Towards Successful Business Models of Cloud Service Providers through Cooperation-based Solutions

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With the intention of receiving critical feedback and discussion of my results, I continuously presented my research at international conferences, working groups, and project workshops. The matured and comprehensively evaluated concepts were ultimately published in scientific journals. I am grateful for the possibility of writing my thesis in a cumulative way. Thereby, I contributed to a quick transfer of research concepts to the target audience.

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Abstract

IT service providers face high competition in a continuously growing and fast changing IT market. This fast growing market offers economic opportunities for IT service providers but the rapid market change is a threat for their survival. "Cloud Computing" is one of the recent trends that changed the IT market and established itself as the new way of IT provisioning. It describes each IT product (infrastructure, platform, software, business processes) as a standardized service based on a shared virtualized resource pool, which can be procured as a flexible, scalable, and transparent IT service via the internet. The present thesis addressed this emerging type of IT provision and aimed at developing robust and validated guidelines for successful business models for cloud service providers.

The thesis was subdivided in two parts. The first research part analyzed business models of cloud providers and their success to derive specific needs, gaps and success factors. A second in-depth part addressed identified gaps and developed design science artifacts that contribute to closing the gaps.

For the foundation, a comprehensive literature review using 70 journals, six conferences, and four scientific databases was conducted to analyze the related work for business models within cloud computing. The literature synthesis revealed networking aspects with partners as important gap for further research. To complement the theoretical perspective, a quantitative cross-sectional study was performed to analyze the business models of a systematically selected sample of 29 IT service providers worldwide. A developed framework, consisting of 103 business model characteristics in eight categories, served as analysis unit for the cloud business models. The results of the business model study confirmed that networking aspects were rarely reflected in cloud business models.

Using the validated business model framework, a larger systematic selection of 45 cloud business models was examined regarding two indicators for success. The evaluation was performed using a more detailed application of the framework, enabling a higher graded differentiation between the business models. A statistical correlation analysis revealed 39 significantly success-related business model characteristics that served as operationalization of generic success factors proposed by the literature. Besides the product portfolio, a high vertical integration, and synergy effects, the results emphasized the partner network as success factor of cloud business models.

Based on the larger and more graded database, a cluster analysis led to a specification of common provider meta types and their prospects for success: Specialized cloud providers showed the most successful business models, while small newcomers had difficulties to compete. These prospects for success were evaluated in expert interviews with 12 IT managers experienced in cloud computing and provision. A qualitative content analysis of the structured interviews revealed recommendations for the success of each provider type. The experts confirmed that a cooperation network between newcomers is a valuable option to survive in the cloud market. As the time-to-market is more relevant than the risk of losing knowhow in a network, disadvantaged cloud providers should cooperate to develop and implement innovative business models.

Based on the findings, the second research part addressed cooperative networks between cloud service providers in detail. Companies with the same needs, legal requirements, goals or the same data can internally share an infrastructure pool, processes, data, or knowhow to compete in the cloud market. To examine the economic value of cooperation, a comparison of 13 network theories revealed cost savings, interdependencies, market strength, resource access, and economies of scale as the basic values of cooperative networks. A framework evaluation of 16 cloud communities indicated that cooperation between cloud providers had a particularly higher economic value compared to cooperation between customers of cloud services.

A case study of a provider-based community cloud project revealed technical, organizational, legal, and individual challenges by migrating into a community cloud. Especially individual challenges regarding an uncertain situation and the lack of cooperativeness of the community members were rarely documented in science and practice. Action research was used to combine both views on this challenge. A business board game was created that served as simulation environment. This game contributed to a more elaborated and realistic user experience for a complex cooperative situation and strategy development in a community cloud. Within a validation workshop, expert IT managers confirmed that the game approach led to an increased individual cooperativeness but showed a remaining limitation regarding an incentivizing allocation of jointly produced profit. This need was addressed with a further combination of design science and action research to develop a mathematical profit sharing mechanism with regard to design goals obtained from extensive discussions with IT managers. The iteratively developed mechanism was based on mathematical equations and offers incentives to all members of the community cloud. Conducting a game-based simulation workshop with different IT managers, the incentive system was evaluated. The results showed that the developed incentive system of a profit sharing mechanism enhanced the cooperativeness of the IT providers and increased the overall profit compared to an egoistic or cooperative strategy without profit sharing.

"Coming together is a beginning;
keeping together is progress;
working together is success."

(Henry Ford, 1863-1947)

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List of Abbreviations

AIS	Association for Information Systems
AMCIS	Americas Conference on Information Systems
API	Application Programming Interface
ARP	Average Ranking Point
ASP	Application Service Providing
BISE	Business and Information Systems Engineering
BM	Business Model
BMC	Business Model Characteristic
BPaaS	Business Process as a Service
CC	Cloud Computing
CCM	Cloud Cube Model
CDN	Content Delivery Network
CRM	Customer Relationship Management
CSP	Cloud Service Provider
DSR	Design Science Research
ECIS	European Conference on Information Systems
GTC	General Terms and Conditions
HM	Hexagon Model
IaaS	Infrastructure as a Service
ICIS	International Conference on Information Systems
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
LNI	Lecture Notes in Informatics
MSP	Managed Service Providing
NIST	National Institute of Standards and Technology
OLAP	Online Analytical Processing
OLTP	Online Transaction Processing
PaaS	Platform as a Service
QoS	Quality of Service
RQ	Research Question
SaaS	Software as a Service
SLA	Service Level Agreements
SME	Small and Medium-sized Enterprises
TCO	Total Cost of Ownership
VHB	Verband der Hochschullehrer für Betriebswirtschaftslehre
VNCC	Value Network of Cloud Computing
VPN	Virtual Private Network
WI	Wirtschaftsinformatik
WKWI	Wissenschaftlichen Kommission Wirtschaftsinformatik im VHB
WWW	World Wide Web

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1 Introduction

This study aimed to analyze the relevance of the business model design for the success of a cloud service provider in the cloud market. This chapter describes the state of the art at the beginning of my study and my motivation to dive into this research area. Consequently, this chapter explains the scope of the study and the specific research questions and methods used to answer these questions.

