Business Analysis of Communication and IT Service Portfolios

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Problem Description

Services and service platforms are subject to two major types of analyses; business and technological. Particularly interesting for the analyses are the service portfolios, materialized as bundling of services. The purpose of this thesis is to analyze a chosen set of communication and IT service portfolios, with emphasis on cash flow optimization and business actor positions and incentives.

A NGN service platform with heterogeneous business and technical structure shall be analyzed. The platform is provided by several business and system actors. It delivers services to end users as a set of service portfolios. Service portfolios shall be modeled by already existing frameworks and models that will have to be adjusted in order to exchange business and technical information. The existing models shall be improved in order to address new analytical issues, such as quantitative analysis of the business actor positions through revenue share/split models.

A case based analysis and optimization shall be conducted on a case from the EU FP6 Spice project or from the PATS experimental service platform. The case based analysis will contain a set of service scenarios and corresponding service portfolios.

Important research questions:
- How can scenarios be used to represent business models and business strategies?
- How can the scenarios be analyzed qualitatively and quantitatively?
- How can the business actor positions be analyzed in the scenarios?
- How can the relations between business actors be analyzed through modeling?

Assignment given: 18. January 2007
Supervisor: Rolv Bræk, ITEM

Preface

This master thesis marks the end of my five year study at the Norwegian University of Science and Technology (NTNU). The thesis itself is the result of five months of research into the area of service portfolio business analysis. During this research period, the knowledge acquired during my years at NTNU has proved most useful. The work on this thesis was carried out from January to June 2006.

This thesis has been prepared under the supervision of Telenor and the Department of Telematics (NTNU). I am indebted to my supervisor at Telenor, Josip Zoric, for valuable feedback throughout my work on this thesis. Furthermore, I would also like to thank Professor Rolv Bræk for his supervision and useful suggestions.

Trondheim, June 7th, 2007

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Stud. techn.

Abstract

The last decades in the communication and IT industry have been influenced by the introduction of numerous new business actors and technological systems. They have brought with them a wide variety of business actors operating on different levels of the value chain, or together in complex value constellations. Old platform specific standards have started to fade away, and new platforms with more streamlined layers have appeared. These new platforms are part of the Next Generation Network (NGN). Services of this network utilize a number of service enablers. The new service platforms deliver services to the end user as a set of service portfolios.

The new NGN communication and IT services are heterogeneous in two ways; technologically and business-wise. Technologically, they consist of pervasive and ubiquitous services, run by heterogeneous and distributed service platforms. Business-wise, multiple business actors with a variety of business models cooperate to produce the services. Valuation of these new heterogeneous NGN communication and IT services has proved to be challenging. Forecasting of demand and acceptance is difficult due to limited historical experience. The interacting business actors and their variety of business actors also bring with them conflicts of interest. In addition to the challenge of getting their technical systems to work together, they have to agree on a revenue share agreement to share the revenue from the co-produced services.

The purpose of this thesis has been to perform a business analysis of a communication and IT service portfolio, with an emphasis on business actor positions and incentives. To make well informed investment decision regarding such service portfolios, it is vital to valuate the projects quantitatively. To account for and compare different business situations and market development, scenarios are used. These scenarios need to describe business actor relations and strategies.

This thesis proposes a quantitative model framework (CF model) for the analysis of a communication and IT service portfolio. The model is based on the work of Langøygard (2006) and Zoric & Lassen (2005). Relevant technical and economic theory is researched to provide a sound background for the model. Two new aspects are included in the model; bargaining power and revenue share. The model developed evaluates a content provisioning portfolio, where the bargaining power of the content providers is important to the outcome of the project. This bargaining power is important because it decides the price of the service enablers provided by the content providers. The revenue share agreement is important because it decides each business actor's share of the revenue from the services sold, and because it affects the incentives of all business actors.

A proof-of-concept test is conducted to test the functionality of the model and to investigate the profitability of the service portfolio subject to valuation. The test shows that the model functions as intended, accounting for aspects such as user acceptance, demand, market development, and the relation between business actors.

The results from the model suggest that the valuated service portfolio is profitable to all business actors for most of the market developments. The results also show that the content providers are better off when their concentration is low and when they have built up barriers to entry by participating in the service platform cooperation. This is because these factors increase their bargaining power and enables them to charge a higher mark up over marginal cost. This higher mark up more than outweighs the costs of participating in the service platform.

The model results also show that a solution acceptable to most business actors can be reached with most of the scenarios. The scenarios include a net present value threshold for some business actors to account for strategic considerations. The new revenue share functionality has to redistribute the revenue in some of the original solutions to reach a feasible solution. Furthermore, the new revenue share functionality is shown to align the incentives of the participating business actors.

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Abbreviations

A4C	Authentication, Authorization, Accounting, Auditing and Charging
BA	Business Actor
CF model	Cash Flow Maximization Model
CP	Content Provider
CtxtP	Context Provider
GPS	Global Positioning System
GSM	Global System for Mobile Communication
HHI	Herfindahl-Hirschman Index
IdP	Identity Provider
IT	Information Technology
MC	Marginal Cost
MSC	Message Sequence Chart
NEIO	New Empirical Industrial Organization
NGN	Next Generation Network
NP	Network Provider
NPT	Norwegian Post and Telecommunication Authority
NPV	Net Present Value
PATS	Platform for Advanced Telecommunication Services
PLC	Product Life Cycle
POI	Point of Interest
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RFID	Radio Frequency Identification
SCP	Structure-Conduct-Performance
SE	Service Enabler
SP	Service Provider
SSB	Statistics Norway (nor: Statistisk sentralbyrå)
UML	Unified Modeling Language
UMTS	Universal Mobile Telecommunications System
WLAN	Wireless Local Area Network

Chapter 1

Introduction

1.1 Background

The last decades in the communication and IT industry have been influenced by the introduction of numerous new business actors and technological systems. In the past, the telecommunications industry in each country was normally dominated by one firm. This firm controlled all parts of the value chain, and operated a state regulated monopoly of telecommunication services (Dodd 2005). The services were homogenous with network and application specific standards, systems and capabilities integrated at channel or customer point.

The Telecommunication Act of 1996, and similar acts across the world, was the beginning of a new era. The networks of the state regulated monopolies were opened up to other firms, and mandatory unbundling was enforced in many areas (Dodd 2005). This brought with it a wide variety of business actors operating on different levels of the value chain, or together in complex value constellations. Old application specific standards started to fade away, and new platforms with more streamlined layers appeared. The new platforms were integrated at solutions or assembly layer, and allowed for a number of business and system actors to cooperate in the production of a service. These new platforms are part of what is called the Next Generation Network (NGN). Services of this network are collected in service platforms, where each service requires a set of enabling services. The platform delivers services to the end user as a set of service portfolios.

The new NGN communication and IT services are heterogeneous in two ways; technologically and business-wise. Technologically, they consist of pervasive and ubiquitous services, run by heterogeneous and distributed service platforms. Business-wise, multiple actors with a variety of business models cooperate to produce services. These actors make up a complex value network that interacts to implement the value creation.

Valuation of these new heterogeneous NGN communication and IT services has proved to be challenging. Forecasting of demand and acceptance is difficult due to limited historical experience. The interacting business actors and their variety of business models also bring with them conflicts of interest. In addition to the challenge of getting technological systems to work together, agreeing on the revenue share agreement is vital to the realization of services with multiple business and system actors.

1.2 Problem Statement

The purpose of this thesis is to perform a business analysis of a communication and IT service portfolio. A Next Generation Network (NGN) service platform is studied. This platform delivers services to the end user as a set of service portfolios. The platform is made up of a number of services and service enablers, which can be provided by a number of business and system actors.

To make a well informed investment decision regarding such NGN service platforms and services, it is important to valuate the platform quantitatively. With a number of business and system actors involved, this is a complex task. This thesis seeks to develop a quantitative model for such a valuation. The goal is to create a model that takes as input information regarding the users, the system and technical model, and the business situation to perform a valuation. This input takes the form of general variables and different scenarios specifying scenario-specific input.

The quantitative model in this thesis is based on the work of Langøygard (2006), Zoric (2005), and Zoric & Lassen (2005). Their work developed models for the valuation of heterogeneous service platforms. The work in this thesis attempts to extend and improve their models to account for important aspects of heterogeneous business situations. One important question is how the varying incentives and bargaining power of each business actor influence the revenue share agreement. Moreover, this thesis tries to answer the following important research questions:

- How can scenarios be used to represent business models and business strategies?
- How can the scenarios be analyzed qualitatively and quantitatively?
- How can the business actor positions be analyzed in the scenarios?
- How can the relations between business actors be analyzed through modeling?

1.3 Scope

The goal of this thesis is to develop a quantitative model for the valuation of heterogeneous communication and IT service portfolios. In order to create this model, the supporting economic and technical theory is investigated. Relevant theory is presented and explained briefly. Risk is accounted for by the use of scenarios describing different input variables. It is out of scope for this thesis to account for risk through the use of financial portfolio theory.

This thesis develops a technical model of the service portfolio, and an economic model for the valuation of the portfolio. These two models are tightly coupled. The formal technical representation of the service portfolio is important to the valuation. How the underlying technology is adapted by the market is important to the evaluation, but the technical specification of the technology is not. Hence, the specification of this technology is out of scope for this thesis.

1.4 Methodology

The work conducted for this thesis consists of two main parts. The first part is the investigation of relevant economic and technical theory surrounding service platforms and their markets. This theory needs to be understood in order to determine which factors influence the valuation of the platform. Technical theory needs to be researched to enable a sound specification of the platform structure and technology. Economic theory needs to be investigated to identify the economic and market mechanisms that will influence the valuation.

The researched theory provides the basis for the quantitative model. The valuation model is Microsoft Excel-based and contains several phases. Each phase takes the calculations one step closer to the result. The model is developed iteratively, by first developing a basic model and then introducing more aspects and calculations for every new iteration. Only the final model is presented in this thesis. The models of Langøygard (2006) and Zoric & Lassen (2005) have influenced the work of this thesis.

1.5 Project Outline

This chapter provides a brief introduction to the history and market of communication and IT services. It also presents the problem statement, defines the scope of the work, and describes the methodology used to solve the problem. Chapter 2 presents the technical theory necessary to understand the concept of service platforms and the components such platforms consist of. It also specifies the service portfolio that is the subject of valuation, and how this portfolio is linked to business and system actors.

Chapter 3 presents the economic theory necessary to perform the quantitative valuation and develop the model. Furthermore, the strategy concepts that influence the way the business actors cooperate and interact to determine the revenue share agreement are presented.

Chapter 4 presents and discusses the different scenarios that are valuated. The scenarios take the form of different input parameters to the model. Chapter 5 presents the cash flow maximization model that has been developed. The model is described by its different phases, each performing important calculations. These phases represent separate work sheets of the Excel model.

Chapter 6 presents the results that have been obtained from the scenario valuations. The quantitative results are discussed, and a qualitative evaluation of the scenarios is performed. Chapter 7 presents the conclusion of this thesis. Areas for future work are also suggested.

Chapter 2

Technical Background

The main purpose of this thesis is to perform an economic valuation of a service portfolio through creating a valuation model framework. But to understand what is being valuated, it is important to understand the underlying technical concepts. There is also an important relationship between the technical system and the business situation that should be understood before proceeding to study the model itself.

2.1 Introduction

This chapter introduces the technical theory that is necessary to understand the model developed. The cash flow maximization model quantitatively determines the value of participating in the co-production of services. There are several technical terms and concepts that are important to understand what the model valuates. Among these are service platforms, service portfolios, services and service enablers. This chapter explains these concepts. Furthermore, there are business aspects that are tightly coupled with the technical aspects. For instance, the technical situation is important to how the business actors interact. An examination of the relation between the technical system and the business situation is conducted in this chapter.

The concept of service portfolios is quite recent, and a result of an ongoing development in the IT and communication industry. This chapter presents a brief summary of the historical development. Services have been delivered by the communication industry for many years, and explaining the development towards the service portfolios of today provides a good background for this thesis.

After having explained the historical development, a more thorough explanation of the technical concepts is given. The service platform itself and the system components and business actors involved in it are described.

Since the model in this thesis is developed to valuate service portfolios, the specific service portfolio that is the subject of valuation is presented in this chapter.

2.2 Historical Development

Telecommunication services have been around for a while, but the type of services and the way they are delivered has changed greatly over the years. The change has been especially rapid during the last two decades. Historically, the telecommunication industry was dominated by one firm in national monopolies. The dominating firm, called the incumbent, was owned by the government or ran a state regulated monopoly. The incumbents controlled all parts of the physical infrastructure, such as the switching centrals and the copper wire connecting households and companies to the network. Because the incumbents were the only firms with access to this infrastructure, they also controlled the services delivered through it. All services were developed, produced, distributed and delivered by the dominating firm (Dodd 2005).

During the 1990s and early in the new millennium, most monopolized national telecommunication industries experienced a softening of the regulation. In the United States, the Telecommunications Act of 1996 became the turning point of the industry. In Europe, governments also decided to soften up the regulation (Dodd 2005). The new regulatory scheme often introduced mandatory unbundling, forcing the incumbents to give other business actors access to their network components. The idea behind the unbundling was that it would facilitate competition among telecommunication providers, and eventually enable competitors to the incumbents to build their own networks (Hausman 2005).

This new regulatory scheme brought with it a number of new business actors. The introduction of these competitors has dramatically changed the telecommunications landscape. Firstly, a number of new and more complex services have been introduced. Secondly, the new business actors have to cooperate to deliver many of these new services. They own different parts of the network infrastructure and have different capabilities. These have to be combined to produce and deliver services.

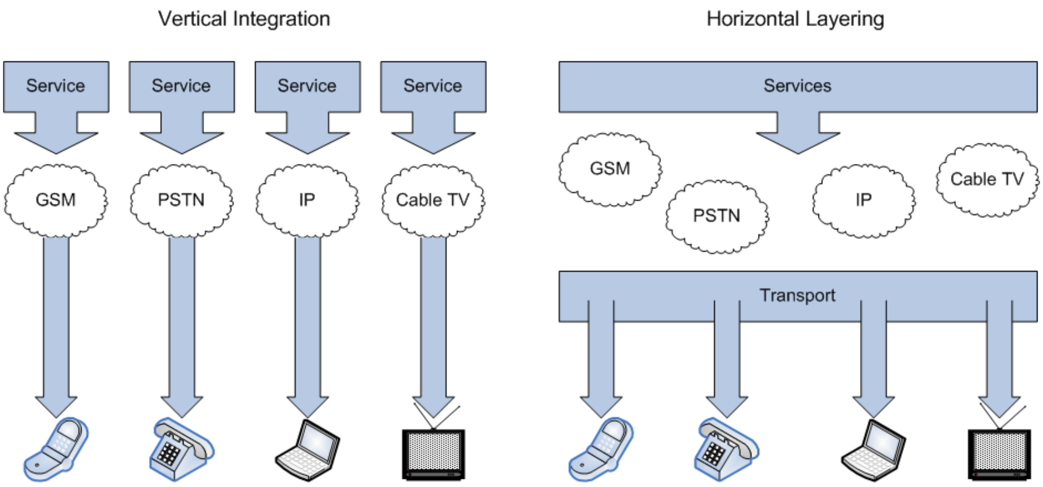


Figure 2.1: Evolution from vertical integration to horizontal layering, based on Boman (2001).

Before the deregulation, the incumbent handled all stages of service production and delivery. Hence, there was no need for publicly specified interfaces and certified standards. The services were delivered through service "stove pipes". Standards were network and application specific, integrated at channel or customer point. Service production and delivery was vertically integrated. Many of the new applications however, have been decoupled from the underlying infrastructure. They are also forcing the development of open standards and agreed upon interfaces. The traditional vertical business and technology segmentation is being transformed into one with a horizontally layered service environment, where the new services can be provided over any underlying network technology (Boman 2001). This development is shown in Figure 2.1.

2.3 Service Platforms

The new services created through the cooperation between different business actors are often heterogeneous services. The term heterogeneous comes from the fact that these services consist of several components and service types. These service types could be video and audio, positioning and content, and

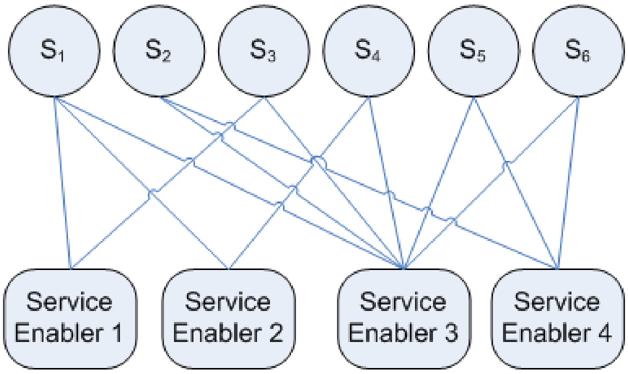


Figure 2.2: Services (top) requiring service enablers (bottom)

so forth. The service types require *service enablers*. The main purpose of such a service enabler is to offer a re-usable building block for the creation of innovative services. A service enabler may have been a service, but as the services evolved it instead became a helper service for other services and as such a service enabler (Ericsson 2006).

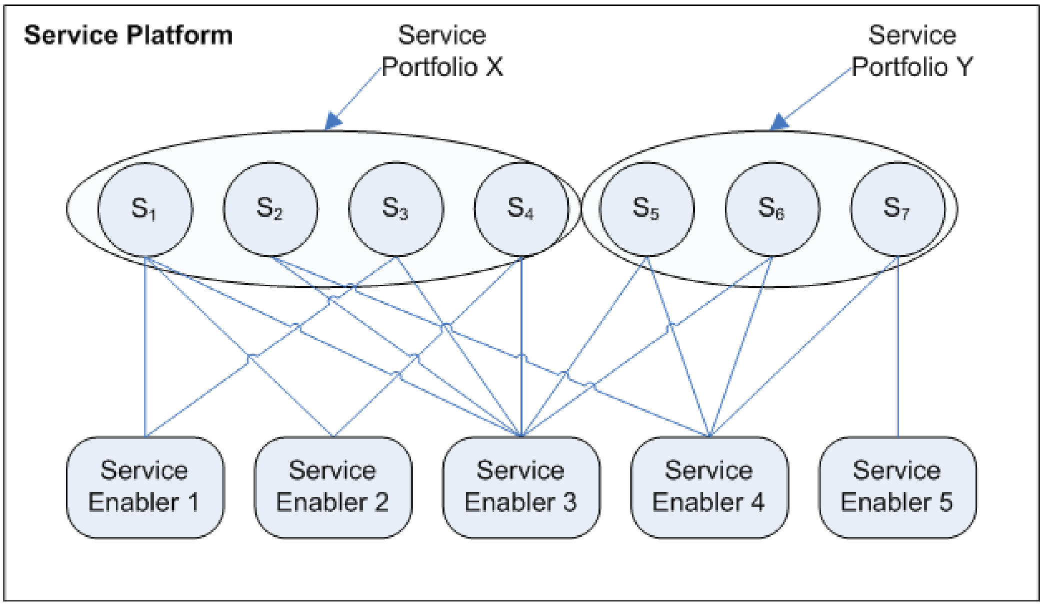


Figure 2.3: Service platform including all components

As business actors have different capabilities and control different network functionality, they provide different service enablers. To allow for a co-production of services by using the service enablers of other business actors, the services are often produced in *service platforms*. Service platforms are an environment for services and applications to operate in, with standardized access to the communication layers. They act as the providers of service enablers (Zhdanova, Zoric, Marengo, Kranenburg, Snoeck, Sutterer, Räck, Droegehorn & Arbanowski 2006).

Another term that needs to be explained is *service portfolio*. A service portfolio is a portfolio of services within the service platform. Such portfolios can be used to group services by functionality or customer value. An example of a service platform, complete with services, service enablers and service portfolios, is given in Figure 2.3.

2.4 PATS Service Platform

This section introduces the PATS (Platform for Advanced Telecommunication Services) service platform that is used in this thesis. PATS is the result of a research agreement between the Norwegian University of Science and Technology (NTNU), Ericsson, Telenor and Hewlett-Packard. The vision of PATS is "to create a virtual centre of excellence on advanced heterogeneous services and fast service development.." (tPATS Portal 2007). In other words, PATS is a research and test platform for new heterogeneous services.

A subset of the services in the PATS service platform is used as input to the cash flow maximization model (CF model) in this thesis. The CF model is developed to be as generic as possible, but it is tested with the PATS input. The purpose of this proof-of-concept test is to analyze the functionality of the model. Using an established set of services from the PATS service platform suits this purpose.

After several years of research and service development, the PATS service platform contains a large set of services. A subset of the available services is chosen for two reasons. Firstly, it makes the quantitative valuation easier to follow. After all, the focus is the model functionality and not the complexity of the input. Secondly, the model requires an input aligned with the research questions it seeks to answer. The model attempts to account for different business situations and the bargaining power of the participating business actors. Hence, the model requires an input with differing business situations and bargaining power.

A content provisioning service portfolio fits the above two purposes. Such a service portfolio is focused around the delivery of content-based services. Examples of such services are guiding tool-based services, content sharing, and content manipulation. All such services require a Content Provision service enabler. However, different content provisioning services may require different types of content. Consequently, there is one type of Content Provision service enabler for each type of content. The number of content providers in such a service portfolio may vary, but the number of other business actors is constant. This brings with it an interesting business situation, discussed further in Chapter 3.

Langøygard (2006) uses the PATS service platform as input to his models. This thesis uses a subset of these services, more specifically the ones that require the Content Provision service enablers. Seven of these services are identified, listed and described in the next section. Through choosing these services, a content provisioning service portfolio is obtained. In the remainder of the text, the chosen service portfolio is referred to as the Service Portfolio.

The service portfolio used in Langøygard's model does not contain specific Content Provision service enablers. However, it does contain a Content Delivery service enabler. The functionality of this enabler overlaps with the Content Provision service enabler introduced in the Service Portfolio. Hence, the Service Portfolio used in this thesis does not include the Content Delivery service enabler used by Langøygard. Furthermore, the service composition presented in Table 2.1 has been modified based on Zoric (2007) to better fit the composition of the PATS platform.

This thesis introduces three new service enablers. These are:

- Content Provision (Context-Based)
- Content Provision (Sharing)
- Content Provision (Information)

In brief, the Service Portfolio used herein does not contain the Content Delivery service enabler used by Langøygard, but introduces the three new service enablers listed above. The portfolio is described in greater detail in the following sections. Note that the Service Portfolio may include more service enablers than the ones described in this thesis, such as service discovery. The components of the Service Platform significant to the valuation, however, are all included.

2.4.1 Services and Service Enablers

As has been noted, services require service enablers. This is also the case for the services of the Service Portfolio. This section presents the service enablers and services of the Service Portfolio. The descriptions are adapted from Langøygard (2006).

The service enablers of the Service Portfolio are:

1. (SE_1): Network service enabler. This is a vital service enabler for all the services, as it provides the physical transfer of data between the users and the service producers. As can be seen from Table 2.1, all services use this service enabler.

2. (SE_2): Context service enabler. Context is any information that characterizes the situation of an entity (Abowd, Dey, Brown, Davies, Smith & Steggles 1999). With IT and communication services, context is often used meaning location, which is a vital component for many new services. In order to provide the user with services that are specifically adapted to the situation, the ability to determine the location of the user can be important. Some technologies used to determine the location of mobile terminals are RFID, GPS, UMTS and Wi-Fi positioning techniques.

3. (SE_3): Service Composition service enabler. This service enabler integrates all the service enablers that are part of a service into an end product that can be delivered to the user. It makes sure that the all the components of the service work together in a proper way. As with SE_1, this service enabler is required by all services.

4. (SE_4): Quality of Service service enabler. This service enabler monitors the performance of the other service enablers. It controls the quality of service parameters through admission control and other QoS mechanisms.

5. (SE_5): A4C service enabler. This service enabler takes care of authentication, authorization, accounting, auditing and charging (A4C). Authentication identifies the two parties involved; the service provider and the users, possibly using an identity obtained from another service enabler. Authorization involves checking whether the user has permission to access the service requested. Accounting, auditing and charging

are mechanisms that are needed to charge users the proper amount for their use of the services.

6. (SE_6): Identity Management service enabler. This service enabler manages the individual user profiles, containing information such as user preferences and passwords.

7. (SE_7): Content Provision (Context-Based) service enabler. This service enabler delivers context-based content. Such content is influenced by the context of the user.

8. (SE_8): Content Provision (Sharing) service enabler. This service enabler delivers content to content-based services that depend on the sharing of content between users, or between users and the service.

9. (SE_9): Content Provision (Information) service enabler. This service enabler delivers information content, such as news.

The services of the Service Portfolio are:

1. (S_1): Location Based services. Location based services are services that provide information and content based on the location of the user.

2. (S_2): Guiding Tool services. These services provide the users with guiding tools, such as maps showing directions or points of interest nearby.

3. (S_3): Presence Information services. Presence information is a status indicator that indicates the availability and willingness to communicate of a user of the service. This service stores and communicates such information to other users of the service.

4. (S_4): Content Manipulation services. Content manipulation services allow users to manipulate content through using this service. The content could either be supplied by the service or provided by the user.

5. (S_5): Content Sharing services. These services allow users to share content. Such content could be text documents, pictures or presentations.

6. (S_6): News services. News services supply the users of the service with news content. News content could be news broadcasts or online newspapers.

7. (S_7): Point-of-Interest (POI) services. A point-of-interest is a location that could be of interest to the user. POI services supply the users with information about such locations. These location could be nearby hotels, stores or museums.

All the services listed above require a set of service enablers. Table 2.1 shows which service enablers that each service requires.

S_i	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6	SE_7	SE_8	SE_9
S_1	x	x	x	x		x	x		
S_2	x	x	x	x	x		x		
S_3	x	x	x	x	x	x	x		
S_4	x		x		x	x		x	
S_5	x		x		x			x	
S_6	x		x			x			x
S_7	x	x	x	x	x				x

Table 2.1: Service composition table.

2.4.2 Business Actors

One of the purposes of service platforms is that several business actors come together to co-produce the services. Technically, this means that service enablers can belong to different business actors. This is an essential property of service enablers that is vital to the CF model. This section presents the business actors involved in the co-production of services.

More specifically, a particular service enabler belongs to a particular system actor. This actor has specific capabilities and assets that enable it to deliver the service enabler. Hence, a system actor is a separate system entity. A business actor is separate business entity. A business actor can represent one or more system actors. By representing a system actor, the business actor handles the service enablers of this system actor. Note that system actor is an abstract concept, and not a real business entity. In the Service Portfolio of this thesis, each system actor is represented by a separate business actor. This means that each service enabler is controlled by a separate firm. Consequently, only the term business actor is used from now on.

Service Provider (BA_1)

The Service Provider is an important actor to the Service Portfolio because it has the main responsibility of composing the services from the different service enablers. It also takes care of the interaction with the users of the services, and handles the collection of revenue. This revenue has to be distributed to the other business actors through a revenue share agreement, and this distribution is the responsibility of the service provider. The Service Provider is the only business actor that has contact with the users directly, and the users might not even be aware of the other business actors.

The Service Provider owns two service enablers; Service Composition service enabler, and A4C service enabler.

Context Provider (BA_2)

Context is any information that can be used to characterize the situation of an entity (Abowd et al. 1999). When considering communication and IT services the most commonly used context information is the location of the user. Another example of context information is the history of user events, which can be used to adapt services to the preferences of the user.

The Context Provider handles context information, and owns the Context Provision service enabler.

Network Provider (BA_3)

The Network Provider is the business actor controlling the network through which the services are delivered. It can control one or more networks, possibly also different types of networks. Some common network types in the communication and IT industry are WLAN, GSM, UMTS and PSTN. The Network Provider controls the network logic and the physical infrastructure.

The Network Provider owns the Network and Quality of Service service enablers.

Identity Provider (BA_4)

Certain services depend on the identity of the user requesting them. The Identity Provider handles the identity information of each user. It also has the responsibility to securely store such information. Upon request, the identity information is provided to the service production through the service enabler of the Identity Provider.

The Identity Provider owns the Identity Management service enabler.

Content Provider ($BA_{5\rightarrow}$)

With the Service Portfolio being a content provisioning service portfolio, this is a very important business actor. All the services in the portfolio require some sort of content, and this must be delivered by a Content Provider.

The Content Providers are different from the other business actors in two ways. Firstly, there are three service enablers that are owned by Content Providers. Secondly, there may be more than one Content Provider taking part in the co-production of services. Consequently, each type of Content Provision service enabler could be owned by one or more different Content Providers. For example, there may be two Content Providers both owning a Content Provision (Context-Based) and Content Provision (Sharing) service enabler, while there is a third and different Content Provider that owns the Content Provision (Information) service enabler.

The service enablers Content Provision (Context-Based), Content Provision (Sharing), and Content Provision (Information) are owned by Content Providers.

The number of Content Providers and which service enablers they own is described for each scenario in Chapter 4. The Content Providers are numbered as the business actors from 5 and upwards.

