sending *delivery status* information to the customers, the service would likely be offered by the value chain integrator on demand, i.e. via the *Request Data Service*, because customers are not required to know the delivery status unless they have questions or concerns about it, and it is less reasonable and affordable for the customers to offer a *Send Data Service* to the value chain integrator.

14. The *i SD model:**



15. The *i SR model:**

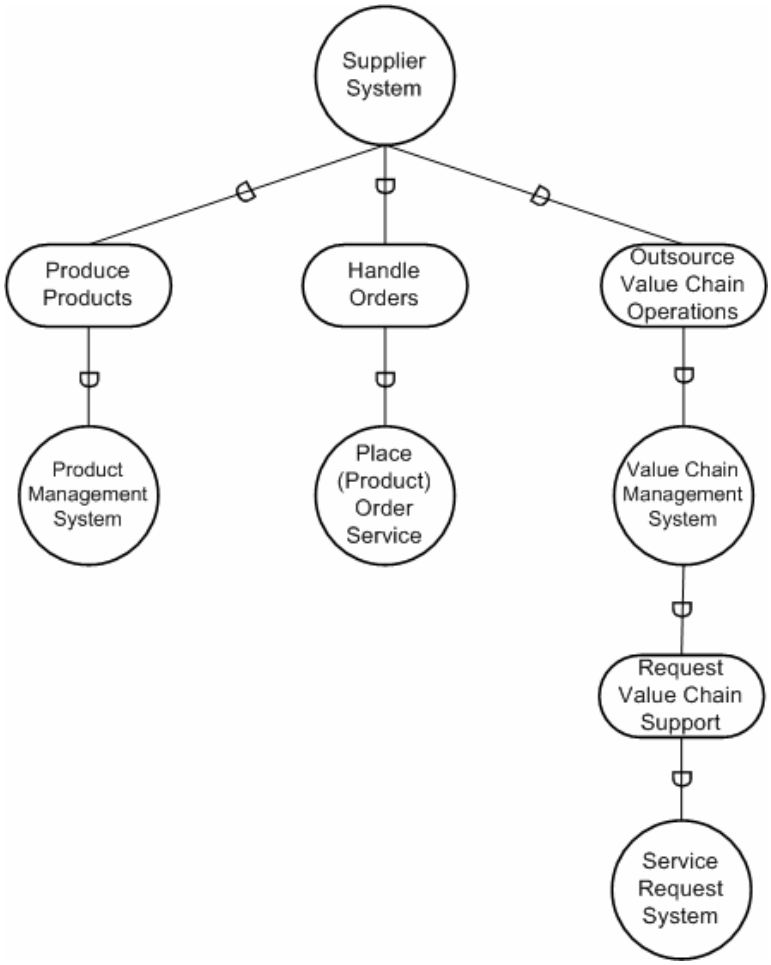


16. List of Business Services:

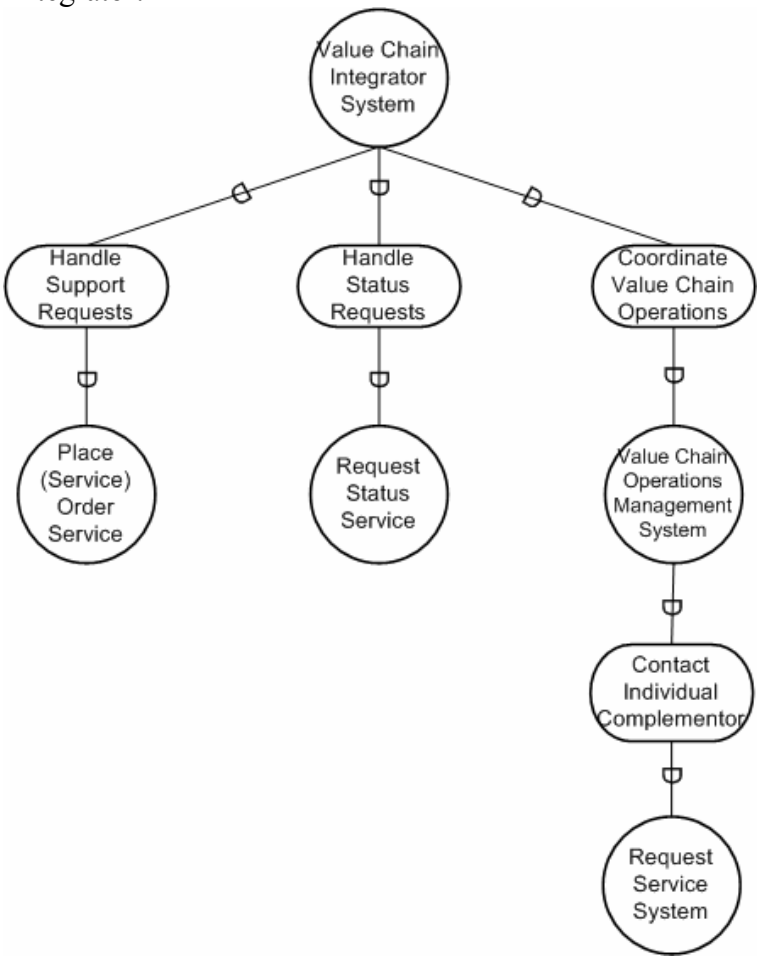
Service in SR model	Requester	Provider	Business Service Pattern
Place (Product) Order	Customer	Supplier	Place Order Service