1.1 Motivation and Initial Situation

Aiming at an efficient design of corporate structures with a focus on core processes, companies tended to outsource their support processes or even their complete information technology (IT) (Dhar, 2012). In the industrialization context of IT outsourcing, cloud computing became a new paradigm as a transparent and needs-oriented IT resource procurement that promises higher cost benefits (Vaquero *et al.*, 2009; Weinhardt *et al.*, 2009). With this new concept, providers started to offer freely scalable IT resources (e.g. servers, storage, or applications) in an on-demand manner via networks (intranet or internet) and established usage-based revenue streams (Mell and Grance, 2011; Weinhardt *et al.*, 2009).

Since 2009, the leading research and consulting institute Gartner voted the cloud paradigm into the Top 10 Strategic Technology Trends until today (Gartner, 2008a, 2009a, 2010, 2011, 2012, 2013a, 2014a). Within this time, the market development of cloud services has exponentially grown (see Figure 1, own representation based on Forrester Research (2014)). Forecasts predict a global public cloud market size of 191 billion US$ for 2020 (Forrester Research, 2014).

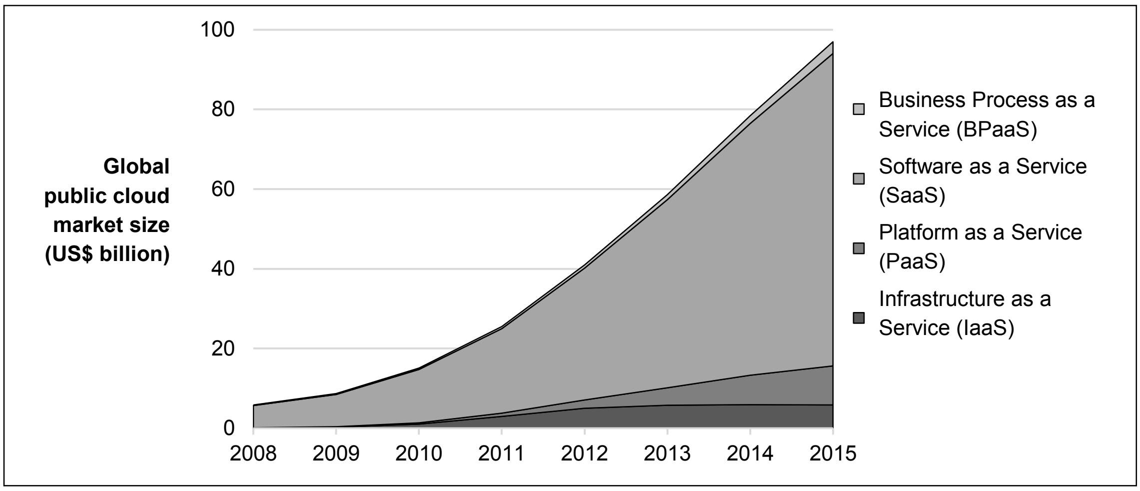


Figure 1: Market Growth of Cloud Computing since 2008

The innovation of cloud computing has its origin in the low utilization of data centers of large companies such as Amazon, Microsoft, Google or IBM with 10-15% in average (Forrester Consulting and VMware, 2009). Their resources idled, consumed energy and money without producing any value so that the providers needed to find new utilization possibilities. On the technology level, cloud computing is not new and rather an evolutionary development based on virtualization tendencies and progress in grid computing (Foster *et al.*, 2008; Weinhardt *et al.*, 2009). However, on the business level, the cloud concept revolutionized the business models of cloud providers and their customers (Marston *et al.*, 2011b; Weinhardt *et al.*, 2009) by changing not only the provision of IT but the whole IT landscape (Clemons and Chen, 2011; Zhang *et al.*, 2010).

Many studies supported the **customers' perspective** of cloud services with guidelines to "when", "why", and "how" use cloud services (Mell and Grance, 2009). The cases that benefit most from cloud computing are IT services with peak loads, unpredictable loads and batch jobs (Armbrust *et al.*, 2010). Batch jobs describe long-running and complex data analyses on consolidation data (Online Analytical Processing, OLAP) while the counterpart describes a transaction-based processing with operational data (Online Transaction Processing, OLTP) (Dehne *et al.*, 2014).

Existing research on decision frameworks considered opportunities and challenges of the cloud adoption (Kaisler *et al.*, 2012; Mahesh *et al.*, 2011) and supported the adoption process (Géczy *et al.*, 2012; Khajeh-Hosseini *et al.*, 2012). Small and medium sized companies have the most benefits of a cloud adoption (Etro, 2009), as cloud based IT solution help them to overcome limitations in staff, knowledge and investment intensity (Mahesh *et al.*, 2011). In contrast, it was shown that large companies have only marginal cost advantages by using cloud services (Etro, 2009). Other studies focused on the selection process and gave recommendations for provider evaluation (Repschlaeger *et al.*, 2012) or methods for service comparison (Reixa *et al.*, 2012).

Studies that analyzed the **providers' perspective** within cloud computing mainly focused on the technical level (Khajeh-Hosseini *et al.*, 2010). Nevertheless, some authors have also analyzed organizational challenges (Khajeh-Hosseini *et al.*, 2010), the changes in the value network (Leimeister *et al.*, 2010), or developed new revenue models (Pueschel *et al.*, 2009). Some early studies created classification frameworks for cloud providers' business models (Chang *et al.*, 2010b; Weinhardt *et al.*, 2009) but discussion of such models is still current topic (Veit *et al.*, 2014). With the acceleration of technical changes in the Information and Communication Technology (ICT) and the diffusion of ICT products, uncertainty and risks encompass new business models. Forecasts or long-term technology plans are limited, thus investments are fraught with higher risks (Bettis and Hitt, 1995). Therefore, research on the providers' business models has an increasing importance for corporate management and a stable market growth.