2.4.3 Service Composition

The service composition is the act of composing a service through combining different service enablers. The business actors provide the necessary service enablers to the composition, and the Service Provider has the main responsi-

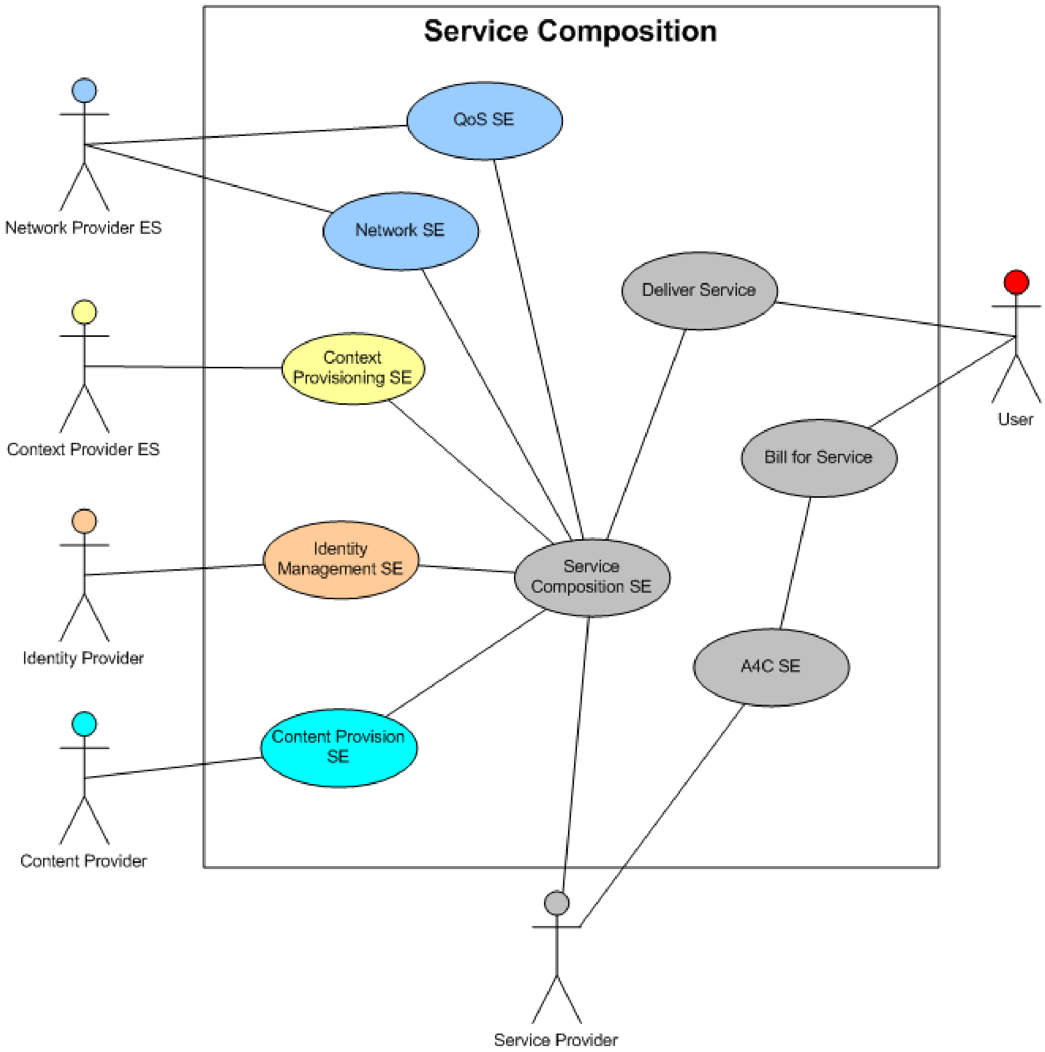


Figure 2.4: UML Use Case diagram of business actors composing and delivering service

bility through the Service Composition service enabler. Figure 2.4 illustrates a service composition involving all business actors and service enablers of the Service Portfolio. The service composition is necessary to produce the heterogeneous services of the Service Portfolio.

The number of service enablers needed, and hence the number of business actors, differs from service to service. Some require a majority of the service enablers, while others require only a few.

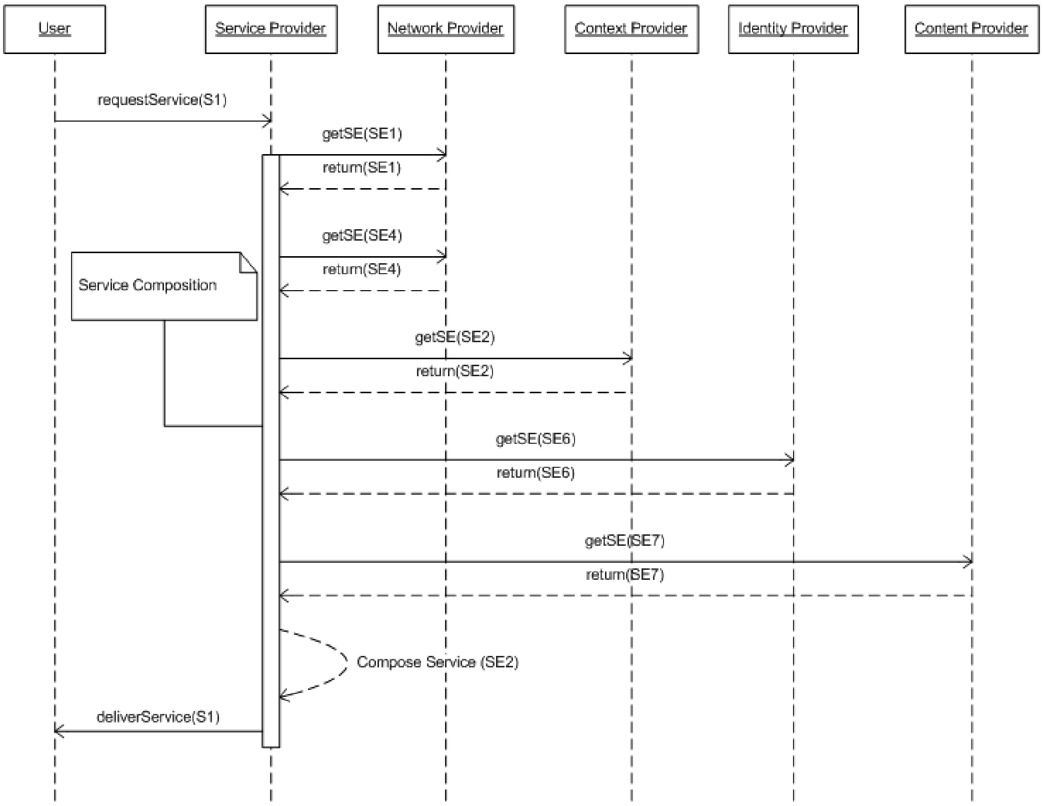


Figure 2.5: UML MSC of service composition for Service 1

UML Message Sequence Charts (MSCs) are a good way of illustrating how the service composition works in greater detail. Figure 2.5 shows the service composition for S_1. We see that the user requests Service 1 from the Service Provider. The service provider requests the necessary service enablers from the other business actors, which return these. Following this, the service provider integrates these into a service through its Service Composition service enabler. The process is similar for all services of the Service Portfolio, but with changing business actors involved. Note that the MSC shows the most important phases of the service composition. There may be more steps included, but the diagram includes the phases important to the Service Portfolio valuation.

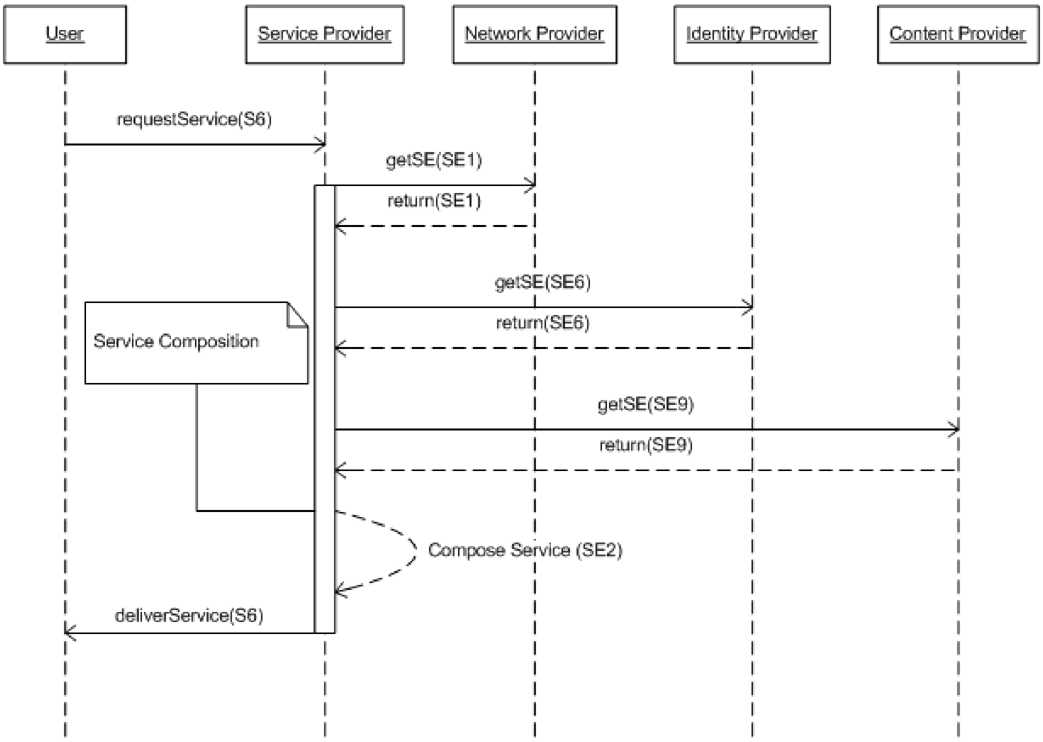


Figure 2.6: UML MSC of service composition for Service 6

Figure 2.6 shows the service composition for Service 6. As can be seen from the figure, this is a less complex service requiring fewer service enablers than Service 1. The composition starts the same way as in Figure 2.5, with the user requesting a service from the Service Provider. As before, the Service Provider requests the necessary service enablers from the other business actors. The main difference is that another set of service enablers is needed for this service.

2.4.4 UML Class Diagrams

To provide an accurate description of the Service Portfolio, the following has been modeled by UML class diagrams:

- The service enablers, Figure A.1

- The services, Figure A.2
- The business actors, Figure A.3
- The service/service enabler relationship, Figure A.4 and Figure A.5

All these UML class diagrams can be found in Appendix A.

Chapter 3

Economic Theory

This chapter presents and discusses the economic theory necessary to perform the valuations in the model developed. The model relies on certain key microeconomic concepts, such as the relationship between price and demand, certain strategic concepts, such as the concept of bargaining power, and other concepts such as regulation and the adoption of services in a population. These concepts and other necessary topics are discussed in this chapter.

The cash flow maximization model (CF model) developed in this thesis is based on the models created by Langøygard (2006) and Zoric & Lassen (2005). Some new modules are added to the model, some are slightly modified, and others are adopted without modification. The theory necessary to support the new modules is studied in detail in this chapter. Theory relevant to the adopted models is also discussed.

3.1 Microeconomic Theory and Strategy

3.1.1 Microeconomic Concepts

This section presents and discusses the key microeconomic concepts that are relevant to the Service Portfolio valuation and the CF model.

Price/Demand Relationship

In an economy, there are producers of goods and services, and consumers of these. Throughout the following explanation, the term goods is used to denote both goods and services. In an economic setting, a supply and demand model describes the interaction between producers and consumers in the market for a certain good. The supply and demand relationship is fundamental to microeconomics. In a perfectly competitive market, the demand is determined by the price of the good (Schotter 2001). It is this interaction that is critical to the quantitative model developed.

To explain the interaction between price and demand, this thesis relies on the classic economic concept of the demand curve. The demand curve represents graphically the relationship between the price set by the producers of a good, and the quantity demanded by consumers. The alternative interpretation is that the firm produces a certain quantity, and gets a price depending on this quantity. However, the most natural interpretation for communication and IT firms is that they set the price, and this interpretation is used in the rest of this thesis. Demand curves can be used to represent the consumption of a good by an individual consumer, or the total demand in a market for a certain good.

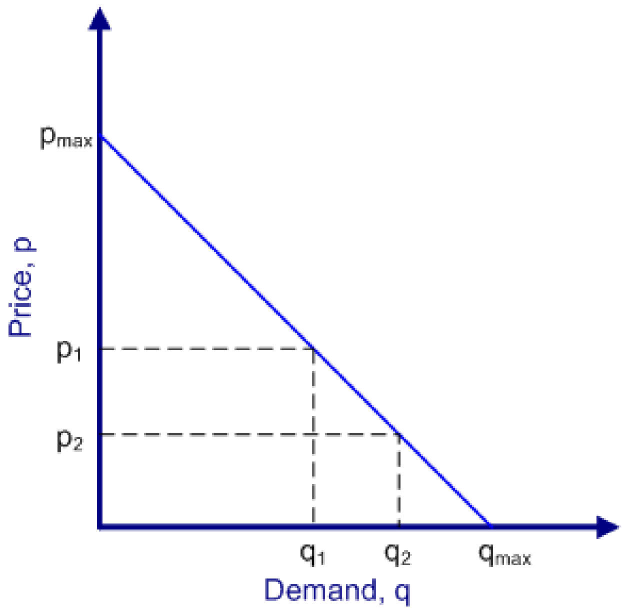


Figure 3.1: Price/demand relationship

Figure 3.1 provides an illustration of a demand curve, where the quantity of goods demanded by consumers is inversely proportional to the price set by the producer. The figure shows how the demand for a certain good changes as its price changes. The quantity of goods demanded depends on the utility function of the consumers, but this concept is not discussed in further detail. For a more thorough discussion of utility and utility functions, the reader can refer to Schotter (2001).

Referring to Figure 3.1, we can see that the maximum quantity demanded is q_{max}, this happens when the price $p = 0$. The price p_{max} denotes the price above which there is no demand for the good. Between these two points, the demand varies linearly. The producer faces a downward sloping demand curve, where the demand for the good is inversely proportional to the price. The price p_1 gives a demand of q_1. A decrease in the price to p_2 gives an increase of the demand to q_2. The relationship between price and demand with a linear demand curve is as follows:

$$Q(p) = \left(1 - \frac{p}{p_{max}}\right) q_{max},\ 0 \leq p \leq p_{max}$$

Elasticity of Demand and the Lerner Index

The elasticity of demand is an important property of demand functions, and it can also tell us something about the market power of a firm. Elasticity of demand measures the sensitivity of consumer demand for a product to changes in its price. More precisely, the elasticity of demand measures the percentage change in the demand for a good that results from a given percentage change in its price (Schotter 2001). Formally, the price elasticity of demand can be expressed:

$$\varepsilon = -\frac{\%\Delta Q}{\%\Delta P} = -\frac{\frac{dQ}{Q}}{\frac{dP}{P}} = -\frac{dQ}{dP}\frac{P}{Q}$$

If a situation with a monopolist facing linear demand $P(Q) = A - bQ$ is considered, we can find the optimal output by setting marginal revenue equal to marginal cost (Schotter 2001). The resulting equation with the optimal price, P^m, and quantity, Q^m, becomes:

$$P^m \left(1 + \frac{dP(Q^m)}{dQ}\frac{Q^m}{P^m}\right) = MC(Q^m)$$

Substituting the price elasticity of demand into the above equation and rearranging yields the Lerner index (L)

$$L = \left(\frac{P^m - MC(Q^m)}{P^m} \right) = \frac{1}{\varepsilon}$$

The interpretation of the Lerner index is discussed in the following sections.

3.1.2 Strategy and Bargaining Power

Church & Ware (2000) state the following about business strategy and the theory of industrial organization:

> The focus of the new industrial organization on the conduct of firms in imperfectly competitive markets involves determining the factors and strategies that provide firms with a competitive advantage. With its focus on the nature and form of rivalry in concentrated markets, much of industrial organization is a theory of business strategy.

Bear in mind that another frequently used term for industrial organization is applied microeconomics. Microeconomic theory and the theory of industrial organization have a close relationship to strategic theory and the concept of bargaining power. This section examines the strategic concepts that are relevant to the Service Portfolio valuation and the CF model.

Market Power

An important topic in business strategy and industrial organization is the concept and determinants of market power. Remember from classical microeconomics that a firm in a perfectly competitive market will price its goods at marginal cost. Such firms act as price-takers; their price is defined by the market. These firms have no market power. On the other hand, a firm has market power if it finds it profitable to raise prices above marginal cost (Church & Ware 2000).

The Lerner index is defined as the ratio of the firm's profit margin $P^m - MC(Q^m)$ and its price. The index is a measure of market power because it measures how much a firm can increase its price over marginal cost. The

Lerner index also shows that for a monopolist, the market power depends on the elasticity of demand. The greater the elasticity of demand, the less is the mark up over marginal cost, and hence market power. The inverse is also true.

For any given firm, the market power depends on the extent to which consumers can substitute to other suppliers. This substitution can be supply side substitution, where the consumers can switch to other producers of the same product, or demand side substitution, where consumers can switch to acceptable substitutes. In general, a firm may have market power even though it is not a monopolist. The extent to which a firm can exercise market power in imperfectly competitive markets depends on the elasticity of its demand curve (Church & Ware 2000).

For a firm to be able to execute and sustain its market power in the long run there must be impediments to entry. If there were not, other firms would enter the market to extract the surplus (Schotter 2001). Porter (1980) lists the following barriers to entry

- Economies of scale
- Product differentiation
- Capital requirements
- Switching costs
- Access to distribution channels
- Cost disadvantages independent of scale
- Government policy

This thesis discusses which of these that are relevant to service platforms in the following sections. First, a strategic evaluation framework will need to be presented.

Strategic Evaluation Framework

The theory of market power and the strategy related to it is comprehensive, and the discussion is limited to the aspects relevant to service platforms. To be able to discuss these aspects, a framework for strategic evaluation is needed. Such a framework proves useful when discussing the structural characteristics of service platforms.

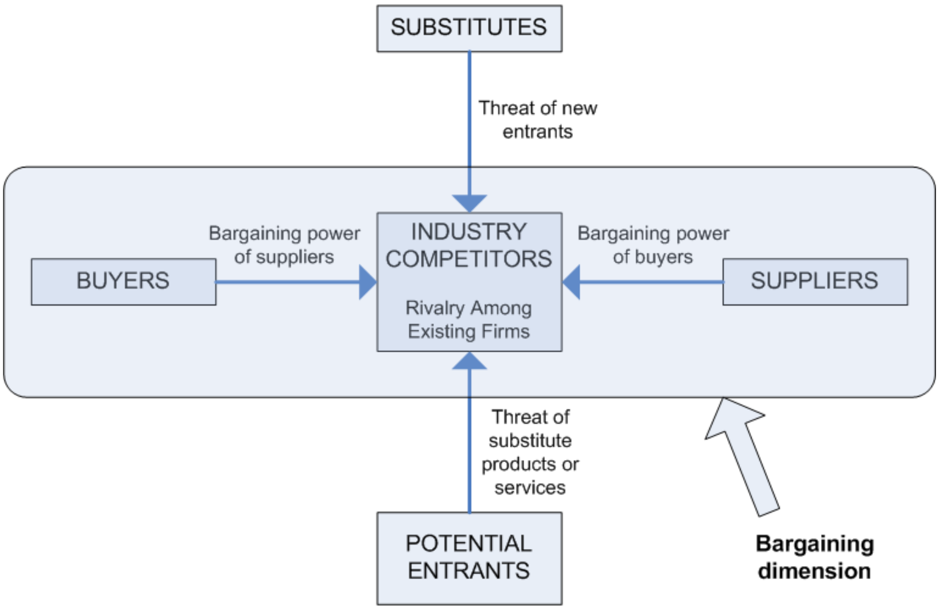


Figure 3.2: Porter's Five Forces of Competition (Porter 1980)

In an industry, or between the participating business actors in a service platform, competitive forces could drive down the return on invested capital towards the competitive floor rate of return. Hence, it is important to evaluate these competitive forces. Porter has identified five competitive forces - entry, threat of substitution, bargaining power of buyers, bargaining power of suppliers, and rivalry among industry competitors (Porter 1980). These five forces of competition are illustrated in Figure 3.2.

The framework of Figure 3.2 is often used to assess industries and their attractiveness. It is not the intention of this thesis to assess the overall attractiveness of the communication and IT industry. Rather, the focus is on investigating the business opportunity that service platforms constitute for the participating business actors. The business actors participating in a service platform have formed what can be seen as a coalition to co-produce and sell services. They face the challenging task of distributing the revenue from these services among themselves. Their bargaining power is essential when negotiating the revenue share. Porter (1985) states the following about coalition partners (author's translation):

> Coalition partners are and stay independent firms, and it be-

> comes a question of how the profits from the coalition should be distributed. The relationship between the bargaining powers of the coalition partners is therefore vital to how the extra profit is shared, and through this it decides the effect of the coalition on the firms' competitive advantage.

The main focus of this thesis is the distribution of revenue, and not on the competitive advantage of the coalition. Although Porter's framework is often used to assess the attractiveness of industries, it can also be applied to evaluate the bargaining and supplier power within coalitions such as those brought about by service platforms with multiple business actors. The bargaining dimension, as illustrated in Figure 3.2, is especially important.

Bargaining Power

Bargaining power is the power that buyers have to drive down prices of the goods they are buying, and the power that suppliers have to drive up prices of the goods they are supplying. Before discussing the consequences of bargaining power to service platform cooperations, it is necessary to identify the drivers of buyer and supplier power. Porter (1980) claims that a supplier group is powerful if the following apply

- It is dominated by a few companies and is more concentrated than the industry it sells to
- It is not obliged to contend with other substitute products for sale to the industry
- The industry is not an important customer of the supplier group
- The suppliers' product is an important input to the buyer's business
- The supplier group's products are differentiated or it has built up switching costs
- The supplier group poses a credible threat of forward integration

He also states that a buyer group is powerful if the following circumstances hold true

- It is concentrated or purchases large volumes relative to seller sales
- The product it purchases from the industry represents a significant fraction of the buyer's costs or purchases
- The products it purchases from the industry are standard or undifferentiated
- It faces few switching costs
- It earns low profits
- Buyers pose a credible threat of backward integration
- The industry's product is unimportant to the quality of the buyer's products or services
- The buyer has full information

If a firm considers its buyers as the market, there is a very close relationship between the terms bargaining power and market power. The determinants of these are also closely linked. This is important to the discussion specific to the Service Portfolio, because the bargaining power of the business actors is being considered, and not their market power in the end user market.

3.1.3 Measuring Bargaining Power

One of the purposes of this thesis is to account for the effects of bargaining power in the quantitative model developed. The bargaining power of business actors affects the revenue share, and hence the profit of each business actor from participating in the project. Consequently, one of the main issues that needs to be resolved is how to measure and quantify this bargaining power. Two measurement issues arise:

- How can the bargaining power of the business actors be measured?
- How can the impact of different factors on the bargaining power of business actors be measured?

These measurement issues are very similar to the ones faced by economists and regulatory authorities when attempting to measure the market power of firms (Church & Ware 2000). Two methods have been used extensively for these types of measurements; Structure-Conduct-Performance (SCP), and the New Empirical Industrial Organization (NEIO). SCP relies on accounting data regarding profits and costs to measure market power. NEIO, which is a more recent approach, uses comparative statistics to simultaneously estimate both market power and marginal costs (Church & Ware 2000).

The model in this thesis uses the SCP approach to measuring market power to measure and quantify the bargaining power of the business actors in the Service Portfolio. This section first presents the SCP method before justifying the choice of the method. The argument for using SCP continues in Section 3.1.4, where it is argued that the structural variables of the SCP equation are suitable for the Service Portfolio business situation.

Structure-Conduct-Performance

The SCP approach assumes that there is a stable relationship between the structure of an industry, the firm conduct, and the market performance (Church & Ware 2000). Since the relationship is assumed to be stable, the two easily observed variables are normally used; structure and performance. The structural variables used in SCP measurements have often been seller concentration and barriers to entry.

Church & Ware (2000) list two underlying assumptions of the SCP model that are repeated here:

1. SCP studies assume a stable relationship and a line of causality that runs from structure through conduct to performance. If a stable relationship is established between structural variables and market power, then the SCP implication is that this structural variable facilitates the exercise of market power. Furthermore, it must be the case that the structural variables are exogenous. Thus, they cannot be determined by the same factors that determine market power. For inter-industry studies, it must also be the case that the implied degree of symmetry in conduct holds across industries.

2. The SCP studies start from the premise that measures of market power can be calculated from available data. Accounting data can be used to construct approximations to the Lerner index or economic profits.

This thesis returns to these assumptions in the next section, and shows that they hold for the business situation in the Service Portfolio.

Returning to the specific SCP method, a typical SCP study involves estimating the following equation or a close variant:

$$\pi_i = \alpha + \beta_1 CON_i + \beta_2 BE_i^1 + \beta_3 BE_i^2 + \cdots + \beta_{N+1} BE_i^N$$

In the above equation, π_i is some measure market power for firm i, such as the Lerner index. CON_i is a measure of concentration, and BE_i^j are indicators of barriers to entry. The SCP hypothesis is that the market power is determined by these factors, and hence that the β-values will be positive and statistically different from zero. The β-values are determined through econometric techniques, and measure the effect on market power from a marginal change in each of the structural variables.

There are several methods for quantifying the concentration in an industry. The most common are the Herfindahl-Hirschman Index (HHI), and the four- or eight-firm concentration ratios (CR_4 or CR_8). This thesis uses the HHI, which is simply the sum of the squares of market shares for all firms in the industry:

$$HHI = \sum_{i=1}^{N} s_i^2$$

As can be seen from the equation, HHI varies from 0 for perfect competition, to 1 for monopoly. If there are N firms with equal market shares, then $HHI = \frac{1}{N}$.

The SCP studies traditionally use one of three measurements of market power; economic profits or rates of return on investment, Lerner index or the price/cost-margin, or Tobin's q. Tobin's q uses stock market variations to assess economic profits (Church & Ware 2000). This thesis uses the Lerner index, which has been presented previously. Normally, accounting data for marginal cost is not available, and an approximation such as the price/cost-margin has to be used for SCP studies. However, this thesis assumes perfect information, and hence the availability of marginal cost information. This facilitates the use of the Lerner index as a measurement of bargaining power.

Note again that SCP studies most commonly are used for inter-industry market power studies, but that this thesis uses the method to measure the market power within the Service Portfolio. In other words, it measures the bargaining power in the bargaining dimension of Porter's five forces, as illustrated in Figure 3.2.

Arguments for SCP

As noted previously, this thesis uses the SCP method for quantifying bargaining power between the business actors cooperating to produce the Service Portfolio. When considering the providers of service enablers as suppliers, and the Service Provider as the buyer, there is an internal market within the Service Portfolio cooperation. Hence, the SCP method traditionally used to measure market power can be used to measure the internal bargaining power. Consequently, the SCP method is used for a study internal to the industry, not an inter-industry study.

One of the main assumptions of the SCP studies is that there must be a stable relationship between structure and performance. This thesis shows that this assumption is aligned with applying bargaining power theory to the Service Portfolio in the next section. Another assumption is that the structural variables are exogenous. This is true for the variables presented in the SCP equation. Furthermore, the assumption that the implied symmetry must hold across industries is not relevant to this study as it is a study internal to the Service Portfolio.

Another main assumption of SCP studies is that market power can be calculated from available data. The availability of data is normally limited in SCP studies. However, the quantitative model developed assumes perfect information regarding marginal costs and prices, and hence this assumption holds for the SCP measurement conducted herein.

3.1.4 Bargaining Power in Service Portfolios

To be able to use the SCP method for measuring bargaining power, it must be the case that the structural variables in the SCP equation are truly the determinants of bargaining power in the Service Portfolio. This section shows that this assumption is consistent with the theory previously presented on bargaining power.

Business Situation in the Service Portfolio

Before proceeding to the necessary arguments, a brief discussion of the business situation in the Service Portfolio is required. This situation was explained in brief in Chapter 2, and is discussed specifically for each scenario in

Chapter 4. The main property of the situation is that there is one business actor of each type, except for the Content Provider. There can be numerous Content Providers, and these can be part of the service platform or they can be outside the platform. Hence, it is important to consider the bargaining power of the Content Providers. In all business situations considered, the Service Provider conducts the service composition by requesting the necessary service enablers from the other business actors. This is described in Chapter 2. Thus, the Service Provider can be regarded as the buyer and the Content Providers as the suppliers.

Furthermore, this thesis assumes that the decision regarding vertical integration already has been made. This means that there is no threat of forward or backward integration, as the business actors have already decided on their capabilities and which service enablers they will provide. The term forward integration means that suppliers of a product integrate the capabilities of their buyers into their business, while backward integration means that buyers integrate the capabilities of their suppliers into their business.

The decision to defer from forward or backward integration is normally made with one or both of the following justifications. Firstly, it could be the case that the total savings of vertical separation for the decision maker are greater than the premium it has to pay for the increased bargaining power of suppliers. Secondly, there may be regulatory or contractual terms that prohibit such integration. The last justification is especially prominent in the telecommunications industry. Business actors here often have regulatory restriction on what parts of the value chain they can do business in. For service platforms, a sound assumption is also that the participating business actors have decided on the responsibilities of each actor before entering the platform. Thus, the assumption that the decision regarding vertical integration has already been made is sound.