Place (Service) Order	Supplier	Value Chain Integrator	Place Order Service
Place (Service) Order	Value Chain Integrator	Complementor	Place Order Service
Request Status	Customer	Value Chain Integrator	Obtain Data Service (Request Data Service, see design rationale no.2)

17. Extended Actor Models:

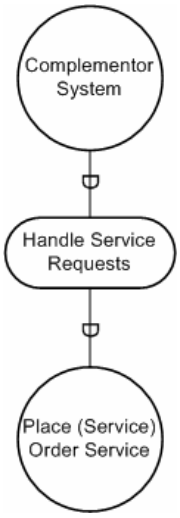
For supplier:



For value chain integrator:



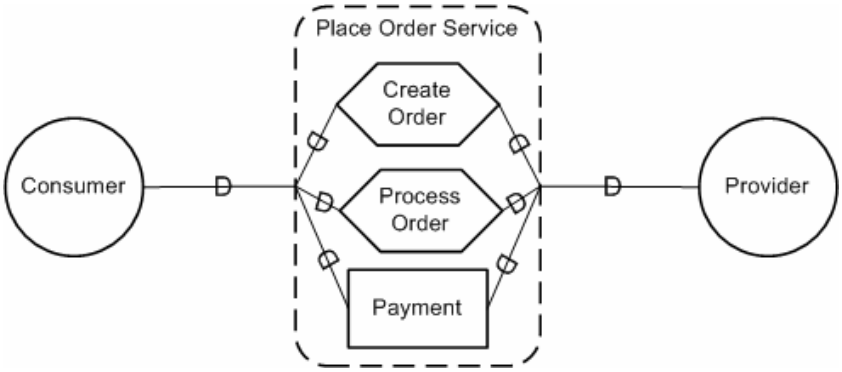
For transporter:



Appendix B - Sample Catalog of Business Service Patterns

Service Pattern No.1: *Place Order Service*

1. The recurring business service:
A business service that may apply this pattern looks similar to the following in the *i** business model:

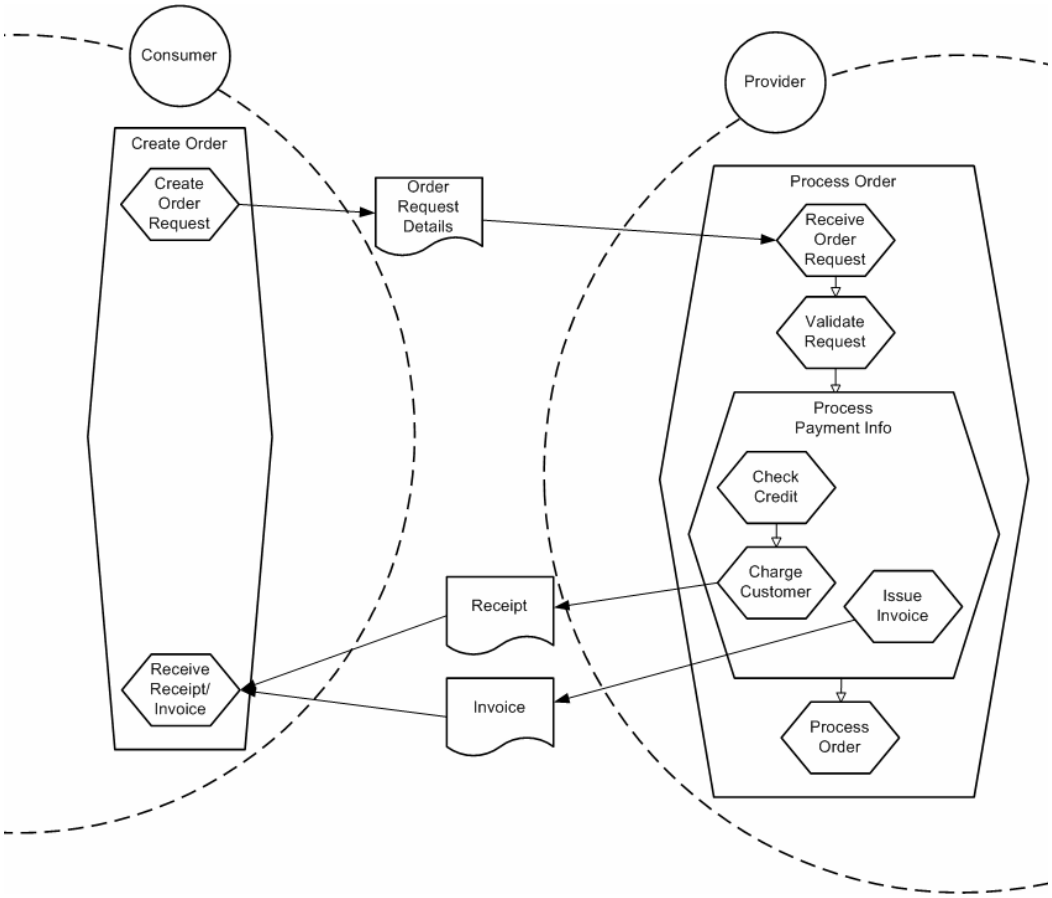


2. Design rationale(s):

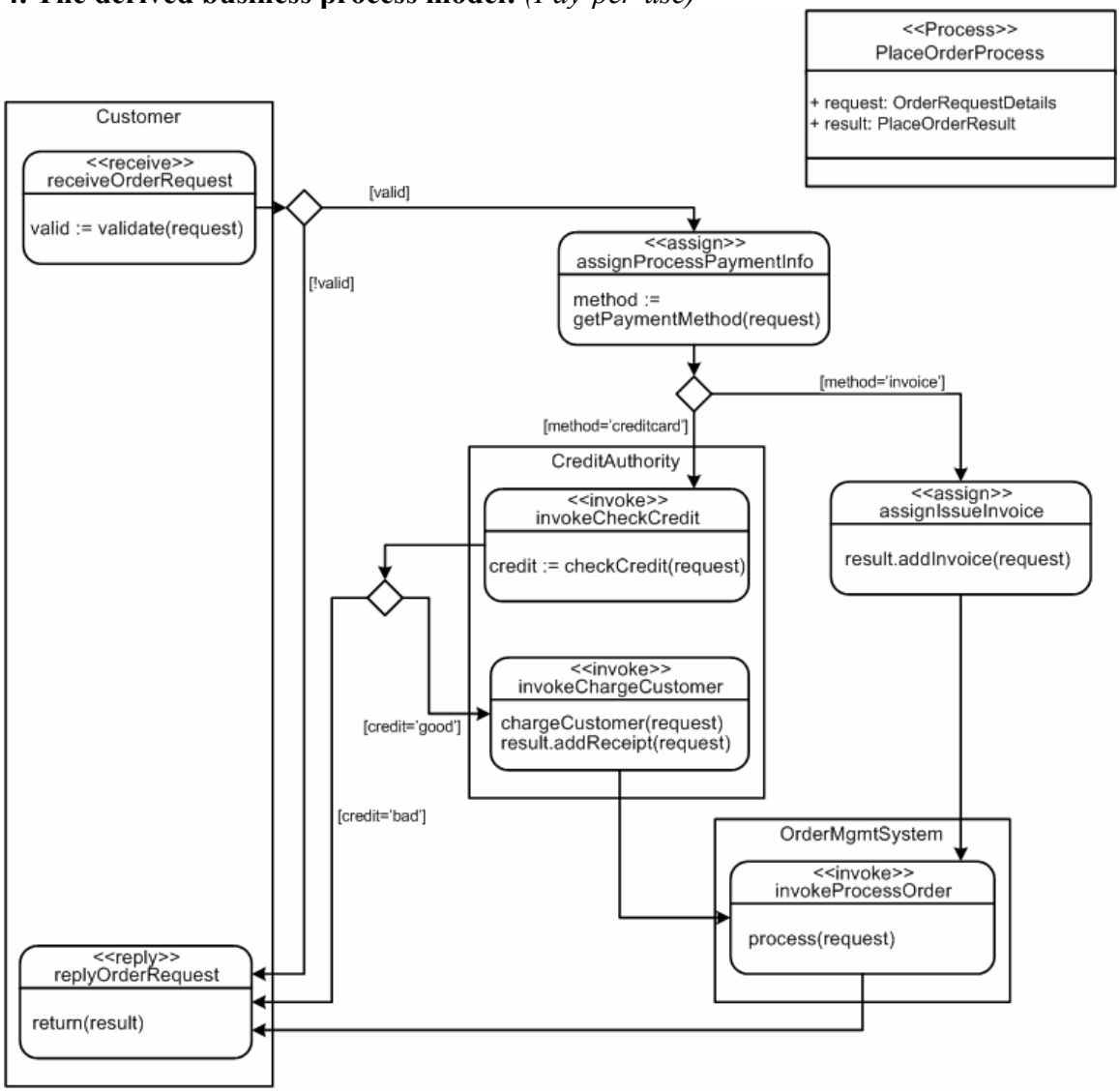
There are a number of different payment options, such as the followings:

	Design options	Intentions or concerns
1	*Pay-per-use* (immediate payment)	Fees are incurred according to the usage rates, and payment must be made at the time of usage.
2	*Pay-per-use* (periodic invoice)	Fees are incurred according to the usage rates, and fee statements are sent to the user periodically.
3	*Subscription-based*	Users of the service are charged periodically, such as daily, monthly or annually, and the subscription fees are incurred irrespective of actual usage rates.

3. The derived business collaboration diagram: *(Pay-per-use)*



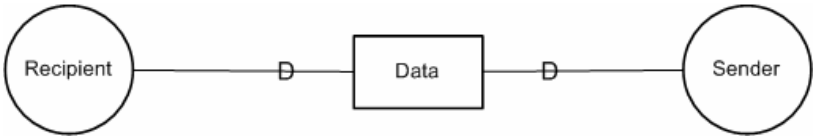
4. The derived business process model: *(Pay-per-use)*