The provision of cloud computing promised many advantages for the providers such as cost savings through economies of scale, increased flexibility of IT service provisioning, and better agility in software deployment (Armbrust *et al.*, 2010; Dhar, 2012; Mell and Grance, 2009; Weinhardt *et al.*, 2009). However, security and trust issues between the customers and cloud providers are an obstacle of cloud computing (Briscoe and Marinos, 2009b; Catteddu, 2010; Wu *et al.*, 2011). While public cloud services can reach the highest economies of scale and scope with its multi-tenancy provisioning, they do not provide high security and trust (Subashini and Kavitha, 2011). To reduce this risk, cloud providers offer private cloud services that are hosted or managed for single tenants. All data is maintained under the legal control of the organization. In such cases, due to the dedicated resources, the scalability and cost reductions based on resource efficiency are limited (Mell and Grance, 2009). Considering those trends, cloud providers need to establish a stable business model that can make use of the advantages without failing at the hurdles (see Figure 2, own representation).

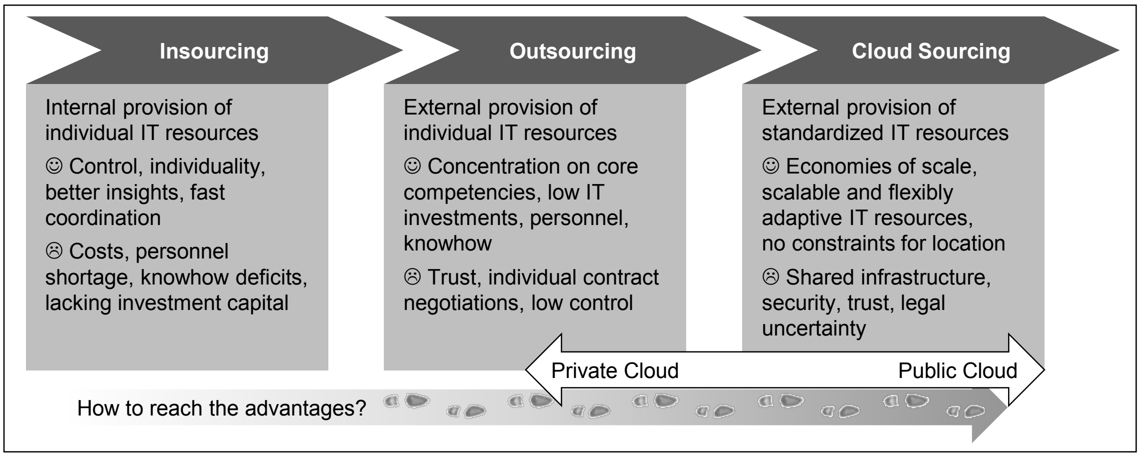


Figure 2: Critical View on the Development towards Cloud Computing

1.2 Research Objectives and Research Questions

The goal of the present study was the analysis of successful cloud business models to develop guidelines and derive recommendations for providers in the cloud market. The business model concept constitutes an analysis unit to examine business changes (Staehler, 2002). The concept is a well-known object of investigation in the information systems (IS) science (see e.g. the increasing temporal distribution of publications for the search item “business model” in the AIS electronic library from in 1 publication in 1995 to 193 in 2014). The study adopted this concept for the field of cloud computing and analyzed existing cloud business models to improve the success of cloud service providers.

The research is divided into two parts: The first part analyzed the state-of-the-art in the field of cloud provider business models with the aim to identify specific gaps with high impact on business model success. These areas were studied in-depth and by developing artifacts in the second part.

As mentioned in the previous section, cloud providers seek for stable guidelines for the prediction of a successful business model in the cloud market. Therefore, the first main research objective addressed following issue:

Research Objective A)

What is the state-of-the-art in cloud business models and what makes a cloud business model successful?

Many researchers contributed to the general cloud computing research so far and it is fundamentally relevant for the current research project summary and to evaluate the state-of-the-art regarding the research on business models in cloud computing. Within the first step, a literature overview should determine the particular influences of the cloud concept on business models in order to reveal research directions for in depth research:

> ***Research Question A.1)***
>
> ***What is the state-of-the-art in cloud business model science and what are relevant research directions?***

To complement the scientific view with the perspective of real life business cases and empirical experiences at the business side, a business model investigation was used to analyze state-of-the-art in implementation of cloud business models. To pursue this study, a detailed analysis unit had to be developed based on the findings of the literature review. In result, the analysis should reveal both, very common and rare characteristics of cloud business models as well as common combinations of these characteristics:

> ***Research Question A.2)***
>
> ***What is the state-of-the-art in cloud business model practice and how does an analysis unit for cloud business models look like?***

Having a combination of literature data and a survey of cloud business models, the focus can be set to specific questions. In this study, the focus was set on success-driving characteristics. A set of generic success factors derived from literature was combined with an extended quantitative business model study to uncover success-driving characteristics within a cloud business model, leading to an operationalization of the generic success factors:

> ***Research Question A.3)***
>
> ***What are general success factors of cloud business models and how can they be operationalized within a cloud business model?***

Finally, the analysis of common patterns within cloud business models led to the description of meta types of cloud business models. These types were assessed regarding the success-driving characteristics. The results of such an assessment was discussed with cloud computing expert to derive recommendations that can support cloud service providers in optimizing their business models to succeed in the cloud market:

> ***Research Question A.4)***
>
> ***What are successful cloud business model types and how can cloud service providers succeed in the cloud market?***

The conclusions from research objective A revealed a highlight in academic research regarding network aspects between cloud providers but a gap in practical implementations. Moreover, the first research part revealed a lack of economic success of newcomers in the cloud market and the recommendation for cooperation between cloud providers in order to improve their success. This direction was addressed in the second part of the study in order to understand why there are less successful business models of newcomers and small providers in the cloud market and how they could improve. Academic authors (Uzzi, 1996; Rosenfeld, 1996) and cloud experts already mentioned that providers can succeed by developing a cooperation network.

Cooperation networks within cloud computing are described by the concept of community cloud (Mell and Grance, 2011) or the inter-cloud concept (Aoyama and Sakai, 2011). Unfortunately, detailed partner network concepts and cooperation-based business models are underrepresented in both, in literature and in economic reality. To contribute to this research gap, the study aimed to address a second research objective:

Research Objective B)

What characterizes a business model of cloud provider cooperation and which design concepts support the cooperative success?