Another assumption of the model is that the decision regarding participation in the service platform has been made. This means that no new business actors can join the service platform throughout the period which the quantitative model considers. Furthermore, the participants of the service platform cannot buy service enablers from actors outside the service platform as long as a business actor within the service platform can provide the same service enabler. This increases the attractiveness of participating in the service platform cooperation for the business actors.

Determinants of Bargaining Power in Service Platforms

Section 3.1.2 presented the determinants of market and bargaining power as listed by Porter (1980). This section goes through the relevant determinants for the Service Portfolio presented in Chapter 2. The determinants previously listed are presented in Table 3.1 and Table 3.2. These tables also include a brief comment on the situation in the Service Portfolio. Recall that the Service Provider is considered the buyer and the Content Providers are considered suppliers.

The tables show that only some of the claims change depending on the business situation. These are the ones concerning the concentration of the Content Providers, the switching cost that has been built up, and the differentiation of the products (service enablers) bought/supplied.

Claims S.1 and S.2 lead to the conclusion that bargaining power of the Content Providers increases with an increase in the concentration of Content Providers. This is consistent with the SCP equation. The value of the CON-variable increases with an increase in concentration, thereby leading to a larger Lerner index for the Content Providers.

Claims S.5, B.3 and B.4 lead to the conclusion that the bargaining power of Content Providers increase with an increase in the degree of differentiation of their products, and with their buildup of switching costs. The Content Providers can build up the switching costs of the Service Providers by participating in the service platform cooperation. By doing this, they assure that the Service Provider cannot buy service enablers they possess from outside the platform. Moreover, the Content Providers have differentiated products if they are the only provider of a Content Provision service enabler. This is strongly correlated with two factors; the concentration of Content Providers, and whether or not they are part of the service platform. From this discussion, it is concluded that the SCP equation should include a BE_1-variable accounting for whether or not the Content Providers are part of the service platform. Furthermore, as the degree of differentiation is correlated with the concentration of Content Providers, this supports the use of the CON-variable in the equation.

The equation used for the quantification of bargaining power will from the above arguments be as follows:

$$L_j = \beta_1 CON_j + \beta_2 BE_j^1$$

Where L_j is the Lerner index for Content Providers in scenario j, CON_j is

(#) Claim	TRUE/FALSE	Comment
(S.1) Supplier group is dominated by a few companies and is more concentrated than the industry it sells to.	TRUE/FALSE	Depends on the concentration of Content Providers.
(S.2) Supplier group is not obliged to contend with other substitute products for sale to the industry.	TRUE/FALSE	Depends on the concentration of Content Providers and whether they are part of the service platform or not.
(S.3) The industry is not an important customer of the supplier group.	FALSE	The Service Provider is the industry in this claim. The statement is false because the Service Provider is an important customer of the Content Providers.
(S.4) The suppliers' product is an important input to the buyer's business.	TRUE	The Content Providers' service enablers are necessary to produce the services.
(S.5) The supplier group's products are differentiated or it has built up switching costs.	TRUE/FALSE	The supplier groups' products can be differentiated if a Content Provider is the only provider of a Content Provision service enabler. The Content Providers can also build up switching (barriers to entry) costs through participating in the service platform.
(S.6) The supplier group poses a credible threat of forward integration.	FALSE	They do not pose such a threat. It is assumed that the decision regarding vertical integration already has been made.

Table 3.1: Supplier (Content Provider) bargaining power. The more TRUE claims, the greater the bargaining power of suppliers.

(#) Claim	TRUE/FALSE	Comment
(B.1) Buyer group it is concentrated or purchases large volumes relative to seller sales.	TRUE	Buyer group is concentrated as it only consists of one firm, the SP. If the platform is significant to the supplier, the relative volumes will also be large.
(B.2) The product it purchases from the industry represent a significant fraction of the buyer's costs or purchases.	TRUE	For the Service Provider, the cost of service enablers represents a significant portion of the service cost.
(B.3) The products it purchases from the industry are standard or undifferentiated.	TRUE/FALSE	The products (service enablers) can be undifferentiated if there are a large number of Content Providers providing the same Content Provision service enablers, especially if the Content Providers are outside the service platform cooperation.
(B.4) It faces few switching costs.	TRUE/FALSE	If the Content Providers are part of the service platform, the claim is true. Otherwise, it is false.
(B.5) It earns low profits.	TRUE/FALSE	Depends on the situation.
(B.6) Buyers pose a credible threat of backward integration.	FALSE	They do not pose such a threat. It is assumed that the decision regarding vertical integration already has been made.
(B.7) The industry's product is unimportant to the quality of the buyer's products or services.	FALSE	The quality of the suppliers product is important, but this consideration should already have been made when entering into service platform cooperation.
(B.8) The buyer has full information.	TRUE	It is assumed that this is true within the service platform.

Table 3.2: Buyer (Service Provider) bargaining power. The more TRUE claims, the greater the bargaining power of buyers.

the HHI concentration measurement for Content Providers in scenario j, and BE_j^1 is a boolean variable indicating the Content Providers' participation in the service platform in scenario j. Figure 3.3 shows an example of a price calculation from the SCP equation. This example is for a case with two content providers, both participating in the service platform. The price of SE_3 from BA_5 is calculated. The example demonstrates that it is possible to calculate the prices of the Content Provision service enablers when knowing the owners' marginal costs.

$$CON_1 = 0.5, \quad BE_1^1 = 1, \quad CostSE_{5,3} = 0.6$$
$$\beta_1 = 0.3, \quad \beta_2 = 0.2$$

$$L_1 = \beta_1 CON_1 + \beta_2 BE_1^1$$
$$P_{5,3} = \frac{CostSE_{5,3}}{1 - \beta_1 CON_1 + \beta_2 BE_1^1}$$
$$P_{5,3} = 0.92$$

Figure 3.3: Example of SCP equation.

The discussion in this chapter shows that the level of profitability will be higher for Content Providers participating in the service platform. Participation in the service platform is a strategic decision, and such strategic decisions to build up barriers to entry often come at a cost. With the service platform in this thesis, it is assumed that the participating business actors will have to contribute to the platform research and development. This will bring with it a higher investment cost for the participants. This is accounted for in the scenarios presented in Chapter 4.

This section has shown that the variables of the SCP equation are consistent with the theory of bargaining power when applying this to the service platform considered. To effectively apply the SCP equation, the β-coefficients need to be determined.

Coefficients of SCP equation

A large amount of research has been conducted on the link between structural characteristics and market power. Church & Ware (2000) present a table of

Lerner estimates for selected industries. Taylor & Zona (1997) estimate the Lerner index for AT&T in the long-distance telephone markets. Bresnahan (1989) conducts an empirical study of industries with market power. All these authors find that some firms in selected industries have significant market power and Lerner indices ranging from 0 to 0.89. The direct link between structure and performance is, however, a disputed area among economists (Church & Ware 2000). Nonetheless, this thesis claims that the link is relevant internal to service platforms. To be able to use the SCP equation in the CF model, a value of the β-coefficients must be set. As noted previously, these coefficients together with two structural variables give a value of the Lerner index for the Content Providers.

To effectively employ the SCP estimate of bargaining power in the CF model, the effects of concentration and service platform participation on price mark up must be empirically estimated. This requires data on firm price mark ups, and the exercise itself is out of scope of this thesis. However, estimates of the β-coefficients are provided in the CF model.

3.1.5 Product Life Cycle Theory

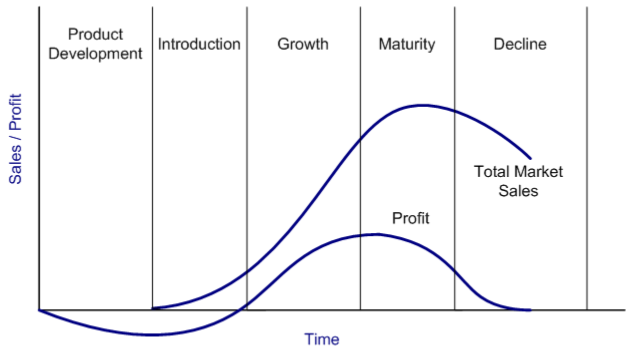


Figure 3.4: Product Life Cycle (PLC) curve

After launching a new product or service, it is the goal of the firm for the product to enjoy a long and prosperous life. Management knows that the product will have a life cycle, but the exact shape and length of it is difficult to predict. Figure 3.4 shows an example of a Product Life Cycle (PLC).

Not all products follow this cycle. Some are introduced and die quickly, while others stay in the market for a very long time (Kotler & Armstrong 2004). Because of rapid technological innovation, communication and IT services tend to have a relatively short life span. This thesis valuates the services in the Service Portfolio from their introduction to the point where they are phased out. Since the services have already been developed, the product development phase is not included in the CF model. The development costs however, can be accounted for by adding investment costs to the costs of the business actors.

The goal of the business actors participating in the Service Portfolio is to maximize their net present value (NPV) of the cash flow from the services. The business actors can determine the prices of the services to influence the product life cycle. The price influences the shape of the PLC curve significantly. By choosing different prices and pricing schemes, the PLC curve takes on different forms.

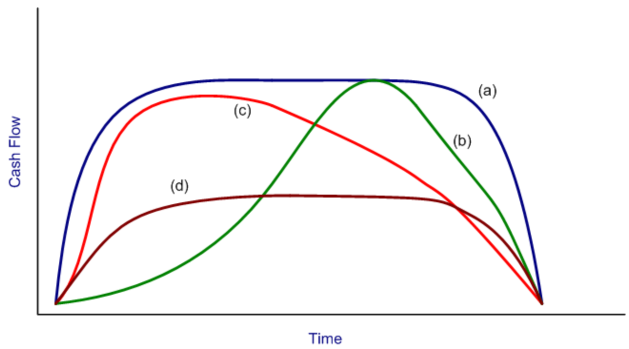


Figure 3.5: Cash flow scenarios

Figure 3.5 shows different cash flow scenarios for a particular business actor. Clearly, curve (a) represents the optimal cash flow. However, it is important to keep the objective of the business actors in mind. This objective is to optimize their NPV, not to seek some certain shape of the PLC curve. Hence, the maximization of their NPV is the objective, and PLC curves like the ones shaped in Figure 3.5 are often the result of this objective. They are not objectives themselves.

3.1.6 Pricing Schemes and Strategies

The price of an IT and communication service can be composed of both a variable and a fixed part.

$$price = f + v$$

In the above equation, f is a fixed price for the use of services independent of the number of service instances used. This can be seen as a subscription fee for the use of services. v is a variable price that depends on the number of service instances used. One of these can be zero, leading to a variety of pricing schemes. Different pricing schemes are often introduced to suit different consumer types. The purpose of this is to transfer as much of the potential consumer surplus to the producer as possible, from as many consumer types as possible. Pricing schemes can also be adapted to suit different consumer segments better than the pricing schemes of the competitors (Schotter 2001).

Pricing is a highly strategic decision. A wide variety of strategies can be employed, and Kotler & Armstrong (2004) discuss some of these. The Service Provider will in the situations evaluated in this model set the price of a new service introduced in the market. Hence, the "new product" pricing strategies discussed in (Kotler & Armstrong 2004) are the most relevant to this model. The two are presented below, with descriptions based on the descriptions of Kotler and Armstrong:

- Market-Skimming Pricing. Products can be launched with initially high prices to skim revenues layer by layer from the market. Market skimming makes sense only under certain conditions. First, the quality and image must be able to support the higher price, and enough buyers must want the product at that price. Furthermore, the costs of producing a smaller volume cannot be so high that they cancel the advantage of charging more.

- Market-Penetration Pricing. Another approach to new product pricing is market-penetration pricing. This approach involves setting a low initial price in order to penetrate the market quickly and deeply. High sales volumes may lead to lower production costs through economies of scale and scope. Like market-skimming pricing, market-penetration pricing only makes sense under certain conditions. First, it must be the case that the market is highly price sensitive so that a low price produces a larger market growth. Second, total production costs should decline as volume increases.

When considering communication and IT services, it is often the case that the marginal costs are low, while the upfront investment costs are high. This means that the average cost per service is significantly higher when producing small volumes. Moreover, experience has shown that the consumers of IT an communication services are highly price sensitive (Shy 2001). Many IT and communication products are also the subject of network externalities. Network externalities make the users of a service better off the larger the number of total users of the service. A large initial adoption of a service would fuel such network externality effects. All of the above factors speak for the market-penetration pricing as the most suitable pricing scheme for the Service Portfolio. This is also the pricing scheme that is modeled in the CF model.

3.1.7 Competition

This chapter has previously discussed the bargaining dimension of Porter's strategic evaluation framework. The other important dimension is the competitive dimension. Porter (1980) notes that "competition in an industry continually works to drive down the rate of return on invested capital toward the competitive floor rate of return". This is also the case for the IT and communication industry considered in this thesis.

The competition in the market is a very important aspect influencing the demand of services from the Service Portfolio. The pace of innovation is rapid in the IT and communication industry, and the type of competition is divided into two categories based on this:

- Competition with the same kind of technology
- Competition with a new and disruptive technology

Competition with the same kind of technology is the competition faced by the Service Portfolio from industry competitors, substitutes and potential entrants all with the same technological platform as the Service Portfolio is based on. For instance, this could be competitors with the same kind of network and positioning technology.

Sometimes a new and disruptive technology is introduced to the competitive arena. A disruptive technology is a technological innovation that eventually overturns the existing technology in the market (Christensen 2003). An example of this is digital photography taking over for traditional film-based photography, or semiconductors replacing vacuum tubes in computers. More specifically for the business actors in the Service Portfolio, they might face a competitor in the future with a superior technology. How they react to such competition greatly influences the value of the services they are selling.

The CF model of this thesis accounts for the competition through the use of different market scenarios. This is the same way as Langøygard (2006) handles competition in his CF model.

3.1.8 User Acceptance

One key factor of the valuation in the CF model is user acceptance. User acceptance deals with how the services of the Service Portfolio will be accepted in the market to which they are sold. Predicting how these services will be accepted throughout the time span of the Service Portfolio is a complex task, but this section will try to investigate the main determinants of user acceptance.

The possible influencing factors are believed to be

- network externalities
- how much the consumers use the services
- how well off the consumers are when using the services

Shy (2001) states that "consumers preferences are said to exhibit network externalities if the utility of each consumer increases with an increase in the total number of consumers purchasing the same compatible brand". This is often the case for traditional telecommunication services. It is, however, less clear if the concept of network externalities applies in the same degree to the services of the Service Portfolio. The services of this portfolio are content provisioning services, where content often is requested from the provider of the services. If this is the case, network externalities are not likely to exist as the consumer is indifferent to the number of consumers purchasing the services. Some of the services of the Service Portfolio involve content sharing between users. It is likely that such a sharing is more valuable if there are a larger number of users of the services. Hence, these services may be subject to network externalities. The service diffusion model presented later in this chapter accounts for some degree of network externalities. The CF model assumes that this is appropriate for the services in the Service Portfolio, and that the network externalities do not have to be modeled when considering user acceptance.

The model of Langøygard (2006) is based on the model of Golebiowski, Langøygard & Tindlund (2005). In the latter model, a rather complex procedure was developed to calculate how usage of a service in one period induced demand for correlated services in the next period. The reasoning behind this effect seems to be reasonable, but the implementation is problematic because it requires the estimation of correlation in demand between the different services. Therefore it was not implemented in Langøygard's model, nor will it be implemented in the model of this thesis.

The last of the previously listed influencing factors on demand is "how well off the consumers are when using the services". How well off consumers are is often measured by the consumer surplus. The consumer surplus is a monetary measure of the benefit a consumer receives from consuming a good at a certain price (Schotter 2001).

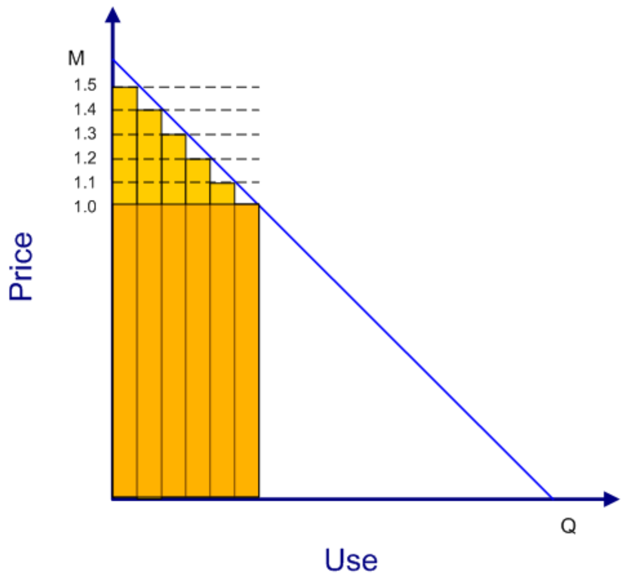


Figure 3.6: Consumer surplus

As noted previously, this thesis will use the demand curve to determine the demand of individual consumers. Such a demand curve can be used to explain the concept of consumer surplus. Consider Figure 3.6, which illustrates the demand for a service for one individual consumer. With the current price 1.0, the consumer purchases six service instances. For the first service instance, the consumer would have been willing to pay 1.5. With a fixed price of 1.0 however, the consumer pays this price for all service instances. The area of the triangle defined by M, P and the intersection of P and the demand curve constitutes the consumer surplus when the number of instances purchased is continuous. The number of services in this situation is discrete, and the consumer surplus is defined by the area of the bars in Figure 3.6.This area is $0.5 + 0.4 + 0.3 + 0.2 + 0.1 = 1.5$, and represents the consumer surplus for this given consumer.

The consumer surplus described above is not used directly in the model. Instead, it is approximated by the price to max price ratio (P/M ratio). This measure is used as a quantification of user acceptance. The user acceptance is in turn used to determine the demand growth from one period to the next. The higher the level of user acceptance in one period, the larger the increase in demand to the next period will be. The P/M ratio measures nearly the same as the consumer surplus; the P/M ratio measures how well off the consumer is when buying the first service instance. Hence the P/M ratio is positively correlated with the consumer surplus.

3.1.9 Capital Budgeting and Net Present Value

Bierman Jr. & Smidt (1993) state the following about capital budgeting decisions

> A capital budgeting decision is characterized by costs and benefits that are spread out over several time periods. This leads to a requirement that the time value of money be considered in order to evaluate the alternatives correctly.

The CF model accounts for the time value of money through discounting the cash flow (costs and benefits) with the appropriate discount factor. This gives the net present value (NPV) of the Service Portfolio for each business actor. An incremental cash flow is an item that changes the bank account balance or cash balance, in this case; revenue, costs and taxes. Financial types of cash flows are not included in the investment analysis (Bierman Jr. & Smidt 1993).

If it is assumed that capital can be borrowed and lent at the same rate of interest, all projects with a positive NPV should be accepted. However, this is not an assumption that will fit the situation of the business actors in the Service Portfolio. The capital available for investments is often limited, and the business actors will have to choose a portfolio of projects that maximize their returns (Bierman Jr. & Smidt 1993).

In Langøygard's (2006) model, a possible is outcome is that some business actors obtain a negative NPV from the valuation, while the total NPV for the Service Portfolio is positive. From the above discussion, this outcome will most likely lead to the business actors with negative NPVs rejecting the project. It might also be the case that some business actors require a NPV above a certain threshold, in this thesis called the net present value threshold.

The net present value threshold might also be set by the optimizer (the business actor optimizing its NPV) based on strategic considerations. For instance, it might be the case the Service Provider wishes to keep the NPV of the Network Provider above NOK 20 mill for the sake of future cooperation. Such situations are discussed in the scenario descriptions of Chapter 4.

The CF model in this thesis implements new functionality to cope with net present value thresholds. Such thresholds can be set for each business actor, and the model will attempt to redistribute revenue to satisfy these constraints. This functionality is discussed further in the description of the CF model in Chapter 5.

3.2 Regulation and Service Diffusion

Regulation and public policy have traditionally been important to the communication and IT industry. This section discusses what regulatory issues that need to be considered by the CF model. Another important area left to discuss is service diffusion; how can the population be expected to adopt the services? A service diffusion model that describes the diffusion of services in a population is presented in this section.

3.2.1 Regulation

The telecommunications industry has traditionally been heavily regulated. Some consequences of this regulation have been described in Chapter 2. Regulatory decisions have had a great impact on the development of the telecommunications industry. Even though the regulation has been softened, it is still one of the most heavily regulated industries around (Dodd 2005, Gruber 2005).

The history of regulation is not important to the CF model, but the current regulatory scheme is. There are several regulatory authorities, in Norway the Norwegian Post and Telecommunications Authority (NPT) is the most important. The regulation regime is complex, and it is not the intention of this thesis to explore all the effects of regulation on telecommunication services. Nonetheless, a brief discussion of regulation for the specific Service Portfolio is necessary.

The Service Portfolio considered in this thesis is a content provisioning portfolio. This means that the portfolio provides a variety of different content to the users. It is important to note that there probably are few barriers to entry for other business actors and service platforms to deliver the same kind of services. Consequently, the chances of market failure are reduced (Shy 2001). Overall, this thesis assumes that the market mechanisms function well for content provisioning services. Nonetheless, it is likely that some restrictions on the minimum price of the services will be imposed. The CF model accounts for this through setting a price floor based on the costs of producing services that the prices cannot drop below.

3.2.2 Service Diffusion Model

Service diffusion is the adoption of a new service or product in a population. Gruber (2005) discusses service diffusion for a range of products, with an emphasis on mobile telecommunication services. He states that technological innovations, such as mobile telecommunications, are typically not immediately adopted by all potential customers. The "epidemic" approach to diffusion models has proved to be particularly popular. This approach models diffusion similar to the way that diseases spread in biology, the number of new adopters is related to the stock of current adopters (Gruber 2005). This closely related to the concept of network externalities that is commonly observed with telecommunication services (Shy 2001).

This thesis will use the most common of the logistic diffusion functions to model the service diffusion. This class of diffusion functions are called S-shaped or sigmoid. The function is as follows

$$y_t = \frac{y^*}{1 + e^{-(a+bt)}}$$

In the above equation, y_t is the number of adopters at time t. The number of potential adopters is y^*. If a function of the above kind is plotted, it will look like the plot of Figure 3.7.

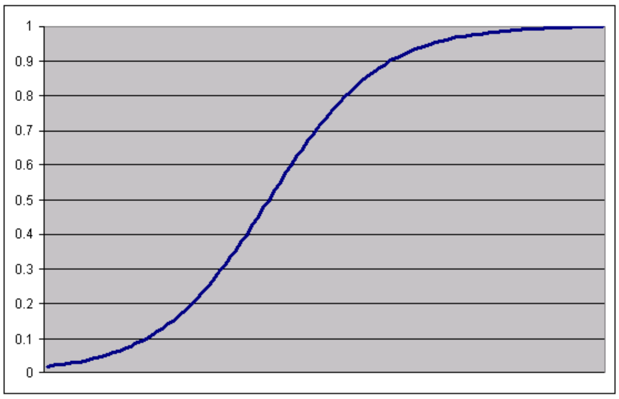


Figure 3.7: Shape of the sigmoid diffusion curve.

The derivative of the sigmoid function reveals more of its properties

$$\frac{dy_t}{dt} = by_t \left(1 - \frac{y_t}{y^*}\right)$$

Rearranging yields

$$\frac{dy_t}{dt}\frac{1}{y_t} = b\left(\frac{y^* - y_t}{y^*}\right)$$

As seen from the above equation, the parameter b indicates the diffusion speed. It equals the growth rate in the number of adopters at time t, relative to the fraction of adopters that have not yet adopted at time t. The sigmoid curve has the property of having a second derivative that changes from positive to negative at $y^*/2$. In other words, the growth rate is at its largest when half of the population have adopted the services (Gruber 2005). The parameter a of the sigmoid function shifts the curve backwards (larger a) or forwards (smaller a). It does not change the shape of the curve otherwise, and can be considered a timing variable.

The sigmoid function is used to estimate the number of adopters at a given time, knowing the number of potential adopters. The number of potential adopters for the mobile services in this thesis can be seen as a proportion of the population in the area where the services are being offered.

$$y_t^* = \gamma_t POP_t$$

In the above equation, POP_t is the total population at time t in the area where the services are being offered. γ_t is the share of this population using mobile services.

Chapter 4

Scenarios

This chapter introduces the scenarios that are used as input to the quantitative model developed. The scenarios are used to conduct a proof-of-concept test on the CF model. The proof-of-concept test is carried through to test the quality of the model and the feasibility of its outcome. To conduct this test proper input data is required. The scenarios presented in this chapter provide this.

4.1 Introduction

The scenarios described in this chapter provide necessary scenario-specific input to the CF model. One of the main goals of the CF model is to account for the effect of bargaining power on the revenue share agreement between the business actors. The bargaining power of the business actors depends on the business situation and the business actor strategies. Another of the main goals of the CF model is to redistribute the revenue to arrive at an outcome acceptable to all business actors. To account for different situations and actors with differing strategies, scenarios are needed to represent different sets of input.

One of the research questions posed in the problem formulation of this thesis is "How can scenarios be used to represent business models and business strategies?". This chapter tries to answer this question through developing scenarios describing these characteristics and justifying the approach chosen.

Chapter 3 discussed how the structural characteristics of the business situation and the service platform affect the bargaining power of the participating business actors, and specifically the content providers. Hence, the scenarios have to contain variables describing these aspects. The scenarios should also contain variables that test the redistribution of revenue.

4.2 Scenario Modeling

This thesis uses three specific scenarios describing different inputs for the CF model. These scenarios are named after the market form when considering the Content Providers; monopoly, oligopoly and free market. They differ in the number of Content Providers offering the necessary Content Provision service enablers, and in the business model and strategy of these Content Providers.

The scenarios are described in three steps. First, a textual explanation of the scenario is given to describe the general situation. Following this, the service composition is described with UML Use Cases. The service composition is important to the bargaining power because it describes how the services are created through the interaction between the business actors. It also illustrates how the Service Provider has to choose between the Content Providers if there are two or more the latter.

The service composition is described technically for two purposes. Firstly, the technical specification describes how the services are created through combining service enablers. This provides a better understanding of how the service platform functions. Secondly, the technical specification illustrates how the business actors interact. This is important to the understanding of bargaining power, and hence to the revenue share.

The last part of each scenario description is the definition of input variables to the CF model. These variables are derived from the textual and technical description of the scenarios, and provide the formal input to the CF model.

4.2.1 Scenario Variables

The following variables are defined for each scenario

Scenario Variables

w_{mn}	the values of the w-matrix
$Invest_{m,t}$	the investment costs incurred by BA_m in time period t
$Cost_{m,t}$	the overhead costs incurred by BA_m in time period t
$CostSE_{mn}$	the cost incurred by BA_m for one usage of SE_n
CON	the concentration of content providers
BE_m	indicating built up barriers to entry by BA_m
$npvT_m$	NPV threshold for BA_m

The w-matrix is the matrix that assigns service enabler ownership to business actors. The entries in the matrix are binary variables that take on the following values:

$$w_{mn} = \begin{cases} 1 & \text{if } BA_m \text{ owns } SE_n \\ 0 & \text{otherwise} \end{cases}$$

The CON-variable measures concentration in the scenarios. The importance of concentration to Content Providers in content provisioning portfolios is discussed in Chapter 3. The chosen measurement is the Herfindahl-Hirshman Index (HHI), and the value of the CON-variable is the value of HHI for the specific scenario.

The BE_m is a binary variable that takes on the following values:

$$BE_m = \begin{cases} 1 & \text{if } BA_m \text{ participates in the service platform} \\ 0 & \text{otherwise} \end{cases}$$

This variable is only defined for the Content Providers, as it is an input to the SCP equation only used to calculate the bargaining power of content providers. As discussed in Chapter 3, a business actor can create barriers to entry by participating in the service platform. The decision of whether or not to participate in the service platform is one of significant strategic importance.

From the SCP equation discussed in Chapter 3 it can be seen that participation in the service platform increases the bargaining power of the Content Providers. This increase in bargaining power leads to a larger value of the Lerner index, and hence a higher level of profitability for the Content Providers. However, this thesis assumes that participation in the service platform to increase bargaining power also has a cost. This cost is accounted for through the $Invest_{m,t}$-variable, which will have a larger value for service platform participants than for the business actors that do not participate.

In addition to the investment costs related to service platform participation, each business actor is assumed to have research and development costs related to their service enablers. This is accounted for through assuming that each business actor will have to pay one unit of research and development personnel for each service enabler they own that is in use. This cost is included in the $Invest_{m,t}$-variable.

Furthermore, each business actor will have overhead costs related to the production of services. These costs are constant, and do not depend on the number of service instances delivered. The costs depend on the number of personnel that each business actor employs. It is assumed that the Service Provider and the Network Provider require two units of personnel for the production of services, and that the remaining business actors require one unit of personnel. The Service Provider will probably need personnel for customer care, and the Network Provider will probably need personnel for network maintenance. Hence, these two business actors are modeled with one more unit of personnel than the other business actors. Overhead costs are accounted for in the $Cost_{m,t}$-variable.