Service Pattern No.2: *Obtain Data Service*

1. The recurring business service:

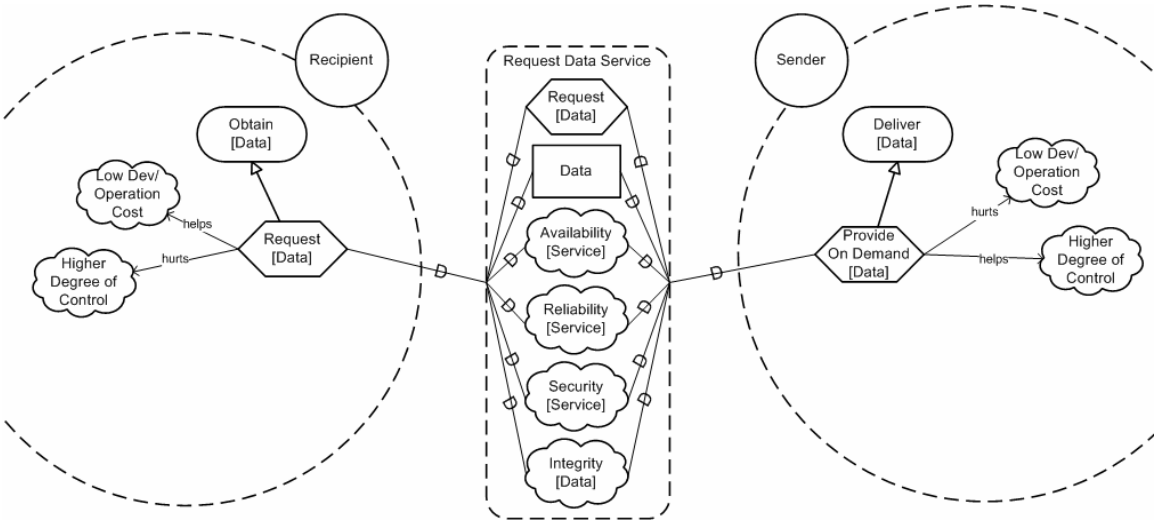
A business service that may apply this pattern looks similar to the following in the *i** business model:



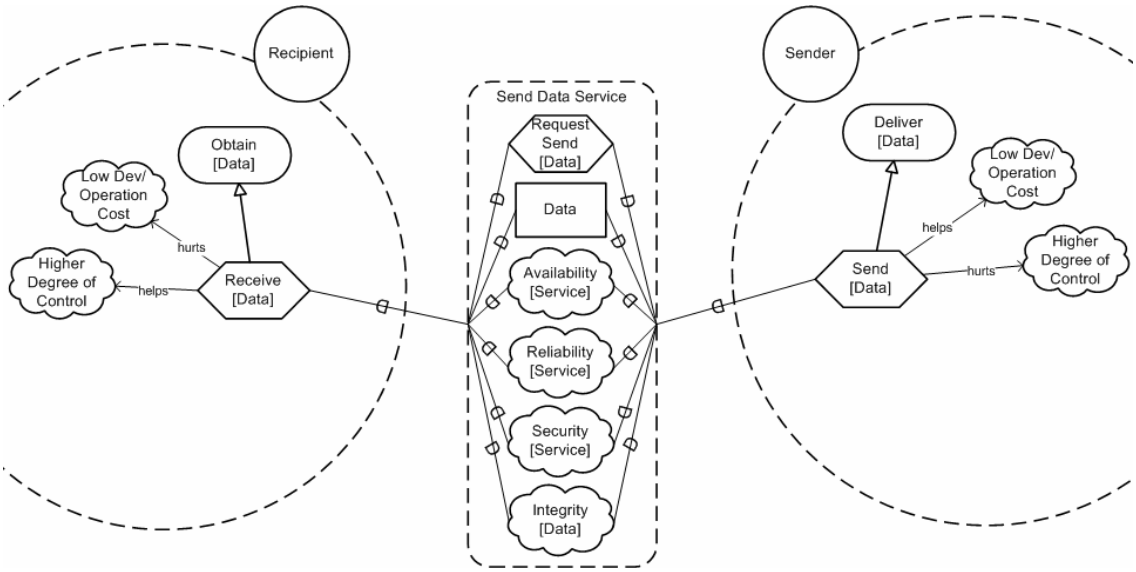
2. Design rationale(s):