To examine the cooperation-based business model concept in cloud computing, a literature analysis provided a basic understanding and revealed common types of community clouds. To analyze the network value in the identified community types, a classification of network theories served as analysis unit. An evaluation of community cloud implementations differentiated the network value for the revealed types and revealed the most precious community type.

Research Question B.1)

How does a framework look like that evaluates the cooperation value of networks and which cooperation type within cloud computing shows the highest benefits?

During the study, it was shown, that provider-based communities with cooperating providers in the value creation have the highest benefits. The provider-based communities are underrepresented in the market compared to customer-based communities. Provider-based communities are faced with greater challenges on a technical, organizational, legal, and individual level (Schoedwell *et al.*, 2014). Especially the latter provides direct ways to an intervention. Individual barriers prevent the cloud service providers from high cooperation involvement, as within a new and uncertain community environment they are not able to estimate the benefits. Such, they feel insecure regarding the behavior of the other members. To cope with the situational sensitivity in advance, cloud providers will benefit from an interactive simulation tool where they can test different strategies before they decide to take part in the contract-related productive mode of the community cloud. During my studies, I aimed to develop such a tool:

Research Question B.2)

How does an interactive simulation tool look like that emulates a provider-based community and produces an elaborate user experience for a cooperative situation?

The developed simulation game can demonstrate the benefits of a community cooperation to the cloud service providers including influences on the overall profit. In order to compensate individual losses in the decision process, the cooperative behavior requires financial incentives. Addressing this challenge, a mechanism should be developed that gives incentives for a cooperative behavior and allocates all assets and liabilities between the community members fairly:

Research Question B.3)

How does an incentivizing profit sharing mechanism for cooperative value creation look like that will lead to a preferred cooperation compared to egoistic behavior?

As described, the research questions are built on each other. Each question was addressed in an individual research project, described by a publication within this thesis. Accordingly, seven publications form this cumulative thesis. The findings will contribute to successful action of practitioners' and to scientific field, as they fill specific gaps and address business needs (see Figure 3, own representation).

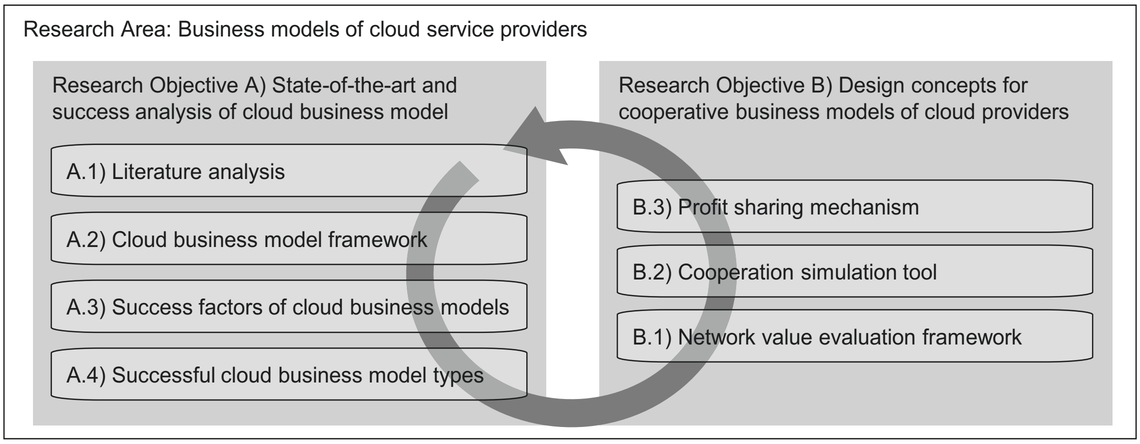


Figure 3: Interrelation between the Research Objectives and Research Questions

1.3 Target Audience

Within the scope of the dissertation project, cloud service providers have the central role as interest group. The analysis results of the first research part such as the developed business model framework, the analyzed success-driving aspects within a cloud business model, the evaluated cloud business model types, and the derived recommendations for action are the contributions for cloud service providers. These guidelines can help cloud service providers in assessing and adjusting their own cloud business model to generate, increase and ensure their success. Related actors on the cloud market, such as aggregators, integrators, consultants, or brokers, are affected by the results also and could include them into the development of their own business model. The second research part considers especially cloud providers that are interested to cooperate with each other in a heterarchical community cloud and support their ventures with artifacts for a concrete application such as a migration model, an interactive simulation environment and a profit sharing mechanism.

The second type of audience is academia. Especially the first part of the thesis aims to contribute to research gaps and provides valuable contributions. Moreover, the developed artifacts within the second part of the thesis are interesting from the researcher's point of view, because their concepts are transferrable to different contexts in associated disciplines.

1.4 Research Approach and Methods

The dissertation project contributes to the research area of information systems (IS). IS research is an interdisciplinary combination of "computer science, management and organization theory, operations research, and accounting" (Hirschheim and Klein, 2012). Therefore, it takes different perspectives into account and comprises multiple theories and methods (Larsen *et al.*, 2015) of adjacent areas as social sciences (Myers, 1997, 2013; Bhattacherjee, 2012). The conceptual framework for research within the IS field bases on an existing business need to ensure the relevance of the research as well as on given foundations and methodologies that can be applied to guarantee a rigor research approach (Hevner *et al.*, 2004). The IS research seeks to develop theories or artifacts that need to be assessed and refined with evaluation methods and contribute to both bases (see Figure 4, own representation based on Hevner *et al.* (2004)).