The model of this thesis assumes that the number of personnel needed for overhead work and research and development is constant, and does not depend on the number of service instances produced. This assumption is made based on the fact that the production of communication and IT services are characterized by significant economies of scale (Dodd 2005).

In addition to the above variables, all scenarios contain a NPV threshold for all business actors except for the Content Providers, $npvT_m$. This variable sets a lower limit on the acceptable NPV of the project for the respective business actors. As discussed in Chapter 3, this limit could be a result of strategic considerations. For instance, the Service Provider could wish to set a limit higher than zero to please certain other business actors.

The scenario variables above are not included in the model of Langøygard (2006), as his model accounts for neither differing business situations nor bargaining power.

4.2.2 Scenario Market Variables

The scenarios also contain the following variables describing the market performance and business environment

Scenario Market Variables	
dP_t	annual growth in price P_t^i
a_t	shifts the sigmoid adoption curve horizontally
$MaxAdoption_t$	max annual growth in demand
$DemandLoss_t$	annual loss of demand to competition

The CF model will use three different market scenarios to account for the market development, one pessimistic, one realistic, and one optimistic. The market scenarios will have different values for the above listed variables. For instance, the $DemandLoss_t$ variable will be larger for the pessimistic scenario, accounting for a larger loss of demand to competition.

These market scenarios will be paired with each of the scenarios describing the business situation, such that there will be three market scenarios for each of the business scenarios. For example, there will be a pessimistic, a realistic and an optimistic market scenario for the monopoly business situation. Hence, there will be nine different sets of input to the CF model.

The scenario market variables are mostly the same as in the scenarios of Langøygard (2006). No probabilities are attached to the market scenarios. The use of market scenarios accounts for risk through illustrating different market development.

4.3 Market Scenarios

The variables of the three market scenarios are shown in Figure 4.1. The market scenarios have different values for all their variables. They are named after the market development seen from the Service Portfolio's perspective; pessimistic, realistic and optimistic.

All scenarios have different values for the a_t-variable shifting the sigmoid diffusion function forwards or backwards. A lower value of a_t, such as for the pessimistic scenario, will shift the sigmoid function forwards. This represents a pessimistic situation where the diffusion starts at a later time than with a higher value of a_t. This is described further in the phase descriptions of Chapter 5.

The $MaxAdoption_t$-variable sets an upper limit on the increase of demand from one period to the next. This upper limit varies from market scenario to market scenario, with the largest value for the optimistic scenario and the

SCENARIO MARKET VARIABLES, Pessimistic Scenario										
Price Growth	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Growth, Variable Price (dP_t)		-10 %	-10 %	-50 %	-50 %	-50 %	-30 %	-20 %	0 %	0 %
Adoption and Competition	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Adoption Shift (a_t)	0.5									
$MaxGrowth_t$		30 %	30 %	30 %	20 %	20 %	20 %	20 %	20 %	20 %
$DemandLoss_t$		0 %	20 %	80 %	80 %	80 %	80 %	80 %	85 %	90 %

SCENARIO MARKET VARIABLES, Realistic Scenario										
Price Growth	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Growth, Variable Price (dP_t)		-5 %	-5 %	-3 %	-3 %	0 %	0 %	0 %	0 %	0 %
Adoption and Competition	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Adoption Shift (a_t)	1.0									
$MaxGrowth_t$		80 %	80 %	60 %	30 %	20 %	20 %	20 %	20 %	20 %
$DemandLoss_t$		5 %	10 %	15 %	25 %	30 %	30 %	50 %	70 %	70 %

SCENARIO MARKET VARIABLES, Optimistic Scenario										
Price Growth	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Growth, Variable Price (dP_t)		0 %	0 %	-3 %	-7 %	-5 %	-3 %	0 %	0 %	0 %
Adoption and Competition	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Adoption Shift (a_t)	1.5									
$MaxGrowth_t$		100 %	100 %	80 %	40 %	30 %	20 %	20 %	20 %	20 %
$DemandLoss_t$		0 %	0 %	0 %	10 %	10 %	15 %	40 %	40 %	50 %

Figure 4.1: Variables of the three market scenarios.

smallest for the pessimistic scenario.

The pessimistic market scenario represents a situation where the Service Portfolio faces competition from a disruptive technology from the fourth year of operation. The disruptive technology offers superior services at a lower price, and the Service Portfolio has a significant demand loss from the fourth year and onwards. To counter the disruptive technology, the Service Portfolio also reduces the prices of the services significantly.

The realistic market scenario represents a situation where the services of the Service Portfolio are adopted on a relatively large scale in the population. The price is decreased slightly throughout the years of operation to retain customers. The demand loss is minor in the first years of operation, but increases towards the end of the time period considered. The increase is due to the ageing services of the Service Portfolio.

The optimistic market scenario represents a situation where the services of the Service Portfolio become very popular, and there is little competition. The price decrease starts later than for the realistic market scenario because there is less competition. The loss of demand is also smaller due to the lower level of competition.

4.4 Scenario 1: Monopoly

- One Content Provider
- Content Provider participates in the service platform
- Content Provider delivers all three Content Provision service enablers
- NPV threshold of 0 for BA 1-4

4.4.1 Description

This scenario represents a business situation where the Content Provider has monopoly on the Content Provision service enablers. In other words, there is only one Content Provider, and it delivers all three of the Content Provision service enablers. Furthermore, the Content Provider is part of the service platform.

As discussed in Chapter 3, the Service Provider cannot purchase the Content Provision service enablers from any business actors outside the service platform when there is a Content Provider participating in the platform cooperation. This means that the Content Provider in this scenario has built up barriers to entry through contractual terms. It is in effect the only choice for the Service Provider.

Both the low concentration of Content Providers (there is only one), and the barrier to entry increase the bargaining power of the Content Provider. The SCP equation will reflect this through a high value of the Lerner index, as explained in Chapter 3

In this scenario the NPV threshold of business actors 1-4 is set to 0. This means that these business actors will accept the project if their NPV from the Service Portfolio is larger than 0. Recall that no NPV threshold is set for the Content Providers.

4.4.2 Service Composition

Figure 4.2 shows a UML Use Case diagram of the service composition in the Monopoly scenario. Note that there is only one Content Provider, and that this Content Provider participates in the service platform. The figure is somewhat simplified as it only shows one Content Provision service enabler.

4.4.3 Variables

Monopoly Scenario Variables
$CON = 1$
$BE_5 = 1$

The remaining variables are found in Figure 4.3.

4.5 Scenario 2: Oligopoly

- Three Content Providers
- Content Providers participate in the service platform

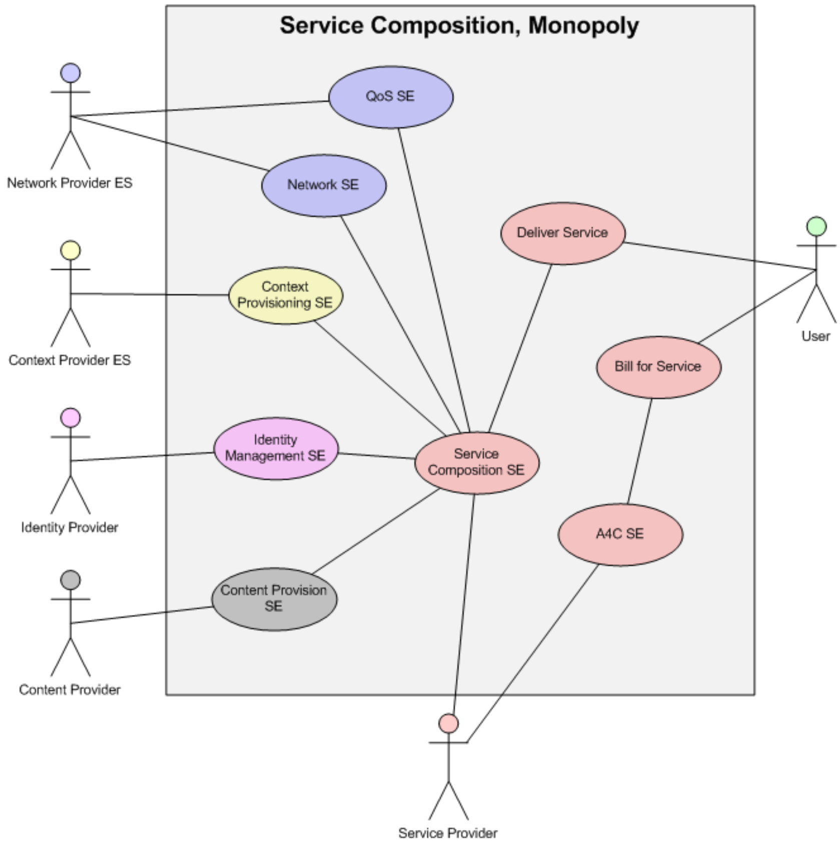


Figure 4.2: Use Case diagram showing service composition in the monopoly scenario.

- Every Content Provider delivers all three Content Provision service enablers
- NPV threshold of 0 for BA 1, 3 and 4. 70 million for BA2.

4.5.1 Description

This scenario represents a business situation where the internal market for Content Provision service enablers can be considered an oligopoly. Oligopoly is a situation where there is a high concentration of producers - competition among the few (Church & Ware 2000). In this scenario there are three Content Providers, with every one of them offering all three Content Provision service enablers. The Content Providers are all part of the service platform cooperation.

Number of CPs	1
Scenario Name	Monopoly

SE Ownernship Matrix (w-matrix)

w_{mn}

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	1	0	1	0	0	0	0
BA2	0	1	0	0	0	0	0	0	0
BA3	1	0	0	1	0	0	0	0	0
BA4	0	0	0	0	0	1	0	0	0
BA5	0	0	0	0	0	0	1	1	1
BA6	0	0	0	0	0	0	0	0	0
BA7	0	0	0	0	0	0	0	0	0
BA8	0	0	0	0	0	0	0	0	0
BA9	0	0	0	0	0	0	0	0	0
BA10	0	0	0	0	0	0	0	0	0
BA11	0	0	0	0	0	0	0	0	0
BA12	0	0	0	0	0	0	0	0	0
BA13	0	0	0	0	0	0	0	0	0
BA14	0	0	0	0	0	0	0	0	0

SE Costs

$CostSE_{mn}$

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	0.02	0	0.02	0	0	0	0
BA2	0	0.01	0	0	0	0	0	0	0
BA3	0.02	0	0	0.03	0	0	0	0	0
BA4	0	0	0	0	0	0.02	0	0	0
BA5	0	0	0	0	0	0	0.06	0.06	0.06
BA6	0	0	0	0	0	0	0	0	0
BA7	0	0	0	0	0	0	0	0	0
BA8	0	0	0	0	0	0	0	0	0
BA9	0	0	0	0	0	0	0	0	0
BA10	0	0	0	0	0	0	0	0	0
BA11	0	0	0	0	0	0	0	0	0
BA12	0	0	0	0	0	0	0	0	0
BA13	0	0	0	0	0	0	0	0	0
BA14	0	0	0	0	0	0	0	0	0

Concentration (HHI)

CON	1

Barriers to Entry

Barrier to Entry	**BEm**
BA5	1
BA6	
BA7	
BA8	
BA9	
BA10	
BA11	
BA12	
BA13	
BA14	

NPV Tresholds

	Threshold
BA1	-
BA2	-
BA3	-
BA4	-

Figure 4.3: Variables of Scenario 1: Monopoly.

Like in the Monopoly scenario, the Service Provider is limited to purchasing the Content Provision service enablers from the three aforementioned Content Providers in this scenario, as they are part of the service platform. Also like in the Monopoly scenario, and for the same reason, these Content Providers have built up barriers to entry.

Compared with the Monopoly scenario, the concentration in this scenario is lower due to the increased number of Content Providers.

In this scenario the NPV threshold of business actors 1, 3 and 4 is set to 0. This means that these business actors will accept the project if their NPV from the Service Portfolio is larger than 0. For the Context Provider (BA2), the NPV threshold is set to 70 million, which means that this business actor will only accept the project with a NPV larger than 70 mill. Recall that no NPV threshold is set for the Content Providers.

4.5.2 Service Composition

Figure 4.4 shows a UML Use Case diagram of the service composition in the Oligopoly scenario. Note that there are three Content Providers, all participating in the service platform. Note also that the Service Provider now has to choose between the three providers. The CF model makes this choice based on the prices of the Content Provision service enabler prices, as explained in Chapter 5.

4.5.3 Variables

Oligopoly Scenario Variables
$CON = \frac{1}{3}$
$BE_m = 1, \quad m \in [5, 7]$

The remaining variables are found in Figure 4.5.

4.6 Scenario 3: Free Market

- Ten Content Providers
- Content Providers *do not* participate in the service platform

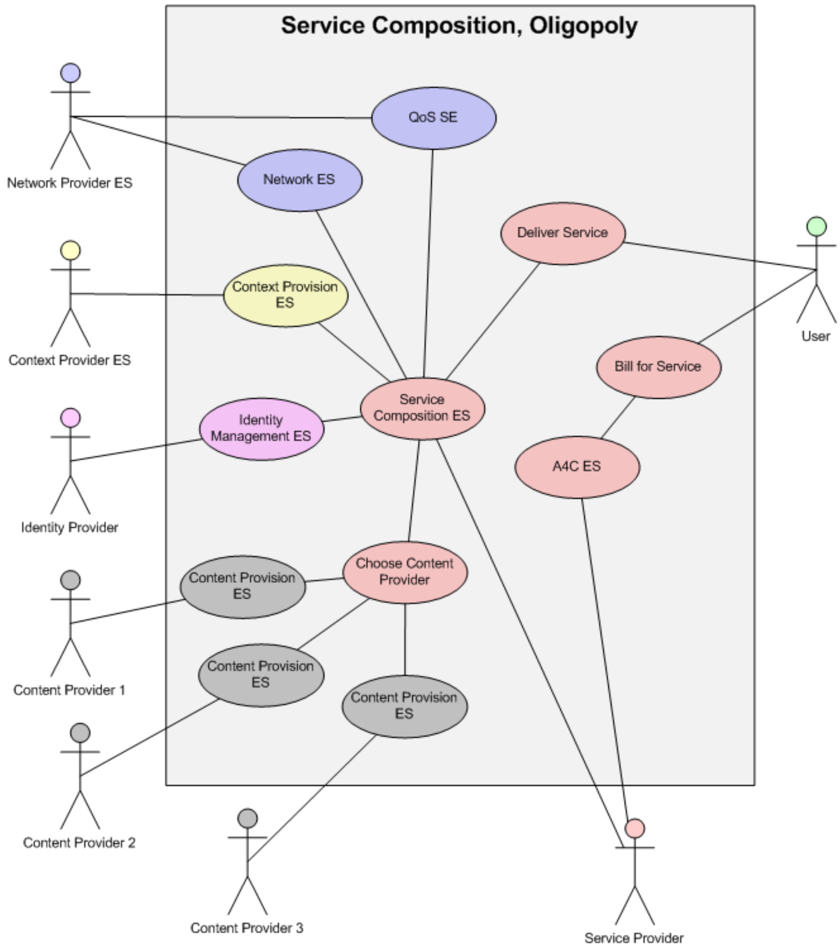


Figure 4.4: Use Case diagram showing service composition in the oligopoly scenario.

- Content Providers deliver different Content Provision service enablers
- NPV threshold of 0 for BA 1-4

4.6.1 Description

This scenario represents a business situation with *close to* perfect competition. In this scenario, there are ten Content Providers. None of them participate in the service platform cooperation. All of them compete to deliver the Content Provision service enablers to the service composition.

Number of CPs	3
Scenario Name	Oligopoly

SE Ownernship Matrix (w-matrix)

w_{mn}

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	1	0	1	0	0	0	0
BA2	0	1	0	0	0	0	0	0	0
BA3	1	0	0	1	0	0	0	0	0
BA4	0	0	0	0	0	1	0	0	0
BA5	0	0	0	0	0	0	1	1	1
BA6	0	0	0	0	0	0	1	1	1
BA7	0	0	0	0	0	0	1	1	1
BA8	0	0	0	0	0	0	0	0	0
BA9	0	0	0	0	0	0	0	0	0
BA10	0	0	0	0	0	0	0	0	0
BA11	0	0	0	0	0	0	0	0	0
BA12	0	0	0	0	0	0	0	0	0
BA13	0	0	0	0	0	0	0	0	0
BA14	0	0	0	0	0	0	0	0	0

SE Costs

$CostSE_{mn}$

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	0.02	0	0.02	0	0	0	0
BA2	0	0.01	0	0	0	0	0	0	0
BA3	0.02	0	0	0.03	0	0	0	0	0
BA4	0	0	0	0	0	0.02	0	0	0
BA5	0	0	0	0	0	0	0.06	1	1
BA6	0	0	0	0	0	0	1	0.06	1
BA7	0	0	0	0	0	0	1	1	0.06
BA8	0	0	0	0	0	0	0	0	0
BA9	0	0	0	0	0	0	0	0	0
BA10	0	0	0	0	0	0	0	0	0
BA11	0	0	0	0	0	0	0	0	0
BA12	0	0	0	0	0	0	0	0	0
BA13	0	0	0	0	0	0	0	0	0
BA14	0	0	0	0	0	0	0	0	0

Concentration (HHI)

CON	0.33

Barriers to Entry

Barrier to Entry	**BEm**
BA5	1
BA6	1
BA7	1
BA8	
BA9	
BA10	
BA11	
BA12	
BA13	
BA14	

NPV Tresholds

	Threshold
BA1	-
BA2	70.0m
BA3	-
BA4	-

Figure 4.5: Variables of Scenario 2: Oligopoly.

Unlike in the previous two scenarios, these Content Providers are not part of the service platform. Hence, they have not built up any barriers to entry. They are free to offer their service enablers to Service Providers in multiple service platforms.

The concentration ratio in this scenario is lower than in the two previous scenarios due to the increase in number of Content Providers. This, together with the lack of participation in the service platform, will result in a lower value of the Lerner index from the SCP equation.

The Content Providers in this scenario have chosen an increased degree of liberty over increased bargaining power. They are free to offer their service enablers to a large number of business actors, but have a lower degree of bargaining power due to the lack of participation in the service platform.

In this scenario the NPV threshold of business actors 1-4 is set to 0. This means that these business actors will accept the project if their NPV from the Service Portfolio is larger than 0. Recall that no NPV threshold is set for the Content Providers.

4.6.2 Service Composition

Figure 4.6 shows a UML Use Case diagram of the service composition in the Free Market scenario. Note that there are ten Content Providers, and that none of them participate in the service platform. As with the Oligopoly scenario, the Service Provider has to choose between the Content Providers available. Also like in the Oligopoly scenario, the Service Provider chooses the Content Providers from their service enabler prices. In this scenario however, the Service Provider is free to "shop around", as it is not limited contractually to a small number of Content Providers participating in the service platform.

4.6.3 Variables

Free Market Scenario Variables
$CON = \frac{1}{10}$
$BE_m = 1, \quad m \in [5, 14]$

The remaining variables are found in Figure 4.7.

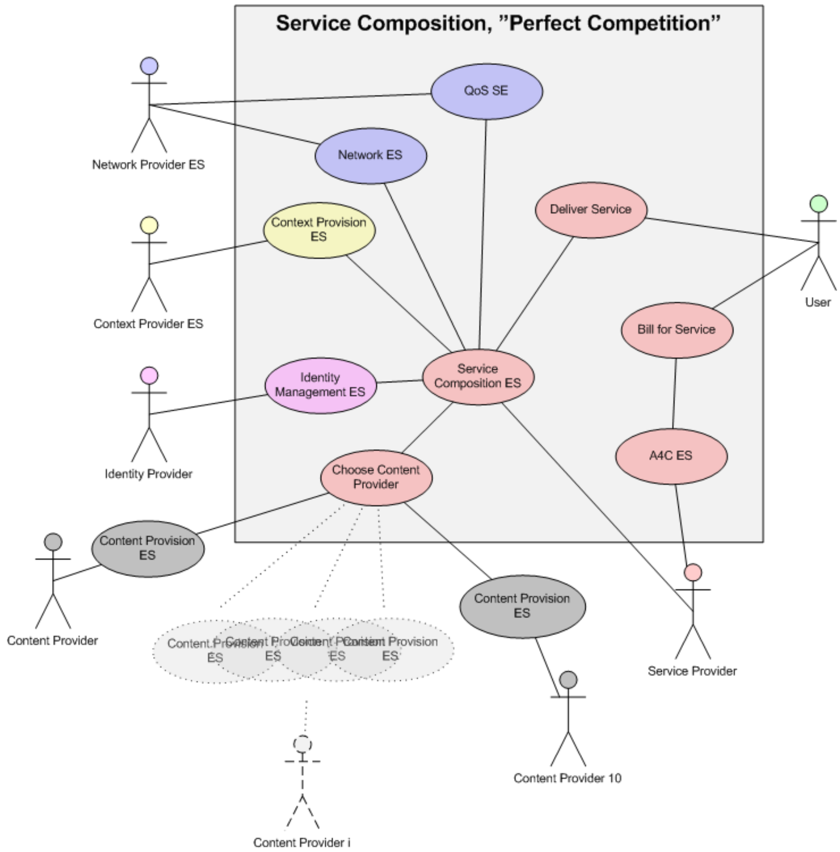


Figure 4.6: Use Case diagram showing service composition in the free market scenario.

4.7 Scenario Summary

Table 4.1 contains a summary of the three different scenarios describing the market situation. A brief comment on their differences and similarities is also included.

Recall that each of these scenarios are paired with all three market scenarios; the pessimistic, the realistic, and the optimistic. This gives a total of $3 \times 3 = 9$ input sets to the CF model.

Number of CPs	10
Scenario Name	Free Market

SE Ownernship Matrix (w-matrix)

wmn

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	1	0	1	0	0	0	0
BA2	0	1	0	0	0	0	0	0	0
BA3	1	0	0	1	0	0	0	0	0
BA4	0	0	0	0	0	1	0	0	0
BA5	0	0	0	0	0	0	1	0	0
BA6	0	0	0	0	0	0	0	1	0
BA7	0	0	0	0	0	0	0	0	1
BA8	0	0	0	0	0	0	1	0	0
BA9	0	0	0	0	0	0	0	1	0
BA10	0	0	0	0	0	0	0	0	1
BA11	0	0	0	0	0	0	1	0	0
BA12	0	0	0	0	0	0	0	1	0
BA13	0	0	0	0	0	0	0	0	1
BA14	0	0	0	0	0	0	1	0	0

SE Costs

CostSEmn

	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9
BA1	0	0	0.02	0	0.02	0	0	0	0
BA2	0	0.01	0	0	0	0	0	0	0
BA3	0.02	0	0	0.03	0	0	0	0	0
BA4	0	0	0	0	0	0.02	0	0	0
BA5	0	0	0	0	0	0	0.06	0	0
BA6	0	0	0	0	0	0	0	0.06	0
BA7	0	0	0	0	0	0	0	0	0.06
BA8	0	0	0	0	0	0	1	0	0
BA9	0	0	0	0	0	0	0	1	0
BA10	0	0	0	0	0	0	0	0	1
BA11	0	0	0	0	0	0	1	0	0
BA12	0	0	0	0	0	0	0	1	0
BA13	0	0	0	0	0	0	0	0	1
BA14	0	0	0	0	0	0	1	0	0

Concentration (HHI)

CON	0.1

Barriers to Entry

Barrier to Entry	**BEm**
BA5	0
BA6	0
BA7	0
BA8	0
BA9	0
BA10	0
BA11	0
BA12	0
BA13	0
BA14	0

NPV Tresholds

	Threshold
BA1	-
BA2	-
BA3	-
BA4	-

Figure 4.7: Variables of Scenario 3: Free Market.

Scenario Name	Main Variables	Comment
Monopoly	$CON = 1$ $BE_5 = 1$	This scenario represents a business situation where the Content Provider is a monopolist; it is the only provider of the Content Provision service enablers. The concentration variable has a value of 1, as there is only one firm. The Content Provider has built up barriers to entry through participating in the service platform, giving the BE-variable a value of 1.
Oligopoly	$CON = \frac{1}{3}$ $BE_m = 1, \quad m \in [5,7]$	This scenario represents a business situation where there are three Content Providers, all participating in the service platform. As with the monopoly scenario, these Content Providers have also built up barriers to entry, giving the same value for the BE-variable. In this situation, however, there are three firms, giving a lower value of the concentration variable.
Free Market	$CON = \frac{1}{10}$ $BE_m = 0, \quad m \in [5,14]$	This scenario represents a business situation close to a market form with perfect competition, with ten Content Providers not participating in the service platform. This gives a lower value of the concentration variable. Furthermore, there are no barriers to entry for new Content Providers, giving a BE-value of 0.

Table 4.1: Comparison of scenarios and their properties

Chapter 5

Cash Flow Maximization Model

Before making investment decisions regarding participation in or the launch of a service portfolio, it is important to valuate the service portfolio quantitatively. Significant factors that influence the valuation are aspects such as user behavior and acceptance, competition, business strategies, the system model and the technology. All these aspects, and more, are accounted for in the model developed.

This chapter presents the cash flow maximization model (CF model) that this thesis has sought to develop. First, a brief introduction to the model and the work it is built on is given. Next, a brief introduction to the model phases are presented before each phase is discussed in detail.

The CF model is developed to be as generic as possible. It is created using Microsoft Excel work sheets and uses phases to be easy to follow. Although the model is tested with input from the PATS service platform, this input can be changed as the users of the model wish to value other service portfolios. Furthermore, the model is created such that only the input variables need to be changed when valuing other service portfolios, the transformations in the interior of the model will still work and conduct a quantitative valuation.

5.1 Introduction

The model in this thesis is based upon the models of Langøygard (2006) and Zoric & Lassen (2005). Their models provide a quantitative framework for the valuation of telecommunication services. Langøygard's model consists of eleven phases, all of which are used in some form in the CF model of this thesis. The differences between the model of this thesis and the model of Langøygard are discussed for each of the phases.

Because the CF model developed here contains a large number of variables and transformations of these, it is divided into separate phases. The purpose of each of these phases is to receive certain variables as input, perform a limited set of transformations on these, and pass the result on to the next phases as output variables from this phase. This approach has several advantages. One advantage is that it makes it easier to account for market mechanisms separately, such as having a separate phase for the calculation of demand. It also facilitates the addition or removal of such mechanisms. Another advantage of the phases-based approach is that it makes it easier to identify errors throughout the development of the model by isolating these errors to specific phases.

A third and very important advantage of the phases-based approach is that it makes it easier to extend the model to account for new aspects. Through adding new phases, and slightly modifying existing ones, this thesis accounts for important new aspects in the valuation of IT and communication service portfolios.

The model in this thesis accounts for two main new aspects in the model

- Bargaining power effects on revenue share
- Redistribution of revenue to reach a solution acceptable to all business actors

The original model of Langøygard (2006) set a fixed per-unit price for the service enablers delivered by the business actors to the service composition. The service provider collected the revenue from the users and paid the co-producing business actors according to this pre-determined price. One problem with this solution is that it does not directly account for the bargaining power of the business actors. Another problem is that it does not align the incentives of the service provider and the other business actors. The other business actors will want to maximize the number of service instances sold, since they are paid on a per-unit basis and not a percentage of the collected revenue. Hence, they are not interested in the total revenue from the project, and will set the price to a minimum to maximize their revenue if they are able to determine the final prices of services.

This thesis extends the model to account for bargaining power and through this compute the revenue share among the business actors. This is done through the specification of the business situation and business actor strategies in scenarios, and using this as input to new phases in the model. The scenarios were described in Chapter 4. This thesis also tries to align the incentives of as many business actors as possible through modifying the revenue share agreement.

Another improvement area is the final distribution of revenue. In Langøygard's model, a possible outcome is that the total NPV of the service portfolio is positive, while the NPV for certain business actors is negative. This implies that the service portfolio project cannot be launched because some of the business actors do not find it profitable to participate. Furthermore, the Service Provider might wish to keep the NPV outcome of certain business actors above a certain threshold, as discussed in Chapter 3. A redistribution of the revenue in such a situation could bring the NPVs of all business actors within the acceptable regions. The model presented in this chapter handles this by adding a new phase that redistributes the revenue after the optimization. This functionality could be run in several iterations in search of a feasible solution.

One significant difference from Langøygard's model is that the CF model of this thesis only has one pricing scheme. During testing with Langøygard's model, implemented in Microsoft Excel, it has been concluded that the Solver[1] cannot find the optimal solution to a model with two pricing schemes. Rather than to support to schemes and get poor results, this model uses one pricing scheme to increase the quality of the results.

5.1.1 Time Span

The product life cycle for telecommunication services varies greatly from service type to service type, and the shape and form of this curve has been discussed in Chapter 3. This thesis uses a life time for the services of ten years. This is thought to be a realistic life time for the content provisioning services of the Service Portfolio. Like the other variables, this should be changed according to the service portfolio being valuated.

[1]Microsoft Excel's built in optimization tool.