	Design options	Intentions or concerns
1	*pulling* the data from the sender to the recipient on demand	• service will be provided by the sender • sender must afford the development or operation costs to support the transaction • sender has higher degree of control over service • recipient is dependant on sender in terms of the availability, reliability, and security of the service (see SR model for option 1 below)
2	*pushing* the data to the recipient from the sender when it is available and ready	• service will be provided by the recipient • recipient must afford the development or operation costs to support the transaction • recipient has higher degree of control over service • sender is dependant on recipient in terms of the availability, reliability, and security of the service (see SR model for option 2 below)

Option 1: Pulling data from sender to recipient on demand

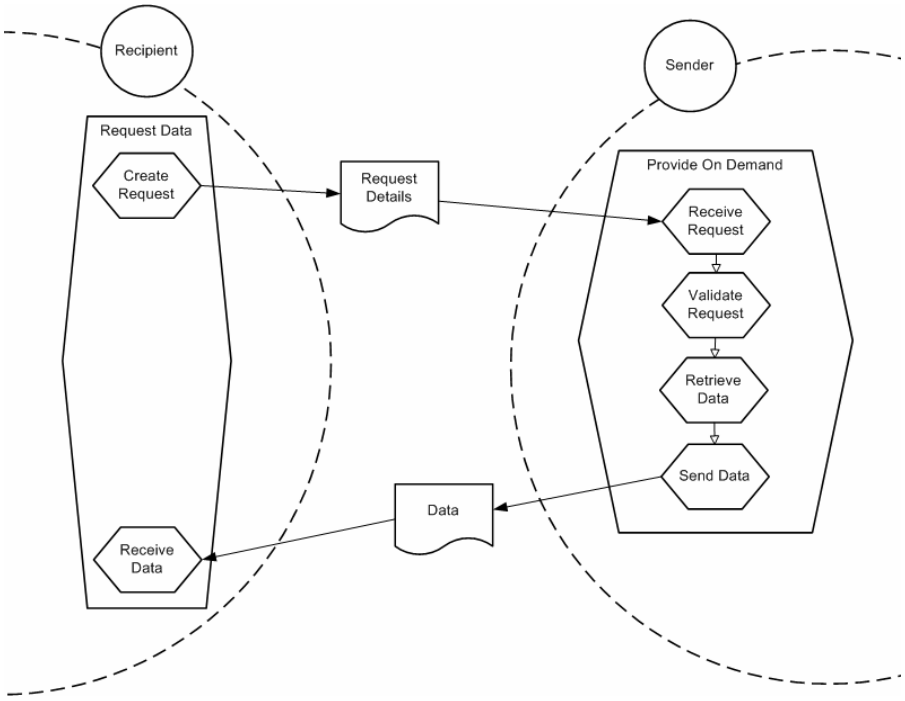


Option 2: Pushing data to recipient from sender when it is available and ready

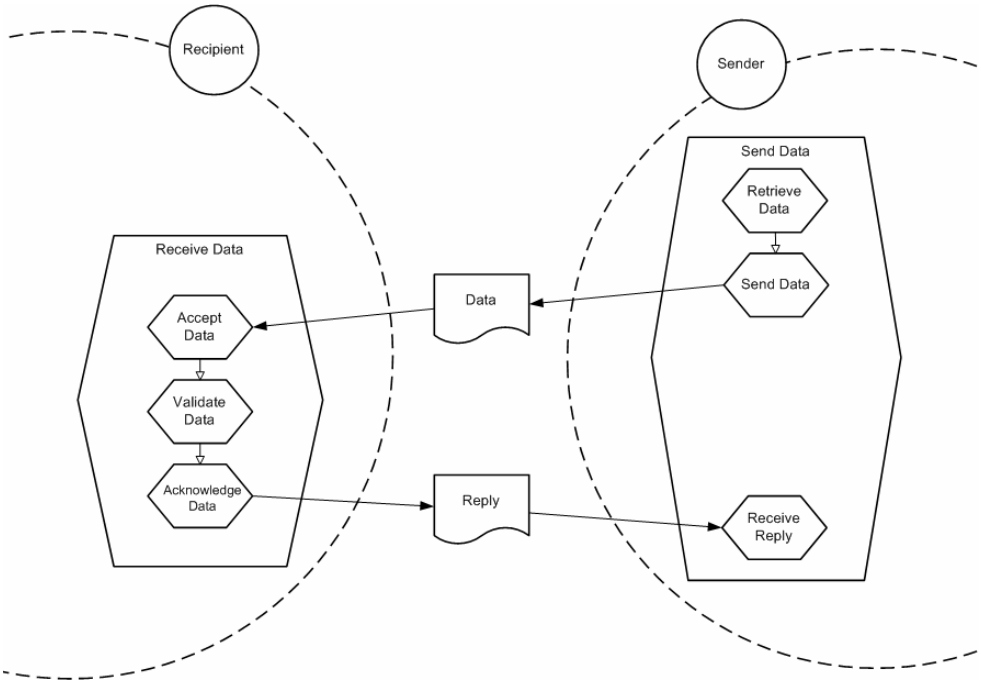


3. The derived business collaboration diagram:

Option 1: Pulling data from sender to recipient on demand

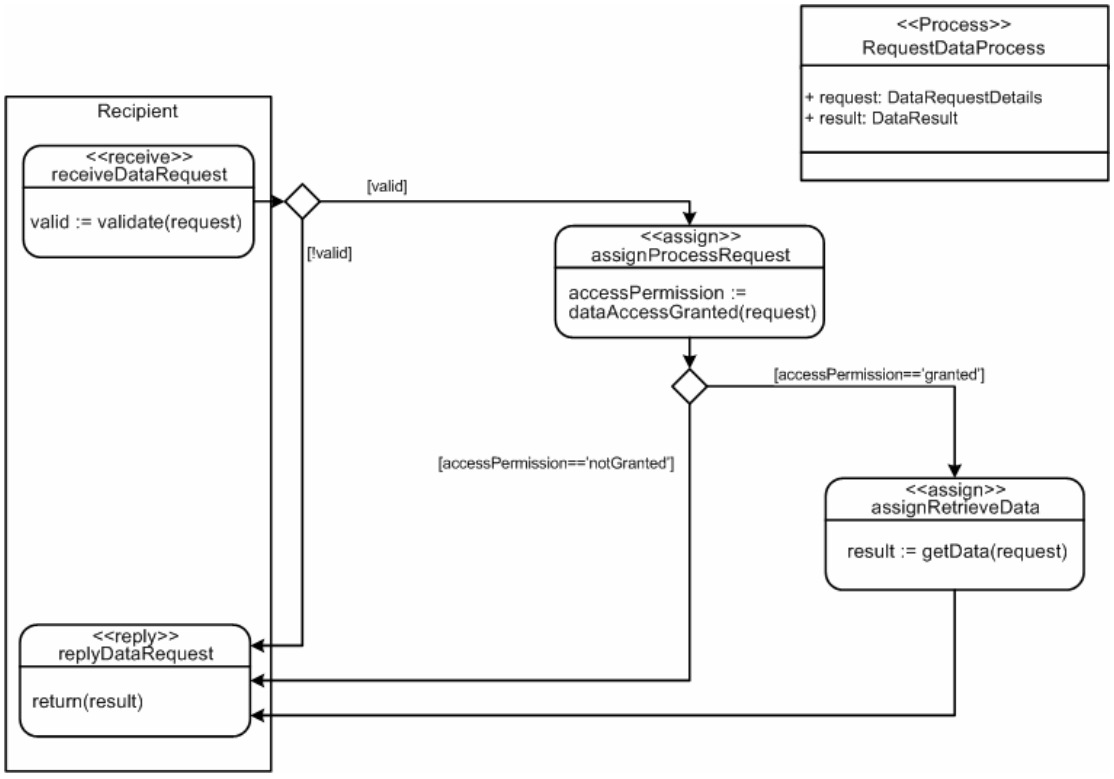


Option 2: Pushing data to recipient from sender when it is available and ready



4. The derived business process model:

Option 1: Pulling data from sender to recipient on demand



Option 2: Pushing data to recipient from sender when it is available and ready