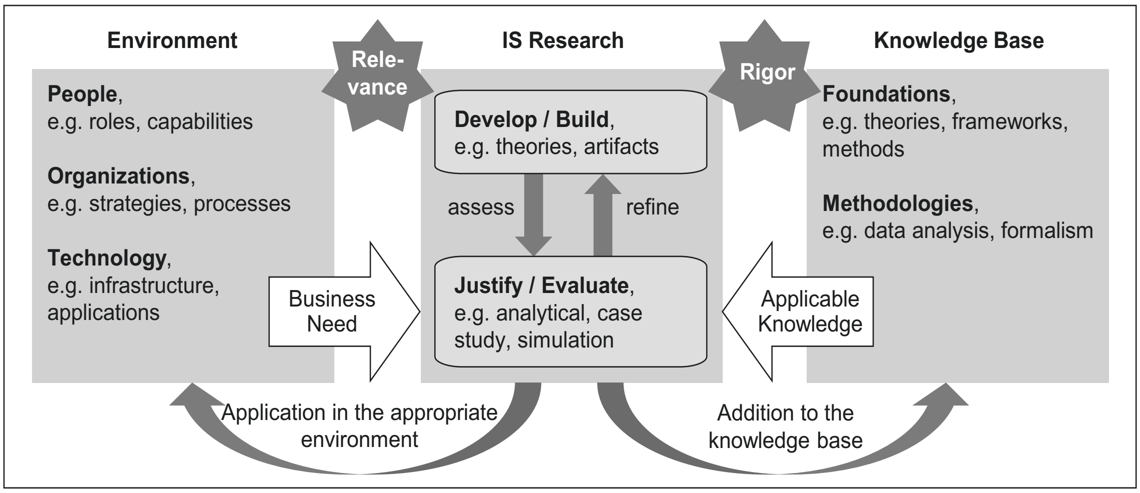


Figure 4: Framework of the Information Systems Research

The IS research is characterized by two **epistemological paradigms**, the behavioral science and the design science (Hevner *et al.*, 2004; Winter, 2008; Gregor and Hevner, 2013). While the behavioral science focuses on developing theories to explore cause-effect relations and behavior of humans or organizations, the design science research

(DSR) creates problem-solving artifacts to be applied within the practical environment (Hevner *et al.*, 2004; Winter, 2008; Wilde and Hess, 2007).

In order to approach IS research, the most common classification is the **degree of formalization** that differentiates between qualitative and quantitative research methods (Myers, 1997; Wilde and Hess, 2007; Myers, 2013). Qualitative methods originated from the social sciences to help the researchers to understand social phenomena and uncertain contexts, e.g. with case studies, qualitative surveys, or action research (Myers, 1997, 2013). Quantitative methods have a more formal character and originated from the natural science to examine natural phenomena e.g. with experiments, quantitative surveys or numerical methods (Myers, 1997, 2013).

Hence, the spectrum of methods in IS research is very diverse. The dissertation project follows a multi-methodological approach (Mingers and Brocklesby, 1997; Venkatesh *et al.*, 2013) and comprises several individual research projects with varying research methods. Within the individual research projects, the aim was always to combine methods in one study to reach triangulation (Jick, 1979; Olsen, 2004). The main methods (Wilde and Hess, 2007) that were pursued in the research projects were particularly chosen as appropriate to the research object:

» Argumentative deductive analysis

» Deductive reference modeling

» Inductive reference modeling

» Quantitative cross-sectional analysis

» Action research

At the beginning of the first research objective, an argumentative deductive analysis (Walton, 1996) formed the basis to analyze the literature in the research field. The literature findings were systemized (Levy and Ellis, 2006; Vom Brocke *et al.*, 2009; Webster and Watson, 2002) regarding components of a business model. The literature overview revealed highlights and gaps within the literature to show further research directions (RQ A.1).

Based on the business model theory and the literature findings, a mixed reference modeling method (Fettke and Loos, 2003) combined deductive (theory) and inductive (literature findings) aspects to create an analysis unit (Vom Brocke, 2003). The evaluation of the analysis unit with a first market analysis of cloud business models showed an impression of cloud business models in reality (RQ A.2).

With the help of the developed analysis unit, a cross-sectional analysis of cloud business models collected qualitative data that was coded and analyzed quantitatively (Thomas, 2006) regarding success factors of cloud business models and successful cloud business model types. The results were evaluated with interviews of cloud experts to give recommendations for action (RQ A.3 & RQ A.4).

The second part of the research regarding the second research objective started with deductive reference modelling to develop an evaluation framework for cooperative value based on the comprehensive analysis of network theories and scientific literature (RQ B.1)

Supported by action research activities, an inductive reference modeling method (Fettke and Loos, 2003) helped to create a simulation environment that emulates a community and produces an elaborate user experience for the cooperative situation. (Avison *et al.*, 1999; Baskerville and Myers, 2004) (RQ B.2).

Finally, a close cooperation with practitioners in a community and many cycles of performed interviews and workshops with external IT service providers were the basis to iteratively develop and evaluate a profit sharing mechanism. This kind of action research (Avison *et al.*, 1999; Baskerville and Myers, 2004) was the basis to increase the profit within cooperative communities (RQ B.3).

A detailed description of the implementation process of the different research methods is given in the publications that describe the individual research projects in particular. To give an overview of the used methods within the whole dissertation project, they can be categorized regarding the differentiation scheme of the IS research that combines the two introduced dimensions of epistemological paradigm and the degree of formalization (Wilde and Hess, 2007). Both parts of the research include approaches from different perspectives to increase the diversity of the contributions (see Figure 5, own representation). While the first part is mainly characterized by behavioral science, the second part designed artifacts for the business need that is discovered by the results of the first part.