5.1.2 Notation

This section presents the general notation used in the CF model. The indices and the general notation are listed below.

Indices	
t	time period, with Service Portfolio: $t = 0 \ldots 9$
i	number of service, with Service Portfolio: $i = 1 \ldots 7$
m	number of business actor, with Service Portfolio: $m = 1 \ldots$
n	number of service enabler, with Service Portfolio: $n = 1 \ldots 9$

General Notation	
S_i	service number i
BA_m	business actor number m
SE_n	service enabler number n

With matrices and vectors, the dimensions are included in the variable name. For instance, the w-matrix presented in Chapter 4 is denoted w_{mn}. This is an m by n matrix, with rows representing business actors (m) and columns representing service enablers (n). When referring to a specific element of this matrix, say the third element on the fourth row, this is written $w_{mn}[4, 3]$. Furthermore, matrix multiplication is denoted by $\times$. Ordinary multiplication is denoted by $\cdot$ or no sign at all. Note that $\cdot$ *does not* represent the scalar product of two vectors.

5.1.3 Service Portfolio

The Service Portfolio was described in Chapter 2. Although the CF model is designed to be generic and adaptable to different service portfolio inputs, this thesis uses the Service Portfolio to test the functionality of the model. Regardless of what input is used, specifying the service composition matrix and the ownership of service enablers is important. This section presents the symbols and matrices that are used to describe the Service Portfolio.

The service composition matrix illustrates which service enablers that are necessary to produce the different services. This matrix is presented in Table 5.1. The table is the same as in Chapter 2, but is repeated here to emphasize the importance of specifying the service composition.

S_i	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6	SE_7	SE_8	SE_9
S_1	x	x	x	x		x	x		
S_2	x	x	x	x	x		x		
S_3	x	x	x	x	x	x	x		
S_4	x		x		x	x		x	
S_5	x		x		x			x	
S_6	x		x			x			x
S_7	x	x	x	x	x				x

Table 5.1: Service composition matrix represented as a table.

$BusinessActorID$	Business Actor	Abbreviation
BA_1	Service Provider	SP
BA_2	Context Provider	CtxtP
BA_3	Network Provider	NP
BA_4	Identity Provider	IdP
$BA_{5\rightarrow}$	Content Provider	CP

Table 5.2: Business actors in Service Portfolio.

Another important piece of input is the matrix that specifies the service enabler ownership. As noted in Chapter 3, service enablers SE_1 to SE_6 are owned by one business actor each. SE_7, SE_8, and SE_9 are owned by Content Providers. There may be one or more Content Providers owning an instance of each service enabler, and a Content Provider may own one, two or all of these service enablers. This was specified in Chapter 4, and hence the exact matrix varies from scenario to scenario. Table 5.2 presents an overview of the business actors participating in the production of services. Table 5.3 illustrates which service enablers each of these business actors own. Note again that there may be more than one Content Provider, and that these are numbered from BA_5 and upwards, represented by the business actor IDs $BA_{5\rightarrow}$.

5.1.4 Scenario Input

The input that is scenario-specific, and thus varies from scenario to scenario, is described in the scenarios presented in Chapter 4. To valuate different business situations and account for this in the revenue share, three different scenarios are used. These differ in the market form and business strategy for

$ServiceEnablerID$	Service Enabler Name	Responsible BA
SE_1	Network	BA_3 - NP
SE_2	Context	BA_2 - CtxtP
SE_3	Service Composition	BA_1 - SP
SE_4	QoS	BA_3 - NP
SE_5	A4C	BA_1 - SP
SE_6	Identity Management	BA_4 - IdP
SE_7	Content Provision (Context-Based)	$BA_{5\rightarrow}$ - CP
SE_8	Content Provision (Sharing)	$BA_{5\rightarrow}$ - CP
SE_9	Content Provision (Information)	$BA_{5\rightarrow}$ - CP

Table 5.3: Service enabler ownership in Service Portfolio.

the Content Providers. Furthermore, each of these scenarios is coupled with the market scenarios. There are three different market scenarios; one pessimistic, one realistic, and one optimistic. Combined, this gives nine different sets of input.

5.1.5 Phases Overview

As noted previously, the model is divided into different phases representing different market mechanisms and calculations. The phases take input from other phases, perform transformations on this input, and pass the processed variables on as output. Each phase represents a work sheet of the Excel model. The model consists of 14 phases, three more than the model of Langøygard (2006). The three new phases have been introduced to account for two new aspects; the bargaining power effects on the revenue share (phases 3 and 4), and the redistribution of revenue to reach a solution acceptable to all business actors (phases 4 and Post-1). A simple black box illustration of the CF model is provided in Figure 5.1. A summary of the functionality of each phase is given in Table 5.4 and Table 5.5. The phases are described in detail in the remainder of this chapter.

The black box illustration in Figure 5.1 provides an overview of the model and its functionality. A black box model like this shows the main input and output of each phase, but does not describe the internal transformations in each phase. These transformations are described in later sections. The rounded rectangles in the illustration represent phases of the model, while the rectangles with pointed edges represent some of the main variables. Some

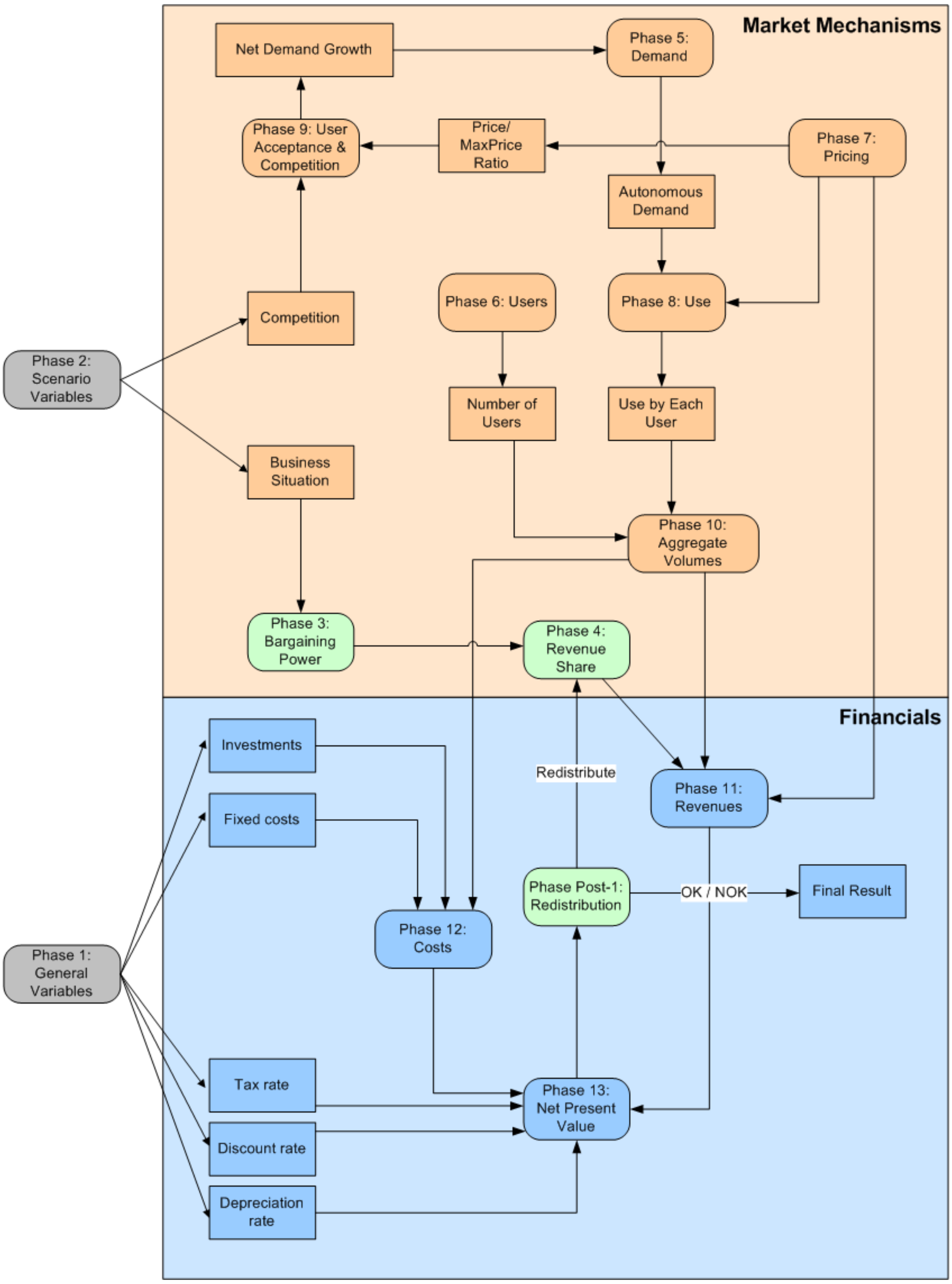


Figure 5.1: Black box illustration of CF model. The rounded rectangles represent phases of the model, and the rectangles with pointed corners represent some of the main variables. The illustration is a simplification; the model itself contains significantly more variables than the ones shown in this illustration.

Phase	Summary
Phase 1: General Variables	Contains general input common to all scenarios.
Phase 2: Scenario Variables	Contains scenario specific input.
Phase 3: Bargaining Power	Calculates the bargaining power of the Content Providers, and chooses a Content Provider for each of the Content Provision SEs.
Phase 4: Revenue Share	Calculates the revenue share matrix from general and bargaining power input.
Phase 5: Demand	Calculates the autonomous demand; the demand given that the services are free. This value provides an extreme point for the demand curve.
Phase 6: Users	Calculates the number of users of each service during the life time of the Service Portfolio.
Phase 7: Pricing	The price variable is used to optimize the NPV of the BAs, subject to certain constraints. There is one pricing scheme, with a variable per-usage price.
Phase 8: Use	Calculates the average use of each user. This use is normally distributed, and a function of the demand from Phase 5 and the price.
Phase 9: User Acceptance and Competition	The demand in the next phase is assumed to increase with an increase of the consumer surplus in the current phase (user acceptance). Competition is accounted for through a scenario variable setting the loss of demand to competition.
Phase 10: Aggregate Volumes	Combines the values of the previous phases to arrive at aggregate service volumes.
Phase 11: Revenues	Calculates the revenue for each business actor.
Phase 12: Costs	Calculates the costs for each business actor.
Phase 13: Net Present Value	Accounts for revenues, costs and financial parameters to arrive at the net present value of the Service Platform for each business actor.

Table 5.4: Overview of the phases of the CF model

Phase	Summary
Phase Post-1: Redistribution	Checks if the result is acceptable to all business actors ($npv_m \geq npvT_m$). Redistributes the revenue through modifying the revenue share matrix if this is not the case, and halts the search if no feasible solution is found.

Table 5.5: Overview of the post-phases of the CF model

of the variables are shown in the illustration to make it more intuitive, while other more detailed variables have been left out to simplify the illustration. The illustration is divided into two main parts, one for the phases that deal with market mechanisms, and another for the phases that deal with financial calculations. The phases have been numbered from 1 to 13, but because the flow of data is not linear the flow of the model does not exactly follow this numbering. It should also be noted that the scenario and general variables phases provide input to more phases than shown in the illustration. When examining the black box illustration, the phase descriptions of Table 5.4 and Table 5.5 could be used for additional information regarding the behavior of the model.

5.2 Phase Descriptions

This section provides a detailed description of each phase of the CF model. The description of each phase consists of a general description, a list of input and output variables, a mathematical description of transformations, and comments on the calculations of the phase. The CF model consists of 14 phases.

As noted previously, the CF model of this thesis adds three phases to the model of Langøygard (2006). These are:

- Phase 3: Bargaining Power
- Phase 4: Revenue Share
- Phase Post-1: Redistribute

Some of the phases that are adopted from Langøygard's model have received minor modifications. As most of the adopted phases are similar to the ones used in Langøygard's model, their descriptions in this thesis is also similar.

5.2.1 Phase 1: General Variables

This phase specifies all the variables that are common to all scenarios. There are no variable transformations in this phase, and all the variables in this phase act as input to other phases.

The general description of the service portfolio and its services is presented in this phase. The service portfolio used in this valuation is the one that was presented in Chapter 2. This Service Portfolio is presented in a way that can be used as input to the valuation in the other phases. More specifically, the general variables phase contains a service composition matrix, describing what service enablers that are necessary to compose the different services.

The user base for each service is also common to all scenarios, and these numbers are presented in this phase. Variables describing the price/demand dynamics are contained in this phase. Furthermore, variables describing financial rates such as the discount and amortization rates are defined here.

The general variables, except the matrices presented earlier in this chapter, are presented in Figure B.1 in Appendix B. The general variables for demand and max price are the same as in Langøygard (2006), as the same services are being modeled.

Variables

General Variables	
z_{in}	values of the service composition matrix
μ_0^i	mean value of demand for service i in year 0
λ^i	relation between mean demand and standard deviation
POP_0	population in the area where the services are offered at $t = 0$
$dPOP$	population growth rate
γ_t	share of the population that uses mobile services
b_t	variable deciding the speed of the user growth
dM_t	annual growth in max price
M_0^i	year 0 max price for service i
r	discount rate
d	depreciation rate
τ	tax rate
β_1	CON-coefficient of the SCP equation
β_2	BE-coefficient of the SCP equation

The z-matrix is the service composition matrix. The entries in the matrix are binary variables that take one the following values:

$$z_{in} = \begin{cases} 1 & \text{if } SE_n \text{ is used by } S_i \\ 0 & \text{otherwise} \end{cases}$$

Comments

This phase contains the variables that have the same value for all scenarios. The variables are the same as those of Langøygard, less some that have to be transferred to Phase 2 due to the new scenario situation. The w-matrix, the fixed costs, and the investments have been moved to Phase 2.

5.2.2 Phase 2: Scenario Variables

This phase resembles the general variables phase in the way that it contains variables that act as input to the other phases, and conducts no variable transformations. The variables in this phase, however, are specific to each of the scenarios. This implies that the input variables that change from scenario to scenario need to be defined in this phase.

Each scenario specified in Chapter 4 contains a set of input variables to the CF model. The business actors vary from scenario to scenario, and are hence specified in this phase. Service enabler ownership is scenario specific and defined here. The calculations of bargaining power in later phases are based on variables from this phase.

As explained in Chapter 4, there are two types of scenarios; business situation scenarios and market scenarios. There are three of each kind. The business situation scenarios are:

- Scenario 1: Monopoly
- Scenario 2: Oligopoly
- Scenario 3: Free Market

In addition to these, there are three market scenarios, containing scenario market variables:

- Pessimistic Scenario
- Realistic Scenario
- Optimistic Scenario

The scenarios above are coupled, giving a total of nine different sets of input to the valuation. For instance, the Monopoly scenario will be run with all three market scenarios. The business situation scenarios contain the variables that determine the effects of bargaining power. The market scenarios account for risk through describing different market development.

Variables

Scenario Variables	
w_{mn}	values of the w-matrix
$Invest_{m,t}$	investment costs incurred by BA_m in time period t
$Cost_{m,t}$	overhead costs incurred by BA_m in time period t
$CostSE_{mn}$	cost incurred by BA_m for one usage of ES_n
CON	concentration of content providers
BE_m	indicating built up barriers to entry by BA_m
$npvT_m$	NPV threshold for BA_m

Scenario Market Variables	
dP_t	annual growth in price
a_t	shifts the sigmoid adoption curve horizontally
$MaxGrowth_t$	max annual growth in demand
$DemandLoss_t$	annual loss of demand to competition

Comments

This section contains the scenario-specific variables. These variables describe the business situation and the market development. The scenarios are discussed in detail in Chapter 4.

5.2.3 Phase 3: Bargaining Power

This phase determines the bargaining power of the business actors participating in the Service Portfolio. More specifically, it quantifies the bargaining power of the Content Providers. This quantification is conducted by applying the theory of Chapter 3 to the scenarios described in Chapter 4. Also, this phase makes the choice between Content Providers based on their service enabler prices, if there is more than one Content Provider providing a certain Content Provision service enabler. The price of each Content Provision service enabler is calculated from the marginal cost and bargaining power of the Content Provider owning this enabler.

Through determining the bargaining power of the business actors the CF model accounts for this new aspect, not included in Langøygard's (2006) model. Accounting for bargaining power is one of the main contributions of this CF model.

Variables

Input Variables	
CON	concentration of content providers (Phase 2)
BE_m	existence of barriers to entry (Phase 2)
β_1	CON-coefficient of the SCP equation (Phase 1)
β_2	BE-coefficient of the SCP equation (Phase 1)
$CostSE_{mn}$	cost incurred by the owning BA_m for one usage of SE_n (Phase 2)
z_{in}	service composition matrix (Phase 1)
w_{mn}	values of the w-matrix (Phase 2)
Output Variables	
$PriceCPSE_{mn}$	price paid to BA_m (CPs) for one usage of SE_n
$\tilde{w}_{mn}$	revised w-matrix
$\widetilde{CostSE}_{mn}$	revised SE cost matrix

Transformation Functions

$$\frac{P_{mn} - CostSE_{mn}}{P_{mn}} = \beta_1 CON + \beta_2 BE_m \tag{5.1}$$

$$P_{mn} = \frac{CostSE_{mn}}{1 - \beta_1 CON - \beta_2 BE_m} \tag{5.2}$$

5.1 is the SCP equation presented in Chapter 3, with the Lerner index as the measure of profitability. Rearranging yields 5.2 and the price of the service enabler. These calculations are conducted for all Content Providers and their service enablers.

The Content Provider with the lowest price for each of the three Content Provision service enablers is chosen to deliver that service enabler to the service production. These prices are combined in a new matrix, $PriceCPSE_{mn}$, as shown in equation 5.3.

$$PriceCPSE_{mn} = \begin{cases} P_{mn} & \text{if } P_{mn} \leq P_{jn},\ \forall j \in m \\ 0 & \text{otherwise} \end{cases} \tag{5.3}$$

When knowing which Content Provider that will provide each of the service enablers, a revised w-matrix can be created. This matrix has an entry in $[m, n]$ if business actor BA_m provides the service enabler SE_n to the service composition. This is shown in equation 5.4.

$$\tilde{w}_{mn} = \begin{cases} 1 & \text{if } BA_m \text{ provides } SE_n \text{ to the service composition} \\ 0 & \text{otherwise} \end{cases} \tag{5.4}$$

For the revenue share agreement in Phase 4, it is important to know the costs involved with producing each service. The $CostSE_{mn}$-matrix needs to be adjusted to only account for the business actors participating in the service production. That is, if a business actor has a cost related to a service enabler that is not being used in the composition of a service, this cost should not be included in the cost-matrix. The revision of the matrix is shown in equation 5.5.

$$\widetilde{CostSE}_{mn}[i, j] = \tilde{w}_{mn}[i, j] \cdot CostSE_{mn}[i, j],\ \forall i, j \tag{5.5}$$

Note that the above matrix now only contains cost entries for service enablers that are being used in the service composition.

Comments

This section calculates the service enabler price charged by the Content Providers as a result of their bargaining power and marginal costs. This price is calculated from the SCP equation, using the CON and BE_m variables and the β-coefficients. The values of β_1 and β_2 are set to 0.3. These values reflect relevant research examined in Chapter 3. When the CF framework developed in this thesis is used for other service portfolios than the one examined in this thesis, the β-values should reflect the industry experience of the firm using the framework. One possibility is to use econometric techniques on previous data and prices of service enablers.

This section also determines which business actors that participate in the service composition. For SEs 1-6 the choice is simple, as there is only one provider of each service enabler. For the Content Provision service enablers however, a choice might have to be made. Based on these choices, the w- and $CostSE_{mn}$-matrices are revised.

5.2.4 Phase 4: Revenue Share

This phase determines the revenue share between the business actors co-producing the services. All revenue is collected by the Service Provider, and then distributed to the other business actors according to the revenue share agreement. The purpose of this phase is to calculate the specific revenue share, giving all business actors offering service enablers in the composition of a service a share of the revenue.

The Revenue Share phase accounts for the bargaining power calculated in the Bargaining Power phase.

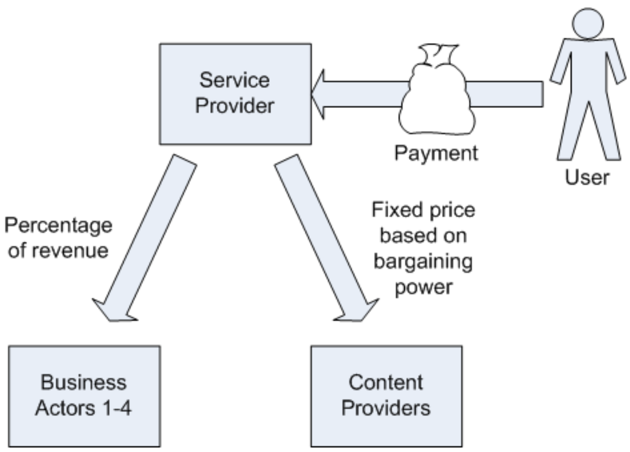


Figure 5.2: The Service Provider collects the payments from the users. The Content Providers receive a fixed price per service enabler instance, while the other business actors receive a percentage of the revenue.

All business actors except for the Content Provider receive a percentage of the revenue. The Content Providers receive a price per service enabler instance. This is illustrated in Figure 5.2. The price was calculated in Phase 3.

This phase is run for the first time during the first iteration. If the Redistribute phase determines that the revenue share should be revised, the revenue share matrix in this phase is adjusted. See the Post-1 Redistribute phase description for further details on this matter.

Variables

Input Variables	
$PriceCPSE_{mn}$	price paid by the SP to CP for one usage of SE_n (Phase 3)
z_{in}	service composition matrix (Phase 1)
$\widetilde{CostSE}_{mn}$	the cost incurred by the owning BA for one usage of SE_n (Phase 3)
Output Variables	
r_{mi}	revenue share matrix
$CostPerService_{mi}$	cost incurred by BA_m for one delivery of service i

Transformation Functions

Phase 3 calculated the price that each Content Provider charges for a service enabler, and chose the Content Provider charging the lowest price. This phase maps this payment from service enablers to services. It calculates the price charged for each service instance by the Content Providers as shown in the equation below. This price decides how much of the revenue that is transferred to the specific Content Providers. The mapping of prices from service enablers to services is shown in Equation 5.6.

$$CPPrice_{mi} = PriceCPSE_{mn} \times z_{in}^{T} \tag{5.6}$$

For all business actors other than the Content Providers, the marginal cost of producing one service instance is what determines their revenue share. When distributing the revenue, the Service Provider first pays the Content Providers their required price. Following this, the remaining business actors receive a percentage of the revenue determined by the ratio of their marginal cost for delivering a service to the total marginal cost of delivering this service. This percentage is calculated in equation 5.7 and 5.8.

$$CostPerService_{mi} = \widetilde{CostSE}_{mn} \times z_{in}^{T} \tag{5.7}$$

$$CostPercentage_{mi} = \frac{CostPerService_{mi}}{\sum_{j=1}^{4} CostPerService_{mj}} \tag{5.8}$$

The above calculations are necessary to arrive at the output of this phase, the revenue share matrix. This matrix consists of two main parts. The first four rows of the matrix, representing the first four business actors, show the percentage of the revenue that these receive. The remaining rows show the price that the CPs charge per service instance delivered. The deduction of the matrix is shown in equation 5.9.

$$r_{mi} = \begin{cases} CostPercentage_{mi} & \text{if } m \leq 4 \\ CPPrice_{mi} & \text{otherwise} \end{cases} \tag{5.9}$$

Comments

This phase calculates the revenue share matrix. All business actors, except for the Content Providers, get a percentage of the total revenue. This percentage is determined by the participating business actors' share of the total marginal production costs.

The entries in the matrix for the Content Providers specify the price that the chosen Content Provider charges for one instance of a specific service. For the other business actors, the matrix contains the share that these will receive of the remaining revenue.

To summarize; Phase 3 determines the prices of the Content Provision service enablers based on the marginal costs and bargaining power of the Content Providers. Phase 3 also selects the cheapest Content Provider(s) for the service composition. Based on this input and the marginal costs of the remaining business actors, Phase 4 calculates the revenue share matrix.

5.2.5 Phase 5: Demand

This phase calculates the autonomous demand; the demand for each service by each consumer assuming that the services are free. The CF model assumes that this demand is normally distributed. The benefit of calculating the autonomous demand before accounting for pricing and market effects is that it is possible to isolate these effects.

This phase takes input from the User Acceptance and Competition phase to account for growth in autonomous demand from consumer surplus and loss of demand to competition.

The autonomous demand calculated in this phase provides an extreme point for the demand curve, the maximum quantity of a service users would consume given that the service is free. The autonomous demand is an important input to Phase 8, where price is taken into account.

Variables

Input Variables	
$NetDemandGrowth_t^i$	annual growth of service demand (Phase 9)
μ_0^i	mean value of demand for service i in year 0 (Phase 1)
λ^i	relation between demand mean and standard deviation for service i (Phase 1)
Output Variables	
Q_t^i	demand for service i in year t
μ_t^i	expected value of Q_t^i
σ_t^i	standard deviation of Q_t^i

Transformation Functions

The Q_t^i variable is normally distributed, with μ_t^i as mean and σ_t^i as standard deviation.

$$Q_t^i \sim N(\mu_t^i, (\sigma_t^i)^2) \tag{5.10}$$

The mean of this distribution is affected by the input from Phase 9, accounting for user acceptance and competition. Note that $NetDemandGrowth$ will be negative if there is a net loss of demand.

$$\mu_{t+1}^i = \mu_t^i(1 + NetDemandGrowth_{t+1}^i) \tag{5.11}$$

The standard deviation is specified in Phase 1 as the relation between demand mean and standard deviation. This relations is assumed to stay constant throughout the lifetime of the Service Portfolio, such that the standard deviation is always given as

$$\sigma_t^i = \lambda^i \mu_t^i \tag{5.12}$$

Comments

The calculations of this phase are quite straight forward. The transformation function accounts for the annual growth in demand and calculates the mean demand and its standard deviation for each service throughout the time span of the Service Portfolio.

5.2.6 Phase 6: Users

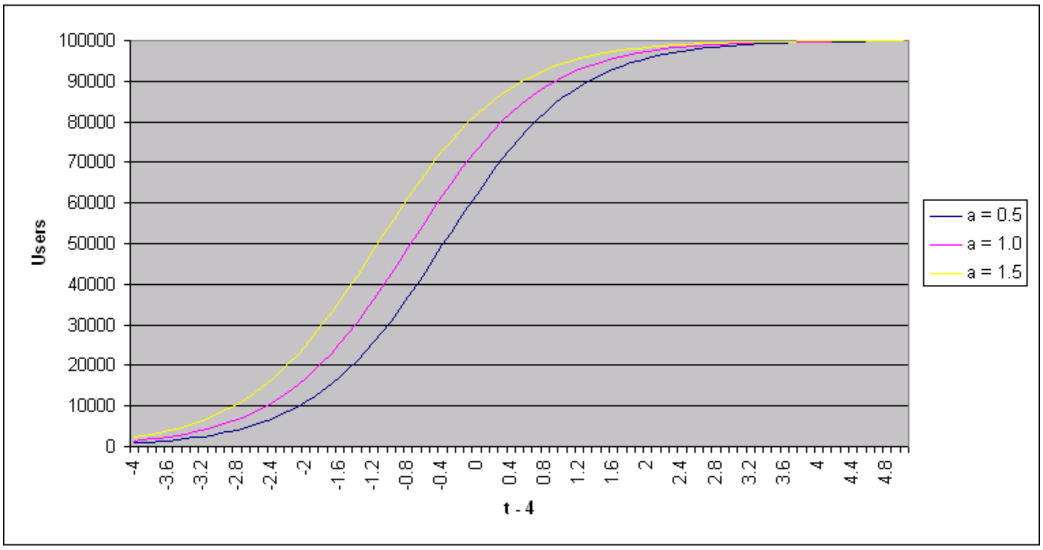


Figure 5.3: The shape of the sigmoid curve for the scenario values of a.

This phase calculates the number of users for the services offered throughout the years of operation. Gruber (2005) shows that the sigmoid logistic diffusion function has been a good measure of the number of users for previous telecommunication services. The sigmoid curve for the scenario values of a_t is shown in Figure 5.3. The diffusion process is described in Chapter 3.

Variables

Input Variables	
POP_0	total population in year 0 (Phase 1)
$dPOP$	population growth rate (Phase 1)
γ_t	share of the population using mobile services (Phase 1)
b_t	variable deciding the speed of the user growth (Phase 1)
a_t	shifts the sigmoid adoption curve horizontally (Phase 2)
Output Variables	
$users_t^i$	the number of users of service i at time t
$users_t^*$	total number of potential users at time t

Transformation Functions

$$POP_{t+1} = POP_t(1 + dPOP) \tag{5.13}$$

$$users_t^* = \gamma_t POP_t \tag{5.14}$$

$$users_t^i = \frac{users_t^*}{1 + e^{(-a_t - b_t t)}} \tag{5.15}$$

Comments

The user base is the same for all the services of the Service Portfolio. The user adoption is determined by the sigmoid function. a_t is a scenario variable shifting the sigmoid function backwards or forwards. b_t decides the diffusion speed, and is the same for all scenarios. In this model, $b_t = 1.3$, $\forall t$.

The variable POP_0 and $dPOP$ are set to 100000 and 0%, respectively. The POP_0 variable should be set according to the population in the area where the services are available. 100000 is regarded as a sound estimate for the Service Portfolio, it is also the value used by Langøygard (2006). The $dPOP$ variable is set to 0% as numbers from Statistics Norway show a population increase of less than one tenth of a per cent over the last years ((SSB) 2007).

The variable γ_t indicates the share of the population using mobile services. Statistics from the Norwegian Post and Telecommunication Authority show that there were 5040573 mobile subscribers in Norway in 2006 ((NPT) 2007). At the same time, numbers from Statistics Norway indicate a population of 4660677 ((SSB) 2007), which gives a value of 1.08 for γ_t. The thesis assumes that the penetration stays the same throughout the considered time span of the CF model.

5.2.7 Phase 7: Pricing

The price is the variable subject of optimization in the CF model. The price is set to maximize the NPV for the business actor performing the optimization. The business actor sets the price for the first year for each service within some constraints described below. The price in the following years is determined by variables from Phase 1 and Phase 2, determining the growth in prices. This phase determines the prices for services in the years following the first, and the constraints that the price has to lie within.

Variables

Input Variables	
M_0^i	max price for service i in year 0 (Phase 1)
' dM_t	annual growth in max price (Phase 1)
dP_t	annual growth in price (Phase 2)
Output Variables	
M_t^i	max price for service i in year t
P_t^i	price of service i in year t

Transformation Functions

$$P_{t+1}^i = P_t^i(1 + dP_t) \tag{5.16}$$

$$M_{t+1}^i = M_t^i(1 + dM_t) \tag{5.17}$$

$$\begin{aligned} Pmin^i &= \sum_{\forall m} \left(\widetilde{CostSE}_{mn} \times z_{in}^T \right) [m,i] \\ &= \sum_{\forall m} CostPerService_{mi}[m,i] \end{aligned} \tag{5.18}$$

$$\begin{aligned} &\max npv_{BA_m} \\ &\text{s.t. } Pmin^i \leq P_t^i \end{aligned} \tag{5.19}$$

Comments

Equation 5.16 calculates the price in the years following the first from the input variables describing the price growth.

The max price variable, M_t^i, determines the maximum price of services. This max price is needed for determining the demand in other phases. The transformation is shown in equation 5.17.

The CF model accounts for regulation through determining a minimum price that the Service Provider can charge for each service. The steps for calculating this minimum price is shown in equation 5.18. The minimum price for a service is set to the total marginal costs of producing this service. This implies that the regulatory authorities do not allow pricing below marginal costs.

The minimum price acts as a condition for the optimization problem, as shown in equation 5.19. The optimization problem maximizes the NPV subject to this condition, by changing the prices of the services.

This phase has one significant change from the corresponding phase of Langøygard's (2006) model. In this CF model, there is only one pricing scheme, as opposed to Langøygard's two. This simplifies the model, and has the advantage of making the optimization solvable by the Micosoft Excel Solver add-in.

5.2.8 Phase 8: Use

This section accounts for the pricing effects on demand. The price/demand relationship is constructed by the two extreme points on the curve; the max price calculated in Phase 7, and the autonomous demand calculated in Phase 5. By combining the price and the demand curve, the demand for each service by each user is calculated. This demand is called use, and hence this is the name of the phase. The demand of each user is assumed to be linear, and inversely proportional to the service price.

Variables

Input Variables	
P_t^i	price of service i in year t (Phase 7)
M_t^i	max price of service i in year t (Phase 7)
Q_t^i	demand for service i in year t (Phase 5)
μ_t^i	expected value of Q_t^i (Phase 5)
σ_t^i	standard deviation of Q_t^i (Phase 5)
Output Variables	
$\overline{U_t^i}$	average use

Transformation Functions

Each user has a downwards sloping linear demand curve, where the normal distribution for use gives one of the extreme points. This extreme point is the autonomous demand, the demand given that the services are free. The maximum price constitutes the other extreme point. Hence, the use of a certain user can be found through the following equation

$$U(Q, P_t^i, M_t^i) = Q\left(1 - \frac{P_t^i}{M_t^i}\right) \tag{5.20}$$

In the above equation P_t^i is the price for service i at time t, and M_t^i is the corresponding max price. These are the same for all users. The Q-variable is the autonomous demand, for this specific user and this specific service. This variable is drawn from the normal distribution $Q_t^i \sim N(\mu_t^i, (\sigma_t^i)^2)$.

Because there is a large number of users of the services, the randomly drawn variable Q can be approximated by the mean demand μ_t^i. Hence, equation 5.20 can be approximated by:

$$\overline{U_t^i} = U(\mu_t^i, P_t^i, M_t^i) = \mu_t^i \left(1 - \frac{P_t^i}{M_t^i}\right) \tag{5.21}$$

Comments

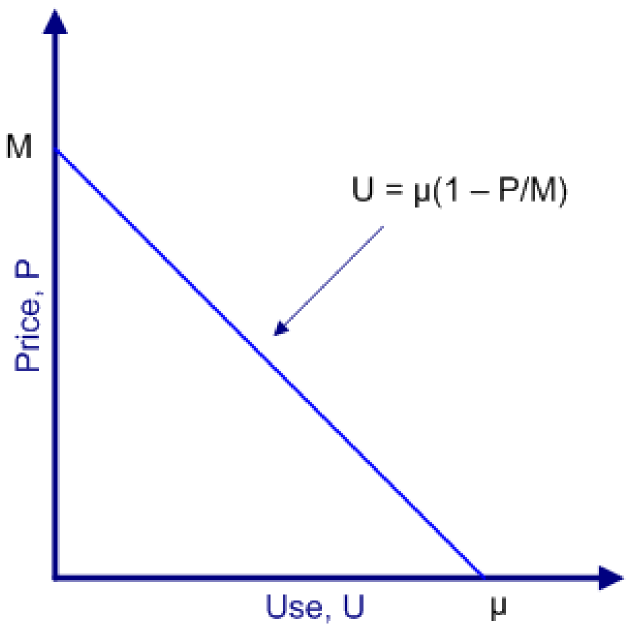


Figure 5.4: Price/demand curve. Extreme points from max price (M) and mean demand (μ).

Figure 5.4 illustrates the demand curve for the users of the services. Note that this demand is the use per user, taking the price into account. Hence, the U-value is the number of service instances requested by each user. This value is a function of the price, the max price, and the average autonomous demand from Phase 5.

5.2.9 Phase 9: User Acceptance and Competition

This phase accounts for the effects of user acceptance and competition on the demand. The model assumes that the increase in demand in the next time period depends on how well off the users are off in the previous period. The model also accounts for competition by including the effects of loss of demand to competition.

Consumer surplus is a common measure of how well off the consumers are (Schotter 2001). This thesis uses the price/max price ratio as an approximation of consumer satisfaction. The less the price/max price ratio, the better off are the consumers. This was discussed in Chapter 3.

Competition is accounted for by including loss off demand to competition.

Variables

Input Variables	
P_t^i	price of service i at time t (Phase 7)
M_t^i	max price of service i at time t (Phase 7)
$MaxGrowth_t$	max growth in demand from P/M ratio (Phase 2)
$DemandLoss_t$	the net transfer of demand to competitors (Phase 2)
Output Variables	
$PMratio_t^i$	ratio between variable price and max price
$GrossDemandGrowth_t^i$	gross annual growth of service demand
$NetDemandGrowth_t^i$	net annual growth of service demand

Transformation Functions

The price to max price ratio needs to be calculated as this ratio is important to the demand growth

$$PMratio_t^i = \frac{P_t^i}{M_t^i} \tag{5.22}$$

The gross demand growth is given from the price to max price ratio, and the net demand growth from the gross demand growth and the loss of demand to competition.

$$GrossDemandGrowth_t^i = 1 - 1.5(PMratio_t^i) \tag{5.23}$$

$$NetDemandGrowth_t^i = GrossDemandGrowth_t^i - DemandLoss_t^i \quad (5.24)$$

The variable $MaxGrowth_t$ limits the $NetDemandGrowth_t^i$ variable. The max growth in demand is determined by this market scenario variable.

Comments

The coefficient of 1.5 for the gross demand growth is the same as used by Langøygard (2006). From the transformation functions, it can be seen that the demand in the next time period is influenced by the price to max price ratio of the current period. The higher this ratio is, the better off the consumers, and the larger the increase in demand. This effect is explained in Chapter 3.

The net demand growth accounts for the loss of demand to competitors. This effect varies from market scenario to market scenario, and is specified in Phase 2. The maximum growth in demand is limited by a scenario variable specified in Phase 2; $MaxGrowth_t$.

5.2.10 Phase 10: Aggregate Volumes

The aggregate demand for all services is calculated in this phase. The output from the phases Use and Users provide the input for this phase. Transformations in this phase are simple multiplications of this input.

Variables

Input Variables	
$users_t^i$	the number of users of service i at time t (Phase 6)
$\overline{U_t^i}$	average use (Phase 8)
Output Variables	
$volume_t^i$	total service volume

Transformation Functions

By combining the average use of each user and the number of users, the total volume of service instances sold is found

$$volume_t^i = \overline{U_t^i} \cdot users_t^i \tag{5.25}$$

Comments

This phase calculates the aggregate volumes through simple multiplications. The total volume is arrived at through combining the average use and the number of users for each service in each time period.

The phase has the same functionality as the corresponding phase in Langøygard's model, except for this model only having one pricing scheme.

5.2.11 Phase 11: Revenue

The Revenue phase calculates revenue for all business actors based on the previous phases. The revenue is collected by the Service Provider and distributed among the business actors participating in the co-production according to the revenue share agreement.

Variables

Input Variables	
$volume_t^i$	total service volume (Phase 10)
r_{mi}	revenue share matrix (Phase 4)
Output Variables	
$revBA_{m,t}$	revenue for BA_m from time period t

Transformation Functions

The Content Providers are paid on a per-service-instance basis, and this payment constitutes their revenue

$$revBA_{m,t} = r_{mi} \times volume_t^i, \quad m \geq 5 \tag{5.26}$$

The other business actors receive a percentage of the remaining revenue

$$revBA_{m,t} = r_{mi} \times remainingRevenue_t^i, \quad m \leq 4 \tag{5.27}$$

Comments

This section calculates the revenue per business actors from the prices, total volumes, and the revenue share matrix. Recall that all business actors except for the Content Providers are paid a percentage of the revenue. The Content Providers receive a per-usage payment for their service enablers.

5.2.12 Phase 12: Costs

In this phase, the variable production costs for each business actor are calculated. Variable costs are determined by the number of service instances delivered of each service, and thereby the number of times the specific service enablers are used in the production of services. Important input to this phase is the aggregate demand for services and the marginal costs for delivering the service enablers that these consist of. The service enabler costs have already been combined to get the cost per service of each business actor in Phase 4, the result was the matrix $CostPerService_{mi}$.

Variables

Input Variables	
$volume_t^i$	total service volume (Phase 10)
$CostPerService_{mi}$	cost matrix (Phase 4)
Output Variables	
$costBA_{m,t}$	variable costs for BA_m in time period t

Transformation Functions

The cost of each business actor is found by combining the cost matrix from Phase 4 and the total service volumes from Phase 10.

$$costBA_{m,t} = CostPerService_{mi} \times volume_t^i \tag{5.28}$$

Comments

This phase calculates the variable costs from the service production for each BA. The variable costs are a multiplication of the service instances produced and the costs for the service enablers required for each service.

5.2.13 Phase 13: Net Present Value

This phase combines the revenue and costs of the business actors to arrive at the cash flow. The cash flow is discounted according to the discount factor to get the net present value, and thereby the valuation of the project for each business actor.

Variables

Input Variables	
$Invest_{m,t}$	investment costs incurred by BA_m in time period t (Phase 2)
$Cost_{m,t}$	overhead costs incurred by BA_m in time period t (Phase 2)
$costBA_{m,t}$	variable costs for BA_m from time period t (Phase 12)
$revBA_{m,t}$	revenue for BA_m from time period t (Phase 11)
r	discount rate (Phase 1)
d	depreciation rate (Phase 1)
τ	tax rate (Phase 1)
Output Variables	
$npvBA_m$	NPV for BA_m from Service Portfolio

Transformation Functions

To arrive at the net present value of the Service Portfolio for each business actor, financial statements are created. An income statement, a book value of investments in assets, and a cash flow statement are constructed for each business actor. The income statement and the book value of investments in assets are necessary to account for taxes.

The book value of investments shows the book value of the investments that have been made. Investments include investments in the service platform for the participants in this, and research and development (R&D) investments through R&D personnel costs. It is necessary to keep track of the book value of investments to calculate the appropriate tax expenses for each business actor. The model in this thesis assumes that the tax depreciation rate is the same as the book depreciation rate, and sets this to 25 percent.

The income statement calculates the gross profit, operating income, EBIT (Earnings Before Interest and Taxes), and the net profit before and after taxes.

The cash flow statement shows all events that affect the bank account balance or cash balance of the business actor. This includes sales, COGS (Cost of Goods Sold), operating expenses, investments, net taxes, and net tax benefit. In case of a net tax benefit or negative net taxes, the model assumes that the business actors have other operating income where this can be deducted. The tax rate is set to 28 percent.

Comments

This phase calculates the net present value of the Service Portfolio for each business actor through discounting the cash flow from the project. The cash flow that is discounted is the net cash flow of the cash flow statement, and the discounting rate is set to 15 percent. An example of the financial statement this phase generates can be seen in Figure C.1 in Appendix C.

5.2.14 Phase Post-1: Redistribute

This phase is named Post-1 because it happens *ex post* the specific valuation of the service portfolio. The phase is introduced in the model because the revenue share might need to be revised to make the project acceptable to all the participating business actors.

After an iteration of the model with the original revenue share agreement, it might be that the NPV for certain business actors is below their NPV threshold. This would imply that the project cannot be carried through because one or more business actors refuse to participate because of the financial outlook. However, it might be possible to revise the revenue share agreement within the limits of each business actor such that all business actors end up with a NPV above their NPV threshold.

The purpose of this phase is hence to check if the NPV outcome is acceptable for all business actors. If not, it investigates if the revenue share agreement can be revised to reach an agreement that all business actors can accept. This search is conducted through providing new input to the Revenue Share phase. A possible outcome is that there is no solution that falls within the business actors' acceptable regions. The search for new solutions is then halted.

Variables

Input Variables	
$npvBA_m$	NPV for BA_m from Service Portfolio (Phase 13)
$npvT_m$	NPV threshold for BA_m (Phase 2)
r_{mi}	revenue share matrix (Phase 4)
Output Variables	
r_{mi}	revised revenue share matrix (Phase 4)

Transformation Functions

This phase examines the NPVs calculated in Phase 13. The NPVs of the Content Providers are not included in the examination, and are not subject to revision. If the total NPV of all business actors is larger than the combined values of the $npvT_m$-values, an acceptable solution can be reached through redistributing the revenue.

This phase works in several iterations. In each iteration, the business actors with an NPV-value less than their $npvT_m$-value get their revenue share percentage increased by one percent for each service they are involved in.

One iteration works as follows:

- If BA_j has a NPV where $npvBA_j < npvT_j$, this phase increases this business actor's revenue share percentage by one percent for all services where the business actor delivers service enablers.
- The business actors which already have a NPV where $npvBA_j \geq npvT_j$

get their revenue share percentage reduced for all services where there is an increase to business actors with NPVs less than their threshold. The reduction is one percent multiplied by this business actor's share of the production costs for this service. Hence, the reduction is proportional to the given business actors percentage of the production cost for the given service.

Comments

This phase has been introduced to arrive at a solution acceptable to all business actors. It redistributes the revenue according to the principles of the revenue share calculations of Phase 4. The functionality of this phase is discussed further in the proof-of-concept tests in Chapter 6.

Chapter 6

Results and Discussion

This chapter presents the results of the proof-of-concept tests conducted with the CF model. The results were obtained through running the scenarios described in Chapter 4 through the model described in Chapter 5. One goal of this thesis is to analyze the scenarios qualitatively and quantitatively, this chapter performs such an analysis. Another goal is to analyze the relations between business actors through modeling. This chapter performs this analysis through looking at the quantitative consequences of business actor relations.

6.1 Introduction

The results of the proof-of-concept tests are presented in this chapter. The proof-of-concept tests have been carried out by using the scenarios of Chapter 4 as input to the CF model. The scenarios represent different business and market situations. All scenarios are based on the technical model and the Service Portfolio presented in Chapter 2. Altogether, the scenarios provide nine different sets of input.

The tests presented in this chapter have two main purposes. Firstly, they test the functionality of the CF model developed. Secondly, they provide valuable insight into the profitability of the modeled Service Portfolio.

The results are presented grouped by the scenarios that have been valuated. For each scenario, a brief summary of the input is given before the results are presented. The results are presented both with NPV results and graphs. Supplementary graphs and financial statements can be found in the appendices, referenced in the text where appropriate. A discussion of each set of results is given at the end of each scenario section. A summary of the results, an analysis of business actor incentives, and an evaluation of the model results can be found at the end of this chapter.

Unless otherwise noted, all results are obtained by optimizing the prices to maximize the NPV from the Service Portfolio for the Service Provider.

6.2 Scenario 1: Monopoly

This section presents the results from the valuation of the Monopoly scenario. The scenario has been valuated with all three market scenarios; pessimistic, realistic, and optimistic. The main results are presented in this section, supplementary graphs and results are found in Appendix C.

6.2.1 Scenario Input

This scenario represents a business situation with only one Content Provider, where this Content Provider participates in the service platform. The concentration of Content Providers is very low (there is only one), and the Content Provider in the service platform has built up barriers to entry through the service platform participation. Both these factors increase the bargaining power of the Content Provider. This increased bargaining power leads to a large Lerner Index through the SCP equation, which again increases the prices that the Content Provider charges for the use of its service enablers. The consequences of this are explored in the following sections.

The NPV threshold is set to 0 for business actors 1 to 4 in this scenario. Recall from Chapter 4 that the Content Providers have no NPV threshold in this model.

6.2.2 CF Model Results

Table 6.1 presents the net present value of participating in the Service Platform for all business actors involved. The Original-column contains results

	Pessimistic		Realistic		Optimistic	
Business Actor	Original	Post	Original	Post	Original	Post
BA_1, SP	7.1	5.7	262.7	262.7	554.3	554.3
BA_2, CtxtP	(2.9)	0.4	44.0	44.0	97.8	97.8
BA_3, NP	9.4	7.2	295.9	295.9	623.2	623.2
BA_4, IdP	(0.2)	0.1	83.4	83.4	178.5	178.5
BA_5, CP	(8.8)	(8.8)	44.2	44.2	123.4	123.4
Total	4.6	4.6	730.2	730.2	1577.2	1577.2

Table 6.1: CF model results with Scenario 1: Monopoly. All figures in million NOK.

before Phase Post-1 is run. The Post-column presents the results after this phase has completed its transformations. Hence, the Post-column shows the results after the revenue share matrix has been adjusted to reach a solution feasible for all business actors.

Service	Pessimistic	Realistic	Optimistic
S_1	4.02	2.11	1.77
S_2	4.02	2.11	1.77
S_3	4.05	2.12	1.79
S_4	3.07	1.59	1.37
S_5	3.04	1.60	1.35
S_6	3.70	0.40	0.37
S_7	3.70	0.43	0.40

Table 6.2: Service prices with Scenario 1: Monopoly.

Table 6.2 presents the prices for all services for this scenario. The revenue share matrices of this scenario are shown in Figure C.4 in Appendix C. Recall that the revenue share matrix contains percentage values of business actors 1-4, and a per-service-instance price for the Content Provider(s).

Pessimistic Market Scenario

For the pessimistic market scenario, the original NPV outcomes for business actors 1-4 are close to zero. The NPV outcome for the Content Provider is negative 8.8 million. After the redistribution, the Context Provider (BA_2) and the Identity Provider (BA_4) obtain a positive NPV, above their NPV threshold of 0. As can be seen from the results, the NPV of the Content Provider is not adjusted. The total NPV from the Service Portfolio is 4.6 million. Note that the total NPV is the same before and after the redistribution, as the only change between these two columns is an adjustment of the revenue share matrix. This adjustment does not affect the total cash flow. Figure C.4 in Appendix C shows the original and adjusted revenue share matrix.

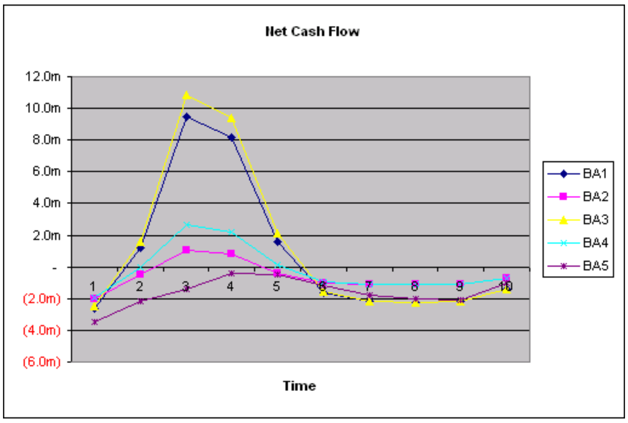
From the prices in Table 6.2, it can be seen that the prices of S_6 and S_7 are above the max price for these services. Hence, there are no sales for these two services. The Service Provider does not find it profitable to sell these services with the pessimistic market scenario. This affects the Content Provider, which has fixed costs and R&D investments related to the Content Provision (Information) service enabler, only required by S_6 and S_7. The max prices for all services can be found in Figure B.1 in Appendix B.

Figure 6.1 shows the net cash flow for all business actors before and after the redistribution of revenue. As can be seen from the graphs and the figures in Table 6.1, the revenue share of the Service Provider and the Network Provider is reduced, while it is increased for the Context Provider and the Identity Provider.

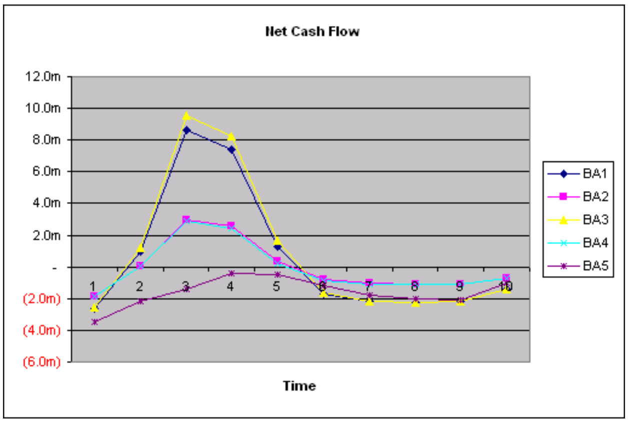
The significant drop in net cash flow at $t = 3$ should also be noted in Figure 6.1. This drop is due to the introduction of competition on a disruptive technology. In the pessimistic market scenario, this is modeled by a large loss of demand to competition, and a significant drop in prices to counter the competition. Together, this constitutes a severe impact to the net cash flow of all business actors.

Realistic Market Scenario

As can be seen from Table 6.1, the results are better for all business actors with the realistic market scenario. This is due to the improved market outlook, which increases the total revenue from the Service Portfolio. For business actors 1-4, this increases their revenue as they receive the same percentage as with the original results of the pessimistic market scenario. It also increases the revenue of the Content Provider, as the total number of service instances sold increases. Recall that the Content Provider is paid on a per-service-instance basis, with its bargaining power and marginal costs deciding the price of its service enablers.

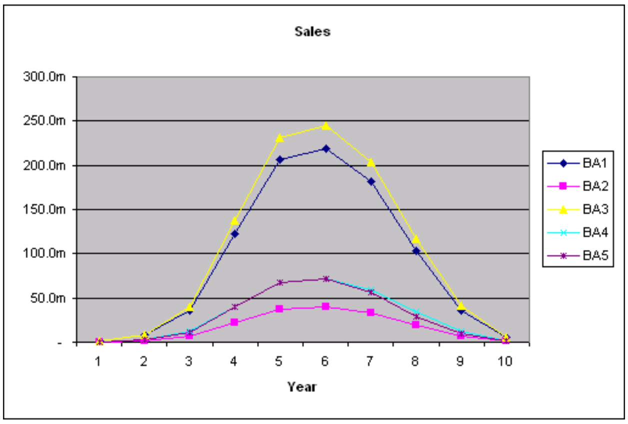


(a) Net cash flow, original

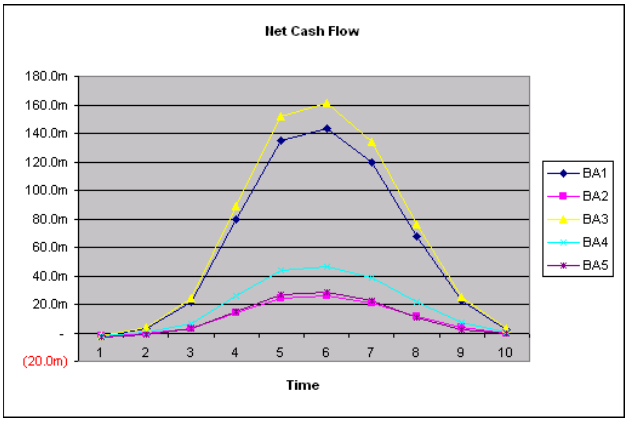


(b) Net cash flow, after redistribution

Figure 6.1: Net cash flow for all business actors in Scenario 1: Monopoly, with the pessimistic market scenario.



(a) Sales



(b) Net Cash Flow

Figure 6.2: Sales and Net Cash flow for all business actors in Scenario 1: Monopoly, with the realistic market scenario.

No redistribution of revenue is necessary for this scenario combination, as the original results have NPVs above the respective thresholds for all business actors. Hence, the results in the Original- and Post-column of Table 6.1 are identical.

The graphs in Figure 6.2 show the sales and net cash flow for all business actors in the realistic market scenario. The financial statement for the Service Provider can be found in Appendix C, Figure C.1. This statement is useful for understanding how the net present value for each business actor is calculated.

Optimistic Market Scenario

The optimistic market scenario provides even better results for all business actors than the previous two market scenarios. The total NPV from the Service Portfolio has amounted to 1577.2 million. No redistribution of revenue is necessary with this market scenario, as the original values are well within the NPV thresholds.

6.2.3 Discussion

By comparing the results from the three market scenarios, it can be seen that the results are promising for all business actors in the realistic and optimistic market scenarios. The final results from the pessimistic market scenarios satisfy the NPV thresholds for business actors 1-4, but predict a negative NPV for the Content Provider.

The Service Provider and the Network Provider have the largest NPVs from the Service Portfolio for all scenarios, significantly larger than for the other business actors. This is due to their participation in all services through their essential service enablers. Their participation in all services has two important consequences. Firstly, they receive a percentage of the revenue from all services. Secondly, the revenue share increases with the business actor's marginal production costs, and these two business actors have an on average higher marginal production costs than the other business actors. The larger revenue share more than outweighs the higher fixed costs and R&D investments these two business actors have. The resulting revenue share matrices are shown in Figure C.4 in Appendix C.

From the prices in Table 6.2, it can also be seen that the prices are affected by the market scenarios. The more optimistic the market scenario, the lower the prices will be.

6.3 Scenario 2: Oligopoly

This section presents the results from the valuation of the Oligopoly scenario. The scenario has been valuated with all three market scenarios; pessimistic, realistic, and optimistic. The main results are presented in this section, supplementary graphs and results are found in Appendix D.

6.3.1 Scenario Input

This scenario represents a business situation with three Content Providers, with all Content Providers participating in the service platform. The concentration of Content Providers is lower than for the Monopoly Scenario, but the Content Providers have still built up barriers to entry through participating in the service platform. With this scenario, the Service Provider will have to choose among the Content Providers for the three Content Provision service enablers, as they all provide all three.

In the Oligopoly scenario, the NPV threshold for the Context Provider is set to 70 million, as described in Chapter 4.

6.3.2 CF Model Results

Table 6.3 presents the net present value of participating in the Service Platform for all business actors involved. The Original-column contains results before Phase Post-1 is run. The Post-column presents the results after this phase has completed its transformations. Hence, the Post-column shows the results after the revenue share matrix has been adjusted to reach a solution feasible for all business actors.

Table 6.2 presents the prices for all services for this scenario. The revenue share matrices of this scenario are shown in Figure D.2 in Appendix D. The revenue share matrix shows that the Content Providers deliver one service enabler each. This is because all Content Providers have the same value of their Lerner index. Hence, the Content Provider with the lowest marginal

	Pessimistic		Realistic		Optimistic	
Business Actor	Original	Post	Original	Post	Original	Post
BA_1, SP	7.9	NA	275.4	265.1	585.3	585.3
BA_2, CtxtP	(2.7)	NA	46.0	75.8	102.5	102.5
BA_3, NP	10.3	NA	309.4	293.7	656.1	656.1
BA_4, IdP	0.0	NA	87.9	84.0	189.4	189.4
BA_5, CP	(5.3)	NA	7.1	7.1	28.2	28.2
BA_6, CP	(5.9)	NA	(0.1)	(0.1)	9.6	9.6
BA_7, CP	(6.4)	NA	0.9	0.9	9.3	9.3
Total	(2.1)	NA	726.6	726.6	1580.4	1580.4

Table 6.3: CF model results with Scenario 1: Oligopoly. All figures in million NOK.