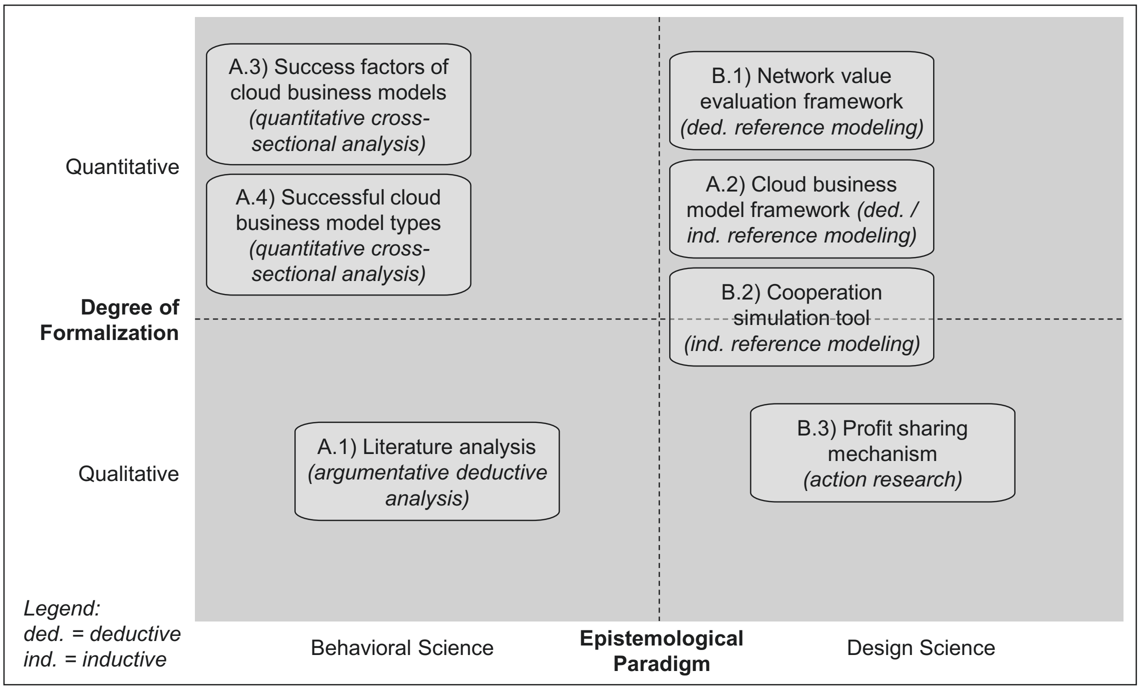


Figure 5: Spectrum of the Research Methods within the Thesis

1.5 Structure of the Research Study and Included Publications

The dissertation thesis consists of five parts (see Figure 6, own representation) spanning from an introduction into the research and the methodological approach, basic theory, to a main body with the research publications and finally leading to a conclusion with a summary of the research results.

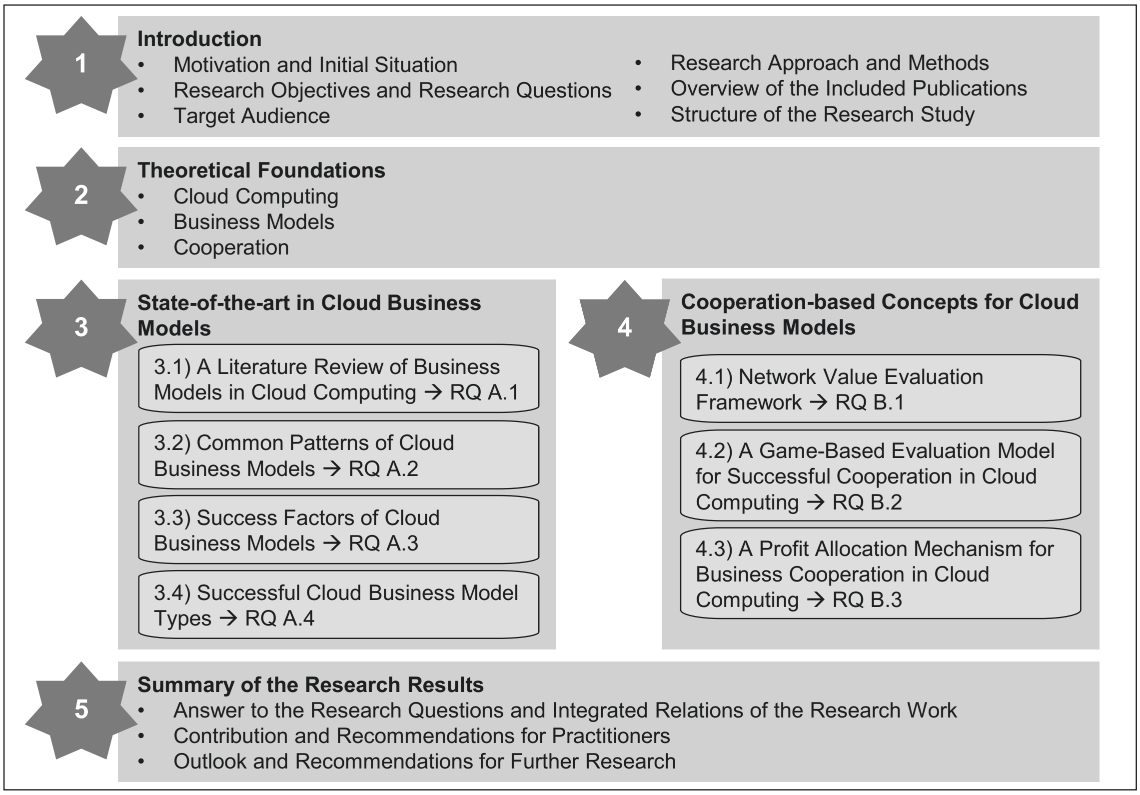


Figure 6: Structure of the Dissertation Thesis

The different publications contributing to this thesis were combined within the two main parts of the thesis using a common format. The first part of the dissertation project includes four and the second part three manuscripts (see Table 1). Aiming at a better readability, the text of the publications went through a final editing process and the figures were optimized visually and logically.

The assessment of the published publications is oriented on two official rankings for journals and conference proceedings in the German IS community. The first ranking is the orientation table of the scientific commission of IS in the association of university professors (WKWI[1]). The second guideline is the ranking of the association of university professors itself (VHB[2]). The whole list of publications that were published for and in parallel to this dissertation project is given in the Annex (see Table 28).