Service	Pessimistic	Realistic	Optimistic
S_1	3.95	2.11	1.72
S_2	3.95	2.11	1.72
S_3	3.98	2.11	1.74
S_4	3.00	1.58	1.32
S_5	2.97	1.58	1.30
S_6	4.20	0.35	0.33
S_7	4.20	0.39	0.36

Table 6.4: Service prices with Scenario 2: Oligopoly.

cost for each service enabler is chosen. Recall the Content Provider marginal cost data in Chapter 4.

Pessimistic Market Scenario

For the pessimistic market scenario, the original NPV results for business actors 1 to 4 are similar to those of the Monopoly scenario. In this scenario however, the NPV of the Context Provider needs to be above the threshold of 70 million for the solution to satisfy the constraints. The total revenue from the Service Portfolio is not large enough to satisfy the NPV thresholds of all business actors, and hence no feasible solution can be found.

Like with the Monopoly scenario, the prices of S_6 and S_7 are above the max prices for these services. BA_7 delivers the Content Provision service enabler to these services, and does not deliver any other service enablers. Hence, this Content Provider incurs with fixed costs and R&D investments without earning any revenue in return.

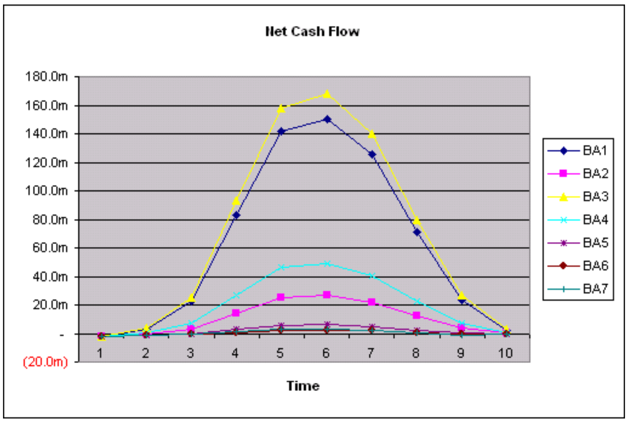
Realistic Market Scenario

As with the Monopoly scenario, the results for the realistic market scenario are better for all business actors. With this scenario combination however, the revenue share matrix needs to be adjusted to satisfy the NPV threshold of the Context Provider. The original and redistributed revenue share matrices can be found in Figure D.2 in Appendix D. This redistribution of revenue is also shown in Figure 6.3. Notice the increase in net cash flow for the Context Provider, BA_2.

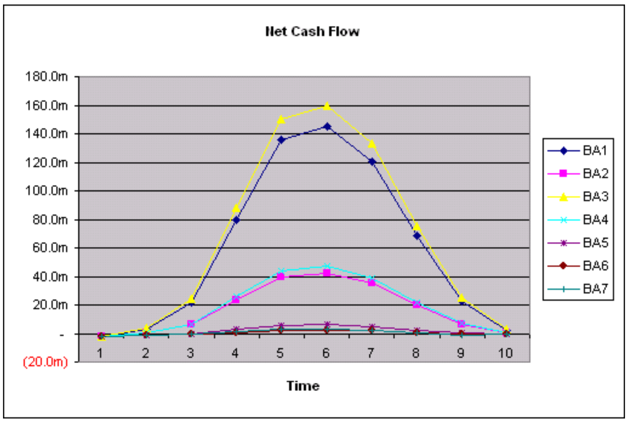
With the Oligopoly scenario, the bargaining power of the Content Providers is reduced due to the reduced concentration. This results in a lower Lerner index for the Content Providers, and thereby lower mark ups over price. As apposed to with the Monopoly ccenario, two Content Providers now have a negative NPV from the Service Portfolio with the realistic market scenario.

Optimistic Market Scenario

With the optimistic market scenario, all business actors are predicted a positive NPV. The total NPV from the Service Portfolio now amounts to 1580.4



(a) Net cash flow



(b) Net cash flow, after redistribution

Figure 6.3: Net cash flow for all business actors in Scenario 2: Oligopoly, with the realistic market scenario.

million. No redistribution of revenue is necessary, as the NPV values for all business actors are above the NPV thresholds.

When comparing the NPVs of the Content Providers, it can be seen that the NPV of BA_5 is higher than for the other Content Providers. This is because this Content Provider sells a larger number of service enabler instances by participating in the production of services 1, 2 and 3. The fixed costs of the Content Providers are identical, but the revenue for BA_5 is larger than for the two other Content Providers.

6.3.3 Discussion

With the Oligopoly scenario, it is not possible to reach a feasible solution with the pessimistic market scenario. This is because the total NPV from the Service Portfolio is not large enough to satisfy the NPV thresholds of all business actors. The results from the realistic and optimistic market scenarios however, satisfy the constraints.

As with the Monopoly scenario, and for the same reasons, the Service Provider and the Network Provider have the largest NPVs from the Service Portfolio for all scenarios.

From Table 6.2 and Table 6.4 it can be seen that the prices in the Oligopoly scenario are slightly lower than for the Monopoly scenario. This is because the marginal costs of producing one service instance are lower with the Oligopoly scenario due to the reduced bargaining power of the Content Providers. With lower marginal production costs, the Service Providers finds it profitable to lower prices to sell more service instances.

6.4 Scenario 3: Free Market

This section presents the results from the valuation of the Free Market scenario. The scenario has been valuated with all three market scenarios; pessimistic, realistic, and optimistic. The main results are presented in this section, supplementary graphs and results are found in Appendix E.

6.4.1 Scenario Input

This scenario represents a situation with ten Content Providers, with none of the Content Providers participating in the service platform. The concentration of Content Provider is lower than for the previous two scenarios, and the Content Providers have not built up any barriers to entry. As with the Oligopoly scenario, the Service Provider will have to choose among the Content Providers for the three Content Provision service enablers.

In the Free Market scenario, the NPV threshold for business actors 1 to 4 is set to 0, as described in Chapter 4.

As the Content Providers in this scenario are not part of the service platform, they do not have the 1 million investment costs for the first year as they do in the other two scenarios.

6.4.2 CF Model Results

	Pessimistic		Realistic		Optimistic	
Business Actor	Original	Post	Original	Post	Original	Post
BA_1, SP	8.5	7.3	285.8	285.8	610.6	610.6
BA_2, CtxtP	(2.6)	0.4	47.5	47.5	106.4	106.4
BA_3, NP	10.9	9.0	320.4	320.4	683.1	683.1
BA_4, IdP	(1.5)	0.4	90.0	90.0	196.7	196.7
BA_5, CP	(5.7)	(5.7)	(5.1)	(5.1)	(4.1)	(4.1)
BA_6, CP	(5.7)	(5.7)	(5.4)	(5.4)	(5.0)	(5.0)
BA_7, CP	(5.7)	(5.7)	(5.3)	(5.3)	(4.8)	(4.8)
Total	0.0	0.0	729.7	729.7	1584.5	1584.5

Table 6.5: CF model results with Scenario 1: Free Market. All figures in million NOK.

Table 6.5 presents the net present value of participating in the Service Platform for all business actors involved. The Original-column contains results before Phase Post-1 is run. The Post-column presents the results after this phase has completed its transformations. Hence, the Post-column shows the results after the revenue share matrix has been adjusted to reach a solution feasible for all business actors.

Table 6.6 presents the prices for all services for this scenario. The revenue

Service	Pessimistic	Realistic	Optimistic
S_1	3.89	2.08	1.72
S_2	3.89	2.08	1.72
S_3	3.92	2.10	1.72
S_4	2.95	1.58	1.29
S_5	2.92	1.56	1.29
S_6	3.97	0.32	0.30
S_7	6.73	0.35	0.33

Table 6.6: Service prices with Scenario 3: Free Market.

share matrices of this scenario are shown in Figure E.2 in Appendix E. The revenue share matrices show that Content Providers BA_5, BA_6 and BA_7 deliver one service enabler each. This is because all Content Providers have the same value of their Lerner index. Hence, the Content Provider with the lowest marginal cost for each service enabler is chosen. Recall the Content Provider marginal cost data of Chapter 4.

Pessimistic Market Scenario

From the results in Table 6.5 we see that a feasible solution is found for the pessimistic market scenario after redistribution. The original and adjusted revenue share matrices are shown in Figure E.2 in Appendix E.

Like with the other two business situation scenarios, the prices of S_6 and S_7 are above the max price for the pessimistic market scenario. Hence, BA_7 incurs fixed and investment costs, but collects no revenue.

Realistic Market Scenario

With the realistic market scenario, no adjustments are necessary to satisfy the NPV thresholds of the business actors. Figure 6.4 shows the net cash flow of all business actors for the realistic market scenario.

The bargaining power of the Content Providers is significantly less with the Free Market scenario than with the two other scenarios. This is due to the reduced concentration and lack of barriers to entry. From Figure 6.5 it can be seen that the net cash flow for the selected Content Providers is negative throughout the time span of the Service Portfolio. This is because the mark

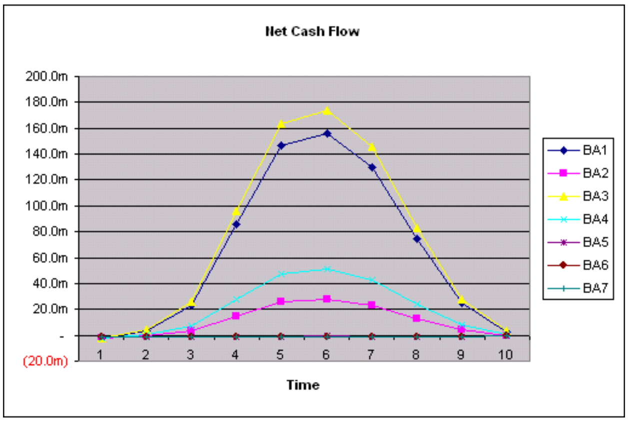


Figure 6.4: Net cash flow for all business actors in Scenario 3: Free Market, with the realistic market scenario.

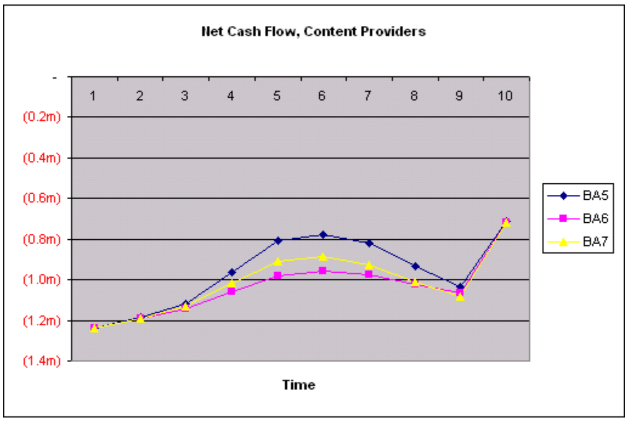


Figure 6.5: Net cash flow for selected Content Providers in Scenario 3: Free Market, with the realistic market scenario.

up they are able to charge over marginal cost is not enough to make up for their fixed costs and investments.

Optimistic Market Scenario

The NPV outcomes for business actors 1 to 4 are even better with the Free Market scenarios than with the other two business situation scenarios. For the Content Providers however, the NPV from participating in the Service Portfolio production is negative.

6.4.3 Discussion

The most significant difference between the Free Market scenario and the other two business situation scenarios is the poorer result for the Content Providers. For all of the market scenarios, the NPV results for the Content Providers are negative. This is due to their reduced bargaining power, which again reduces the mark up they are able to charge over marginal costs. The reduced investment costs from not participating in the service platform are not enough to make up for the reduced bargaining power.

The effects of bargaining power through the concentration and barrier to entry-variables are investigated in the next section.

6.5 Business Situation Sensitivity

This section investigates the consequences of the different business situation that the three main scenarios represent. From the previously presented results, it can be seen that the market form in the scenarios affects the profitability of the Service Portfolio for all business actors. The Content Providers seem to be particularly sensitive to the market form in the scenarios.

Recall the SCP equation from Chapter 3

$$L = \beta_1 CON + \beta_2 BE$$

The result of this SCP calculation is shown in the right-most column of Table 6.7. Recall also how the Lerner index is related to marginal cost and

Scenario	CP Revenue %	CON	BE	L
Monopoly	10.7%	1.00	1	0.60
Oligopoly	7.6%	0.33	1	0.40
Free Market	5.0%	0.10	0	0.03

Table 6.7: Key business situation data for the three scenarios.

price

$$L = \left(\frac{P - MC}{P}\right)$$

Hence, the Lerner index calculated with the SCP equation for the different scenarios determines how much the Content Providers can mark up their price over marginal cost. This mark up needs to be large enough to cover fixed costs and R&D investments if the Content Providers are to find the Service Portfolio profitable.

From Table 6.7 it can also be seen that the percentage of total revenue going to the Content Providers decreases significantly when their bargaining power, and hence Lerner index, decreases. This is because their bargaining power and their marginal costs determine the price they can charge for their service enablers. For all three scenarios, the marginal costs of the selected Content Providers are the same. Hence, with decreasing bargaining power, the prices of their service enablers decrease. The decreasing prices affect their share of the total revenue negatively.

By examining the figures in Table 6.7 and the NPV results from the previous sections, it can be seen that the Content Provider in the Monopoly scenario is predicted the most profitable outcome from the Service Portfolio. For the Oligopoly scenario, the situation is somewhat worse. For the Free Market scenario, the Content Providers are predicted a negative NPV with all market scenarios. The opposite is true for business actors 1-4, where the Free Market scenario predicts the most profitable outcome.

Another result that should be pointed is the identical original revenue share matrices for business actors 1-4 for all business scenarios, paired with all market scenarios. This is because the revenue share of these business actors is determined by their percentage of the total marginal production cost less the production costs of the Content Providers. Their marginal production costs are identical for all scenarios. Hence, the way these business actors share the remaining revenue does not change from scenario to scenario.

6.6 Business Actor Incentives

The CF model developed in this thesis has introduced a different revenue share scheme than Langøygard's (2006) model. It also accounts for the bargaining power of Content Providers, and the effects of participating in the service platform. This section will investigate what incentives this gives the business actors.

6.6.1 Pricing

One problem with the revenue share scheme in Langøygard's (2006) model was that all business actors except for the Service Provider would price at minimum price when optimizing the prices for their NPV from the Service Portfolio. This was because they were paid on a per-service-instance basis, and thus wanted to maximize the number of service instances sold. The total revenue from the Service Portfolio was of less importance.

The results presented previously in this chapter have been from setting the prices to maximize the revenue of the Service Provider. This section investigates the outcome when setting the prices to maximize the revenue of the Network Provider. The Network Provider is chosen because this business actor participates in the production of all services, and hence has preferences for the prices of all services. The optimization is run with Scenario 1: Oligopoly, with all market scenarios.

	Pessimistic		Realistic		Optimistic	
Business Actor	Original	Post	Original	Post	Original	Post
BA_1, SP	7.9	NA	275.4	265.1	585.3	585.3
BA_2, CtxtP	(2.7)	NA	46.0	75.8	102.5	102.5
BA_3, NP	10.3	NA	309.4	293.7	656.1	656.1
BA_4, IdP	0.0	NA	87.9	84.0	189.4	189.4
BA_5, CP	(5.3)	NA	7.1	7.1	28.2	28.2
BA_6, CP	(5.9)	NA	(0.1)	(0.1)	9.6	9.6
BA_7, CP	(6.4)	NA	0.9	0.9	9.3	9.3
Total	(2.1)	NA	726.6	726.6	1580.4	1580.4

Table 6.8: CF model results with Scenario 1: Oligopoly. All figures in million NOK. Optimized for BA_3.

Service	Pessimistic	Realistic	Optimistic
S_1	3.95	2.11	1.72
S_2	3.95	2.11	1.72
S_3	3.98	2.11	1.74
S_4	3.00	1.58	1.32
S_5	2.97	1.58	1.30
S_6	4.20	0.35	0.33
S_7	4.20	0.39	0.36

Table 6.9: Service prices with Scenario 2: Oligopoly. Optimized for BA_3.

The results of the optimization are found in Table 6.8 and Table 6.9. When comparing these two tables to the original optimization results in Table 6.3 and Table 6.4, it can be seen that the results are exactly the same. Hence, the revenue share scheme developed in thesis aligns the incentives of the Service Provider and the Network Provider. This is important because all business actors in the service platform will have to agree on the price of their services. When the incentives are aligned, reaching an agreement becomes easier.

6.6.2 Service Platform Participation

Business actors 1 to 4 participate in the service platform for all scenarios. Because the CF model models a content provisioning portfolio and accounts for the bargaining power of Content Providers, these are modeled both participating and not participating in the service platform.

From the results presented in this chapter, it is clear that the Content Provider participating in the service platform in the Monopoly scenario faces the most profitable situation. Furthermore, the Content Providers in the Oligopoly scenario face a more profitable situation than the Content Providers in the Free Market scenario. If one of the Content Providers in the Free Market scenario were given the opportunity to participate in the service platform and paying the investment costs for this participation, the model results indicate that the Content Provider would seize this opportunity. Thus, the model results indicate that the Content Providers have a desire to participate in the service platform. For the other business actors however, the opposite is the case. They would prefer to buy Content Provision service enablers from a large number of Content Providers outside the service platform. Consequently, the model results indicate that the Content Providers and the rest of the business actors have different preferences on this point.

It should also be taken into account that Content Providers outside the service platform most likely will have better opportunities to sell service enablers to multiple service platforms. This aspect is not accounted for in the CF model as it only valuates the profitability of the Service Portfolio. Such opportunities may increase the profitability of not participating in the service platform.

6.7 Discussion

There are a few key properties and assumptions of the model that should be considered when evaluating the results presented herein. Firstly, the model assumes perfect information regarding the costs of the business actors. This is necessary to determine the revenue share and the financial figures for each business actor. In a real business situation it might be the case that the business actors do not wish to reveal their costs to each other. The CF model should then be used with approximated values.

Secondly, the SCP equation used to quantify bargaining power is very sensitive to the β-values. The CF model has been tested with β-values of 0.3, as discussed in Chapter 3 and in the phase descriptions of Chapter 5. Preferably, these values should be determined by applying econometric techniques on situations similar to the one modeled. Such a determination is out of scope of this thesis, but should be conducted if the CF model framework is applied to other service portfolios. Furthermore, it should be noted that the SCP implementation is aligned with economic theory on the subject, but not checked against statistical data on content provider pricing.

Thirdly, the CF model in this thesis implements only one pricing scheme as opposed to the two pricing schemes implemented by Langøygard (2006). The reason for this is the limitations of the Solver add-in used to solve the optimization problems. When investigating Langøygard's model, it was concluded that the Solver add-in was not able to solve the problem with two pricing schemes in a satisfactory manner. The Solver did not reach optimal solution unless strict restraints were imposed on the prices in the fixed pricing scheme. Langøygard chose to impose such restraints to be able to use two pricing schemes. This CF model chooses to impose less strict restraints, but limits the number of pricing schemes to one.

Fourthly, the CF model in this thesis implements a fixed decrease in prices set together with the scenario variables. This reduces the liberty of determining prices for the business actor setting prices to optimize its outcome of the project. Preferably, the CF model should implement all necessary market mechanisms, and then let the business actors set price without any restrictions except for regulation. However, extensive trials showed that the Solver add-in was not able to arrive at the optimal solution when the prices of all services for all years were the subject of optimization. Consequently, the CF model lets the optimizer set the prices of all services only for the first year of operation. In the following years, the prices are determined by the price decrease variables. This way of determining prices is the same as in the model of Langøygard (2006).

6.8 Summary

This chapter has presented the results of valuating the Service Portfolio with the CF model. The business situation scenarios representing the market forms monopoly, oligopoly and free market provided input describing the business situation and the business actor strategies. The market scenarios pessimistic, realistic and optimistic provided input regarding the market development. The business and market scenarios have been combined to produce a total of nine different sets of input. The technical model of the Service Portfolio presented in Chapter 2 has been the same for all sets of input, except for the varying number of Content Providers and their service enablers.

The results of the CF model valuation shows that the predicted outcome for the Service Provider, Context Provider, Network Provider and Identity Provider look promising. Their NPV from the Service Portfolio varies slightly from market scenario to market scenario. Overall, results for the optimistic and realistic market scenarios predict positive NPV values for all these business actors. With the pessimistic market scenario, the model is able to reach a feasible solution for all scenarios, except with the Oligopoly scenario where the Context Provider has a NPV threshold of 70 million.

For the Content Providers, the results are promising with the Monopoly scenario. The NPV outcome is somewhat worse for the Oligopoly scenario, and the model predicts a negative NPV for all selected Content Providers with all market scenarios in the Free Market scenario. The CF model quantification of bargaining power significantly affects the outcome for the Content Providers, and their outcome has been shown to be highly dependent on the business scenarios.

The nine different sets of input provided to the CF model in the proof-of-concept tests also test the functionality of the model. The model seems to work as desired, and all phases seem to conduct their transformations in a satisfactory manner. Bargaining power is accounted for in the model by quantifying the bargaining power of the Content Providers from structural parameters. The revenue share agreement is devised in such a way that the business actors deciding the price of services have their incentives aligned.

Chapter 7

Conclusion

This section concludes this thesis. The main results are examined and compared to the problem formulation. It is shown that a solution has been proposed to the problem formulation, and that answers have been proposed to all defined research questions. Concluding comments on the CF model are also given. Moreover, this section suggests important areas for future work.

7.1 Results

The purpose of this thesis has been to analyze a chosen set of communication and IT service portfolios, with an emphasis on cash flow optimization and business actor positions and incentives. The quantitative framework developed for the analysis has been based on the frameworks developed by Langøygard (2006) and Zoric & Lassen (2005). The thesis set out to analyze and improve these models. More specifically, four important research questions were identified in the problem formulation:

- How can scenarios be used to represent business models and business strategies?
- How can the scenarios be analyzed qualitatively and quantitatively?
- How can the business actor positions be analyzed in the scenarios?
- How can the relations between business actors be analyzed through modeling?

In Chapter 4, scenarios are developed to represent business models and business strategies. Three scenarios describing three different business situations are created. These scenarios represent the market forms of monopoly, oligopoly and free market. Furthermore, three market scenarios are developed to account for different market developments. In all scenarios, the participating business actors are modeled with different business models and business strategies. The technical model is described in Chapter 2, and kept constant throughout the scenarios to focus on the business situation. The business actor strategies are modeled emphasizing two main strategic matters. Firstly, the scenarios include the strategic decision of participation in the service platform for the Content Providers. Secondly, the strategic effect of net present value thresholds is accounted for through setting this parameter for certain business actors.

The main work of this thesis has been the quantitative and qualitative analysis of the scenarios developed in Chapter 4. The technical and economic theory investigated in Chapter 2 and Chapter 3 provides a necessary background for the analysis performed. Furthermore, the bargaining power of business actors in the scenarios is investigated. However, the quantitative CF model is the main contribution of this thesis. The CF model takes the different scenarios as input and performs a quantitative valuation of the Service Portfolio for all business actors. The CF model accounts for market parameters, the business situation and the strategic preferences of business actors. The results from the proof-of-concept test presented in Chapter 6 provide valuable insight into the profitability of the Service Portfolio. Moreover, the results give valuable insight into the consequences of changing business situation or market parameters, and into the functionality of the model.

Business actor positions have been analyzed through accounting for bargaining power in the CF model. Relevant economic and strategic theory has been examined to investigate how bargaining power could be accounted for in the model. The drivers of bargaining power in Service Platforms have been identified, and the business actor positions defined according to this. The thesis finds that barriers to entry created through participation in the service platform are a likely driver of bargaining power. Furthermore, the concentration of Content Providers is thought to be an essential parameter affecting their bargaining power.

Relations between business actors have been analyzed in the model through implementing a new revenue share model. The model of Langøygard (2006), on which the CF model of this thesis is built, had some shortcomings when dealing with the revenue share agreement. The CF model of this thesis proposes a new approach to the revenue share agreement, by accounting for bargaining power and business actor positions. This proposed revenue share agreement aligns the incentives of the business actors, except for the Content Providers. Strategic relations between business actors are accounted for through introducing a new phase to the model that redistributes the revenue after the rest of the model has finished the valuation. This redistribution tries to propose a solution that is acceptable to all business actors.

7.2 CF Model Comments

When using a quantitative model like the one developed in this thesis, it is important to remember that the results are never any better than the input that is provided. If the CF model framework is to be applied to other service portfolios, care should be given to the quality of the input parameters. Some input parameters are relatively easy to predict, such as the population in the area where the services are offered. Other parameters are harder to estimate, such as the mean demand for each service.

Measurement of bargaining power is done quantitatively in the CF model. The investigation of economic theory shows that the approach chosen is consistent with such theory. However, no empirical investigation of the relationship between structural properties and bargaining power is conducted. Econometric techniques could be applied to industry data to examine if the approach chosen in thesis is appropriate. Moreover, further investigation into the β-parameters of the SCP equation would serve the model well.

The CF model of this thesis develops a revenue share matrix based on business actor marginal costs and the bargaining power of Content Providers. However, such revenue share agreements between business actors will always be subject to negotiation. This should be kept in mind when using the results from the model. A redistribution of revenue according to strategic parameters, such as a net present value threshold, is also implemented in the model. This implementation shows that a solution acceptable to all business actors can be reached by modifying the revenue share agreement from the original valuation. However, such modifications of the agreement will also be subject to negotiation in real world service portfolio projects. Nonetheless, the implementation in the CF model contributes by showing that an agreement can be reached.

The Service Portfolio modeled in this thesis is a content provisioning service portfolio. Because of this, the Content Providers are treated separately from the other business actors. This should be altered if the CF model framework is applied to another type of service portfolio.

The Microsoft Excel Solver add-in used to solve the optimization problems in the model imposes two main constraints. Firstly, it was found that optimal solutions could be found only with one pricing scheme. Secondly, the Solver add-in limited the price dynamics of the model. Preferably, the market mechanisms should be included in the model, and the business actors should be able to price all services freely throughout the time span of the valuation. However, fixed price increases/decreases have been implemented to bring the model to a level of complexity solvable by the add-in.

Despite the difficulties encountered when developing the model, and the limitations of the valuation, a solution has been proposed to the problem formulation. The four main research questions have all been solved by the proposed CF model and the qualitative analyses. Future work to improve the model is discussed in the next section.

7.3 Suggestions for Future Work

The limitations of the model have been discussed in the previous section. It is clear that the model could benefit from being implemented in an environment capable of solving more complex problems. This would allow for the introduction of more pricing schemes than the one implemented in the current model. Moreover, such an environment would preferably also allow more flexible pricing opportunities in the optimization problem.

It has also been pointed out that an empirical investigation of the relationship between structural properties and bargaining power in service platforms would benefit the model. Such an investigation is an interesting area for future work. However, such an investigation would need extensive data from previous experience and hence probably have to be carried out by an experienced industry business actor.

It would be interesting to compare the results of the model to real world data. Econometric techniques could be applied to the results and previous experience to examine the correctness of the CF model output. In the long run, the best test of the model would be comparing the results of the model with experience from launching the same service portfolio in the market.