1 Orientierungslisten der Wissenschaftlichen Kommission Wirtschaftsinformatik im Verband der Hochschullehrer für Betriebswirtschaftslehre (WKWI), http://wi.vhbonline.org/zeitschriftenrankings/ (status as of 2008)

2 VHB Jourqual 3.0, Verband der Hochschullehrer für Betriebswirtschaftslehre (VHB), http://vhbonline.org/de/service/jourqual/vhb-jourqual-3/teilrating-wi/ (status as of 2015)

Table 1: Overview of the Included Publications within the Thesis

Section		Title	Authors	Published (*Submitted**)	Ranking WKWI	Ranking VHB
State-of-the-Art	3.1 (RQ A.1)	A Literature Review of Business Models in Cloud Computing (origin: German)	Stine Labes, Koray Erek, Rüdiger Zarnekow	Proceedings of the International Conference on Wirtschaftsinformatik (WI 2013)	A	C
State-of-the-Art	3.2 (RQ A.2)	Common Patterns of Cloud Business Models	Stine Labes, Koray Erek, Rüdiger Zarnekow	Proceedings of the Americas Conference on Information Systems (AMCIS 2013)	B	D
State-of-the-Art	3.3 (RQ A.3)	Success Factors of Cloud Business Models	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow	Proceedings of the European Conference on Information Systems (ECIS 2015)	A	B
State-of-the-Art	3.4 (RQ A.4)	Successful Cloud Business Model Types	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow	International Journal of Business & Information Systems Engineering (BISE 2016)	A	B
Cloud cooperation	4.1 (RQ B.1)	The Value of Community Clouds for Collaboration in the Public Sector	Stine Labes, Rüdiger Zarnekow	Proceedings of the Americas Conference on Information Systems (AMCIS 2015)	B	D
Cloud cooperation	4.2 (RQ B.2)	A Game-based Evaluation Model for a Successful Cooperation in Cloud Computing	Stine Labes	Proceedings of the Informatik Konferenz – Jahrestagung der Gesellschaft für Informatik. Lecture Notes in Informatics (LNI 2014) P.232	C	C
Cloud cooperation	4.3 (RQ B.3)	A Profit Allocation Mechanism for Business Cooperation in Cloud Computing	Stine Labes, Rüdiger Zarnekow	*Journal of Electronic Markets (EM 2016, 1st review round)* Rejected for resubmission*	A	B

2 Theoretical Background

The research of this thesis combines science from particular topics, i.e. cloud computing, cooperation, and business models. My published articles were used to compile this chapter, giving the theoretical concepts for the subsequent research (see Table 2). Hence, this chapter highlights definitions, evolution of concepts and provides the underlying theories.

Table 2: Basic Publications for the Theoretical Foundations

Section	Title	Authors	Published	Year
2.1 Cloud Computing	Konzept und Bewertung von Cloud Computing	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2012
	Grundlagen des Cloud Computing: Konzept und Bewertung von Cloud Computing	Stine Labes	Projektberichte IKM Band 01. Universitätsverlag der TU Berlin	2012
2.2 Cooperation	Community Clouds for Provider-based and Customer-based Collaboration in the Public Sector	Stine Labes, Rüdiger Zarnekow	Proceedings of the 21st Americas Conference on Information Systems (AMCIS)	2015
	Herausforderungen und Erfolgsfaktoren der Migration in eine Community Cloud für die öffentliche Verwaltung	Stine Labes, Björn Schödwell, Rüdiger Zarnekow	HMD – Praxis der Wirtschaftsinformatik	2014
2.3 Business Models	Geschäftsmodell, Aufbau und Prozesse im GGC-Lab	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2015
	Geschäftsmodelle im Cloud Computing	Rüdiger Zarnekow, Stine Labes	Wirtschaftsinformatik in Wissenschaft und Praxis (Festschrift für Hubert Österle). Springer Verlag Berlin Heidelberg	2014
	Erfolgreiche Kombinationsmuster in Cloud-Geschäftsmodellen.	Stine Labes, Rüdiger Zarnekow	Industrie Management	2013
	Geschäftsmodelle im Cloud Computing	Stine Labes, Christopher Hahn, Koray Erek, Rüdiger Zarnekow	Digitalisierung und Innovation. Springer Fachmedien Wiesbaden	2013

2.1 Cloud Computing

As a new concept of IT outsourcing, cloud computing turned out to be an evolution in technology but a revolution in business (Weinhardt *et al.*, 2009). The next subsections define the cloud concept, show the technological development towards cloud computing, and describe revolutionary service innovations accompanying cloud computing. Finally, an overview depicts the value network as well as different provider roles within cloud computing.

2.1.1 Cloud Concept and Definition

Cloud computing is a new paradigm of IT provision that describes scalable and flexible IT services via the internet (Mell and Grance, 2011; Hayes, 2008). In 2008, the concept appeared the first time in the "Gartner Hype Cycle for Emerging Technologies" as a technology trigger (Gartner, 2008b). It reached the peak of expectations in 2009 (Gartner, 2009b) and decreased to its current status (in 2014) at the bottom of the "Disillusionment" with two to five years left to mainstream adoption (Gartner, 2014b). With the start of the cloud "hype" in 2008, it was speculated that cloud computing would be just a temporary trend. In contrast, scientific researchers recognized that cloud computing will have a deep and lasting effect on the worldwide industry (Zhang *et al.*, 2010; Wyld, 2010; Clemons and Chen, 2011; Sharif, 2010). The Google Search Trend for the key word "cloud computing" showed the hype wave from 2006 to 2015 and forecasted that the interest in cloud computing will level on a considerable plateau in future (Figure 7, own representation based on Google).