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Appendix A

UML class diagrams

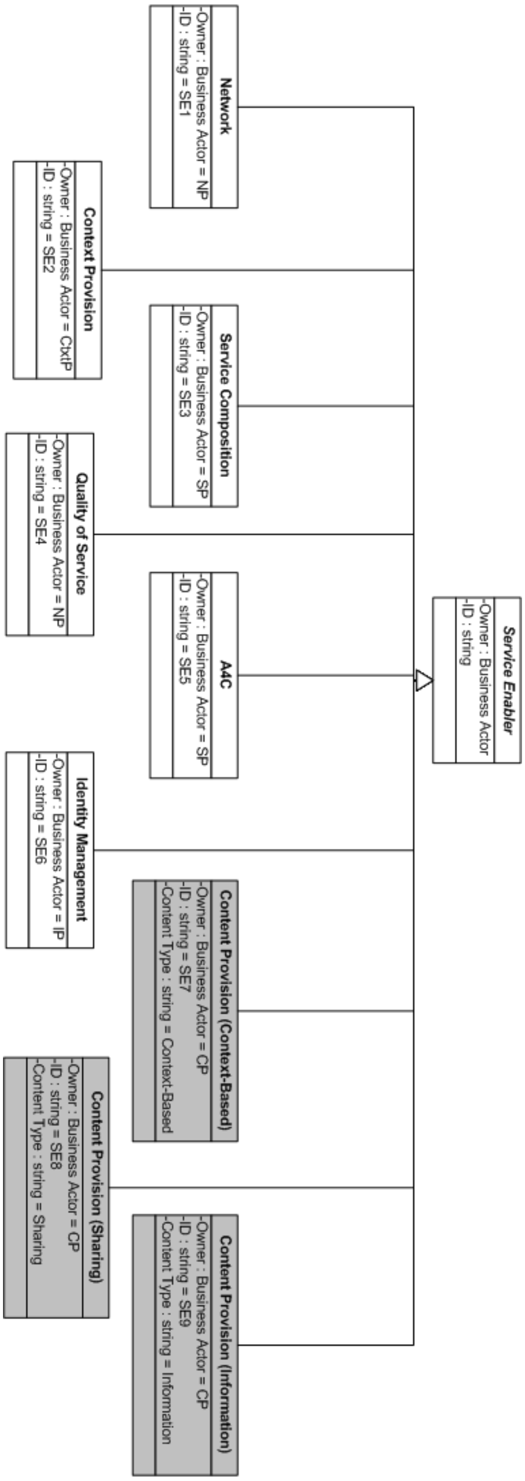


Figure A.1: UML class diagram of service enablers

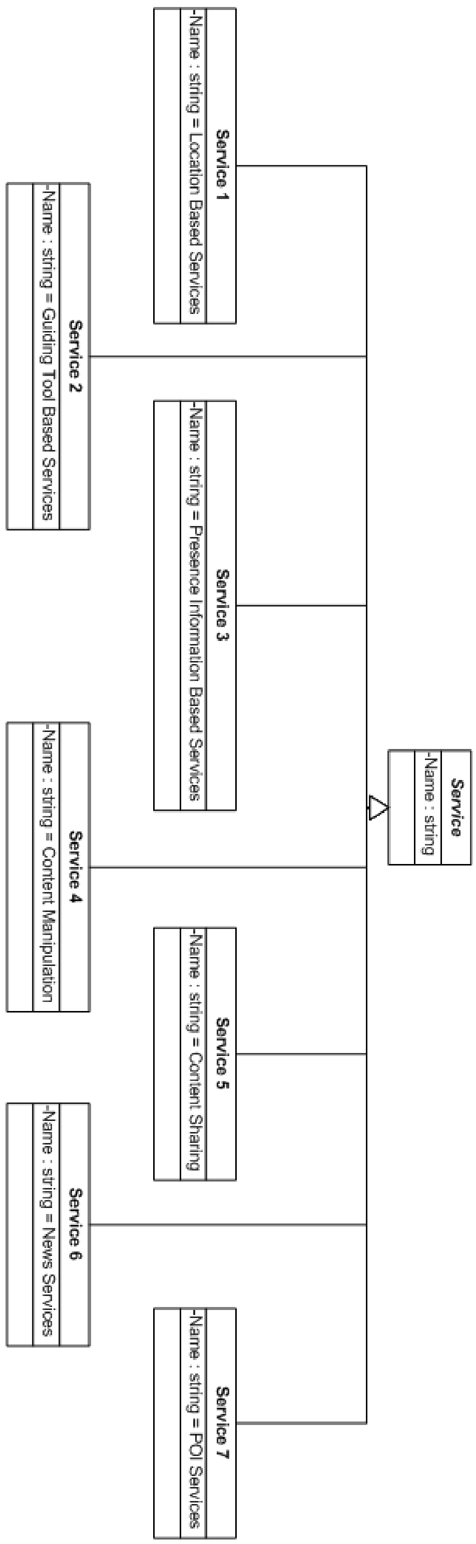


Figure A.2: UML class diagram of services

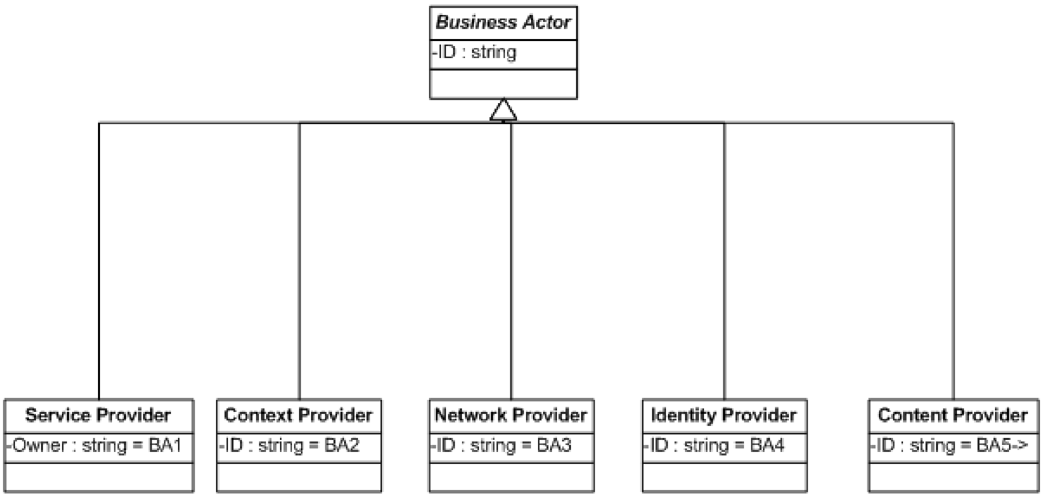


Figure A.3: UML class diagram of business actors

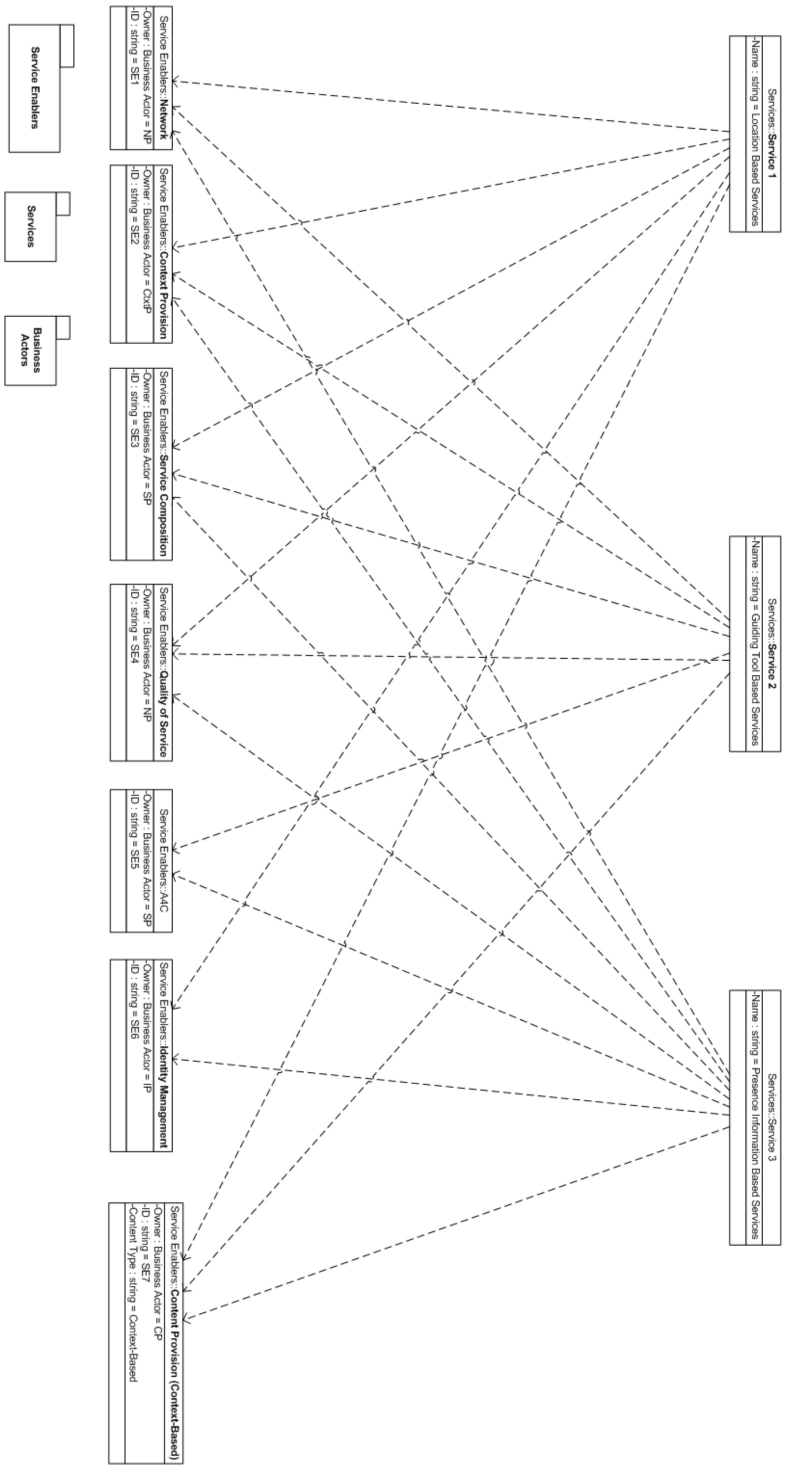


Figure A.4: UML class diagram showing service and service enabler relationships. Services 1 through 3.

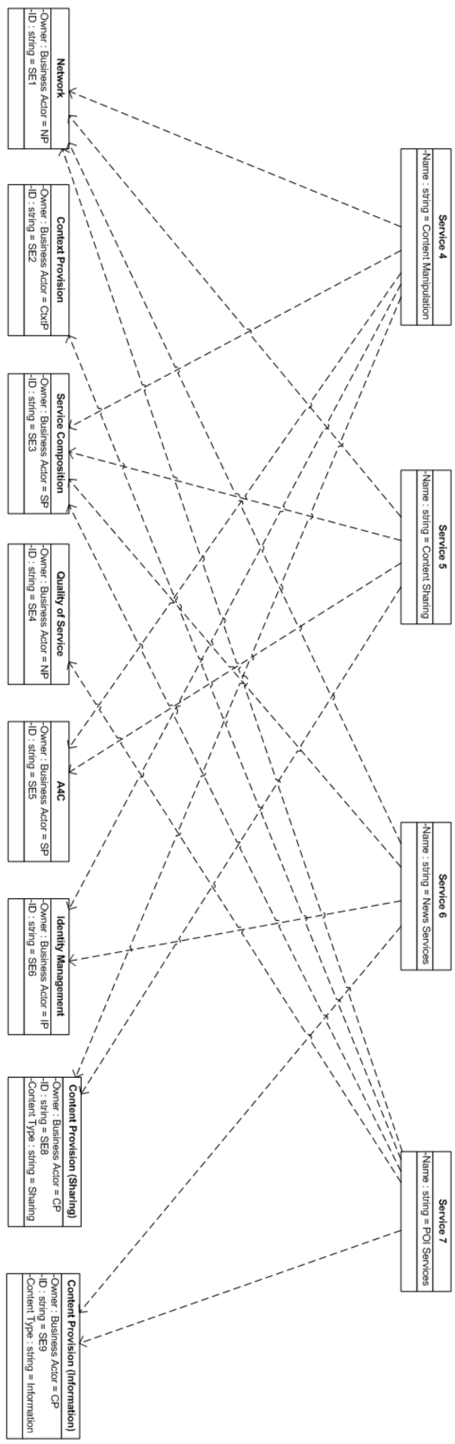


Figure A.5: UML class diagram showing service and service enabler relationships. Services 4 through 7.

Appendix B

General Variables

DEMAND

Demand	Y0
Initial Mean Value (μ_0^i)	
	400
	400
	400
	280
	280
	600
	600
Relationship Between and Standard Deviation (λ^i)	
S_1	0.20
S_2	0.20
S_3	0.20
S_4	0.15
S_5	0.15
S_6	0.05
S_7	0.05

POPULATION

Population	Y0
Initial Population (POP_0)	100,000
Population Growth (dPOP)	0.00 %

Adoption	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Mobility Population Share (γ_t)	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Diffusion Speed (b_t)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

PRICE AND GROWTH

Max Price	Y0
Max Price (M_0^i)	
S_1	8
S_2	8
S_3	8
S_4	6
S_5	6
S_6	1
S_7	1

Growth	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Growth in Max Price (dM_t)		-10 %	-10 %	-10 %	-10 %	-20 %	-20 %	-20 %	-20 %	-20 %

FINANCIALS

Financial Rates	
Discount Rate	15 %
Tax Rate	28 %
Depreciation Rate	25 %

SERVICE PLATFORM COSTS (INVESTMENT)

Costs of Participation	Y0
Participation Cost	1000.0k

INVESTMENT COSTS

Investments	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
R&D Personnel Cost	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k

PERSONNEL COSTS

Personnel Costs	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Cost per Person	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k	750.0k

Figure B.1: General Variables, input to all scenario valuations.

Appendix C

Results from Scenario 1: Monopoly

NPV BA_1

INCOME STATEMENT

Income Statement	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Sales	1.5m	7.9m	35.8m	122.2m	206.0m	218.6m	181.8m	103.6m	36.4m	5.3m
Cost of Goods Sold (COGS)	(0.1m)	(0.6m)	(2.6m)	(8.9m)	(15.4m)	(16.2m)	(13.0m)	(6.8m)	(2.3m)	(0.3m)
Gross Profit	1.4m	7.4m	33.1m	113.3m	190.6m	202.4m	168.8m	96.8m	34.1m	5.0m
Operating Expenses	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)
Depreciation	(0.6m)	(0.8m)	(1.0m)	(1.1m)	(1.2m)	(1.3m)	(1.3m)	(1.4m)	(1.4m)	(1.4m)
Operating Income	(0.7m)	5.0m	30.6m	110.7m	187.9m	199.6m	166.0m	93.9m	31.2m	2.1m
Other Income	-	-	-	-	-	-	-	-	-	-
EBIT	(0.7m)	5.0m	30.6m	110.7m	187.9m	199.6m	166.0m	93.9m	31.2m	2.1m
Interest Expense	-	-	-	-	-	-	-	-	-	-
Net Profit Before Taxes (NPBT)	(0.7m)	5.0m	30.6m	110.7m	187.9m	199.6m	166.0m	93.9m	31.2m	2.1m
Net Taxes (28%)	0.2m	(1.4m)	(8.6m)	(31.0m)	(52.6m)	(55.9m)	(46.5m)	(26.3m)	(8.7m)	(0.6m)
Net Profit After Taxes (NPAT)	(1.2m)	26.1m	147.1m	525.0m	889.6m	945.0m	786.3m	446.3m	150.3m	12.7m

BOOK VALUE OF INVESTMENTS IN ASSETS

Book Value of Assets	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Investments/R&D	(2.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)
Book Value of Assets	2.5m	3.4m	4.0m	4.5m	4.9m	5.2m	5.4m	5.5m	5.6m	5.7m
Depreciation	0.6m	0.8m	1.0m	1.1m	1.2m	1.3m	1.3m	1.4m	1.4m	1.4m

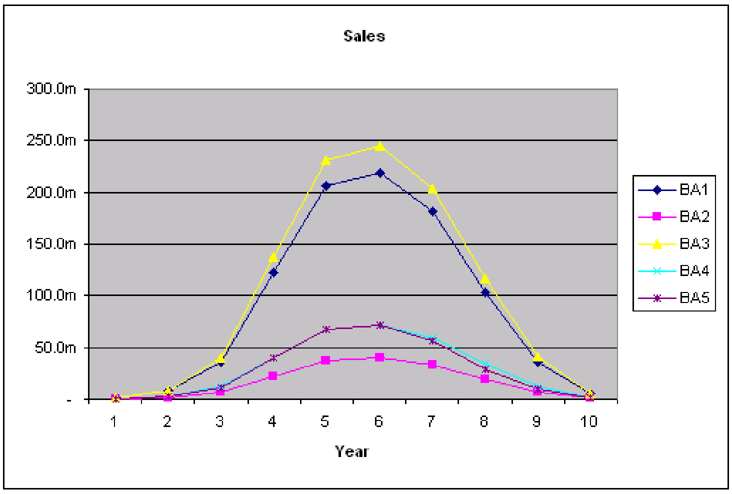
CASH FLOW STATEMENT

Cash Flow Statement										
Sales	1.5m	7.9m	35.8m	122.2m	206.0m	218.6m	181.8m	103.6m	36.4m	5.3m
COGS	(0.1m)	(0.6m)	(2.6m)	(8.9m)	(15.4m)	(16.2m)	(13.0m)	(6.8m)	(2.3m)	(0.3m)
Operating Expenses	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)
Investments/R&D	(2.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)	(1.5m)
Net Taxes	0.2m	(1.4m)	(8.6m)	(31.0m)	(52.6m)	(55.9m)	(46.5m)	(26.3m)	(8.7m)	(0.6m)
NPV Tax Benefit Y9	-	-	-	-	-	-	-	-	-	0.8m
Net Cash Flow	**(2.4m)**	**3.0m**	**21.6m**	**79.3m**	**135.0m**	**143.5m**	**119.4m**	**67.5m**	**22.4m**	**2.2m**

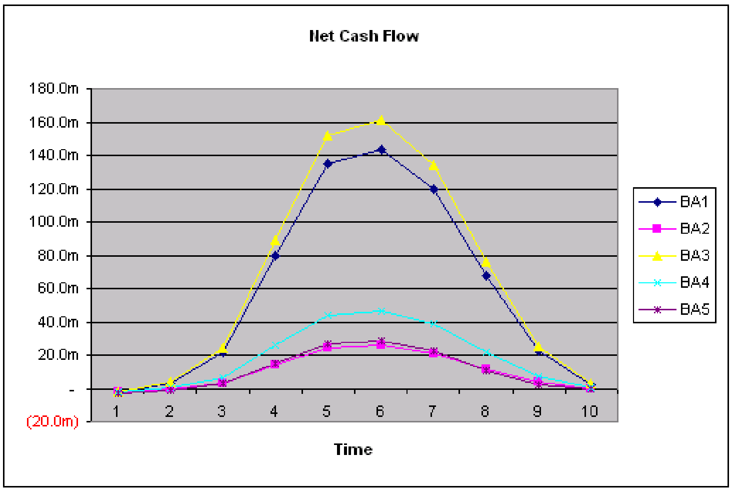
NET PRESENT VALUE

Net Present Value	
NPV	262.7m

Figure C.1: Results for BA_1, the Service Provider with the monopoly scenario and realistic market scenario. The illustration shows the income statement, the book value of assets, the cash flow statement, and the net present value of the project.

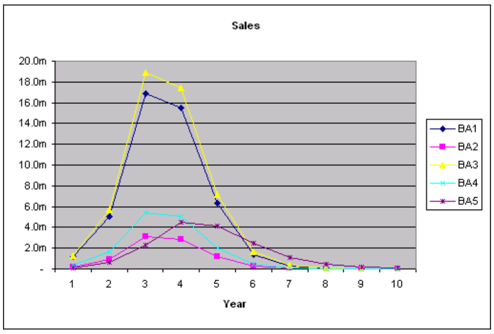


(a) Sales

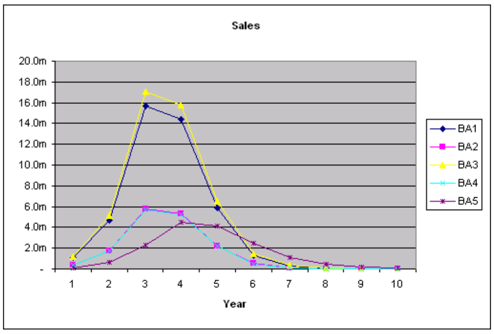


(b) Net Cash Flow

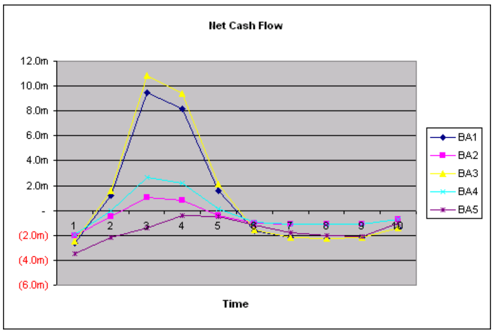
Figure C.2: Sales and Net Cash flow for all business actors in Scenario 1: Monopoly, with the realistic market scenario.



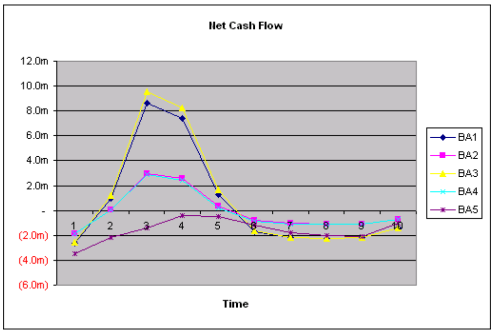
(a) Sales, original



(b) Sales, after redistribution



(c) Net Cash Flow, original



(d) Net Cash Flow, after redistribution

Figure C.3: Sales and Net Cash Flow for all business actors in Scenario 1: Monopoly, with the pessimistic market scenario.

	S1	S2	S3	S4	S5	S6	S7
BA1	0.20	0.40	0.33	0.50	0.67	0.33	0.40
BA2	0.10	0.10	0.08	0.00	0.00	0.00	0.10
BA3	0.50	0.50	0.42	0.25	0.33	0.33	0.50
BA4	0.20	0.00	0.17	0.25	0.00	0.33	0.00
BA5	0.15	0.15	0.15	0.15	0.15	0.15	0.15
BA6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(a) Original revenue share matrix, all market scenarios

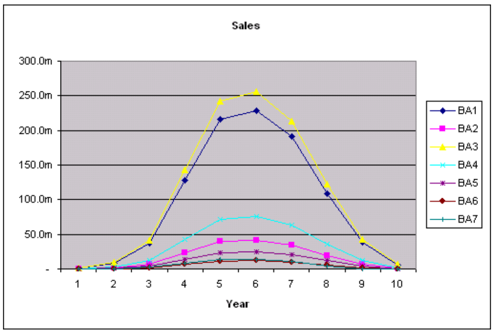
	S1	S2	S3	S4	S5	S6	S7
BA1	0.17	0.36	0.29	0.49	0.67	0.33	0.36
BA2	0.18	0.18	0.16	0.00	0.00	0.00	0.18
BA3	0.44	0.46	0.37	0.25	0.33	0.33	0.46
BA4	0.21	0.00	0.18	0.26	0.00	0.34	0.00
BA5	0.15	0.15	0.15	0.15	0.15	0.15	0.15
BA6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(b) Revenue share matrix after redistribution, pessimistic market scenario

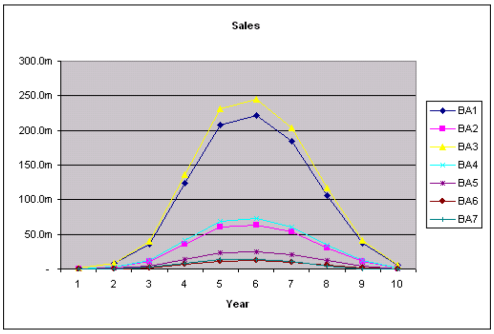
Figure C.4: Revenue share matrices of Scenario 1: Monopoly.

Appendix D

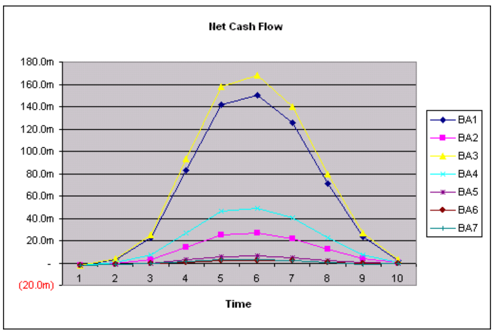
Results from Scenario 2: Oligopoly



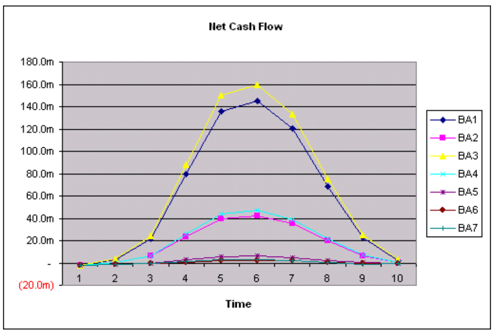
(a) Sales, original



(b) Sales, after redistribution



(c) Net Cash Flow, original



(d) Net Cash Flow, after redistribution

Figure D.1: Sales and Net Cash Flow for all business actors in Scenario 2: Oligopoly, with the realistic market scenario.

	S1	S2	S3	S4	S5	S6	S7
BA1	0.20	0.40	0.33	0.50	0.67	0.33	0.40
BA2	0.10	0.10	0.08	0.00	0.00	0.00	0.10
BA3	0.50	0.50	0.42	0.25	0.33	0.33	0.50
BA4	0.20	0.00	0.17	0.25	0.00	0.33	0.00
BA5	0.10	0.10	0.10	0.00	0.00	0.00	0.00
BA6	0.00	0.00	0.00	0.10	0.10	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.10	0.10
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(a) Original revenue share matrix, all market scenarios

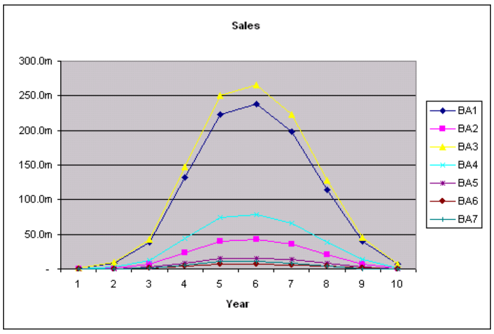
	S1	S2	S3	S4	S5	S6	S7
BA1	0.19	0.38	0.32	0.50	0.67	0.33	0.38
BA2	0.15	0.15	0.13	0.00	0.00	0.00	0.15
BA3	0.47	0.47	0.39	0.25	0.33	0.33	0.47
BA4	0.19	0.00	0.16	0.25	0.00	0.33	0.00
BA5	0.10	0.10	0.10	0.00	0.00	0.00	0.00
BA6	0.00	0.00	0.00	0.10	0.10	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.10	0.10
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(b) Revenue share matrix after redistribution, realistic market scenario

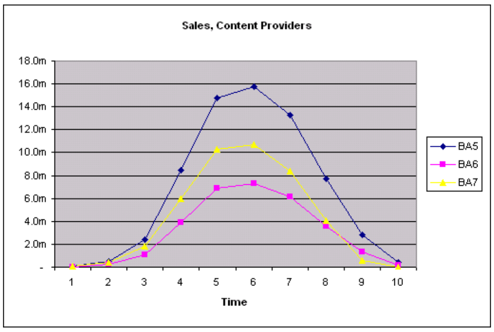
Figure D.2: Revenue share matrices of Scenario 2: Oligopoly.

Appendix E

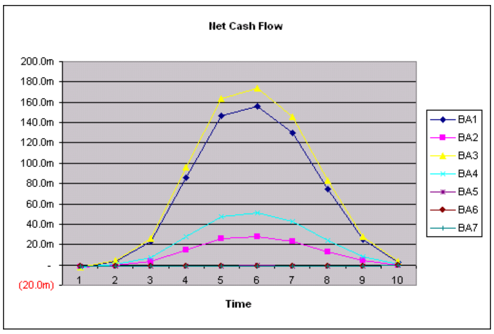
Results from Scenario 3: Free Market



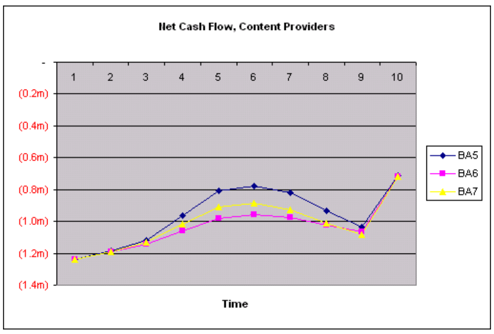
(a) Sales, all BAs



(b) Sales, Content Providers



(c) Net Cash Flow, all BAs



(d) Net Cash Flow, Content Providers

Figure E.1: Sales and Net Cash Flow for all business actors in Scenario 2: Free Market, with the realistic market scenario.

	S1	S2	S3	S4	S5	S6	S7
BA1	0.20	0.40	0.33	0.50	0.67	0.33	0.40
BA2	0.10	0.10	0.08	0.00	0.00	0.00	0.10
BA3	0.50	0.50	0.42	0.25	0.33	0.33	0.50
BA4	0.20	0.00	0.17	0.25	0.00	0.33	0.00
BA5	0.06	0.06	0.06	0.00	0.00	0.00	0.00
BA6	0.00	0.00	0.00	0.06	0.06	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.06	0.06
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(a) Original revenue share matrix, all market scenarios

	S1	S2	S3	S4	S5	S6	S7
BA1	0.18	0.37	0.30	0.49	0.67	0.33	0.37
BA2	0.17	0.17	0.15	0.00	0.00	0.00	0.17
BA3	0.45	0.46	0.38	0.25	0.33	0.33	0.46
BA4	0.20	0.00	0.17	0.26	0.00	0.34	0.00
BA5	0.06	0.06	0.06	0.00	0.00	0.00	0.00
BA6	0.00	0.00	0.00	0.06	0.06	0.00	0.00
BA7	0.00	0.00	0.00	0.00	0.00	0.06	0.06
BA8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BA14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(b) Revenue share matrix after redistribution, pessimistic market scenario

Figure E.2: Revenue share matrices of Scenario 3: Free Market.