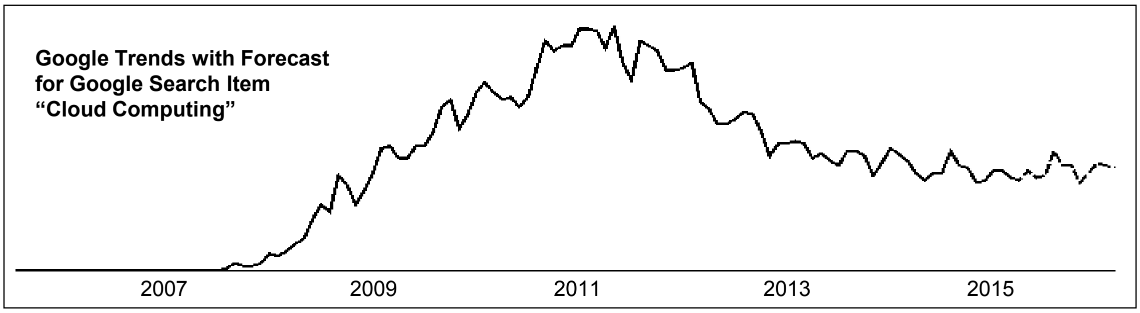


Figure 7: Google Trends with a Forecast for Search Item "Cloud Computing"[3]

Quite early, many authors addressed the delineation tangle of cloud definitions and analyzed existing approaches (e.g. Vaquero *et al.* (2009) and Yang and Tate (2012)). Although all authors used similar definitions and described the same characteristics, repeatedly, authors stated that there is no common definition (Weinhardt *et al.*, 2009; Böhm *et al.*, 2009; Yang and Tate, 2009; Wang and Laszewski, 2008). Only when the definition of the National Institute of Standards and Technology (NIST) was published (Mell and Grance, 2011), a widely accepted and subsequently applied definition was available (Yang and Tate, 2012):

> *"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*

According to the authors, the cloud concept was described with five essential characteristics, three service levels and four deployment (or provisioning) models (Mell and Grance, 2011) (see Figure 8, own representation).

[3] Google Trends: http://www.google.com/trends/explore#q=cloud%20computing&cmpt=q&tz= (last update 2015-04-18)

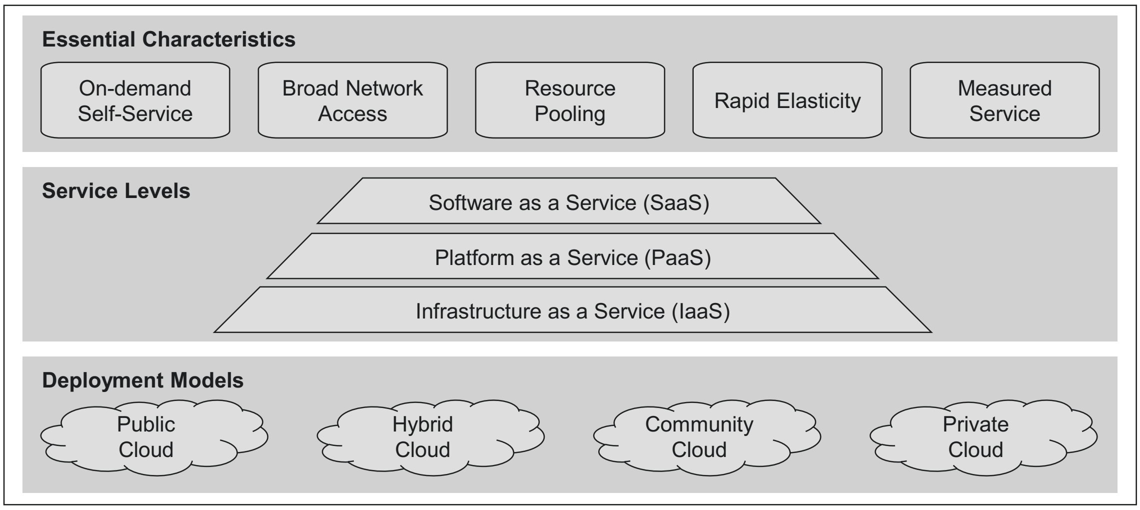


Figure 8: Illustration of the Cloud Computing Concept

2.1.2 Evolutionary Development of Cloud Computing

On the technology level, cloud computing is a further development of already existing technologies (Foster *et al.*, 2008; Sadashiv and Kumar, 2011; Sharif, 2010). Since the beginning of the 1990s, the internet (WWW) was available for the wider public and provided a basis for many new business ideas. In the mid-1990s, providers started to offer web hosting services and provided IT resources via the internet, such as storage, servers, databases or email services (Almeida *et al.*, 1998). The advancement of these services was the application service providing (ASP) offering applications via the internet (Tao, 2001; Knolmayer, 2000). Since 2005, grid computing enabled distributed computing on loosely linked computers working on a large scale task (Foster *et al.*, 2008; Velte *et al.*, 2009). With the help of the virtualization concept, these distributed resources can be combined to an abstract virtualized resource pool being the direct precondition for cloud computing (Xing and Zhan, 2012; Buhl and Winter, 2009; Wang and Laszewski, 2008) (see Figure 9, own representation).

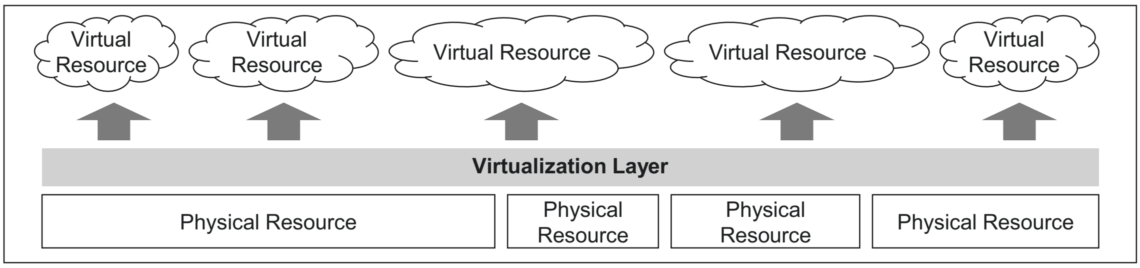


Figure 9: Abstraction of Physical Resources with Virtualization

Due to the lack of common standards, perfect security concepts and cooperation models, the ideal concept of the "Open Cloud" vision is still in the developmental phase (Nelson, 2009; Edmonds *et al.*, 2012; Mell and Grance, 2009). The ideal concept describes the unconditional cloud sourcing in public clouds to reach the highest economies of scale and scope with its multi-tenancy provisioning. However, customers prefer a higher security in private clouds (KPMG, 2013; Maher *et al.*, 2013). The difference between the different deployment models will be described in section 2.1.4.

Nevertheless, the development of cloud computing is a big step towards the efficient usage of hard- and software resources and counteracts the resource wasting underutilization in the data centers of large IT service providers (see Figure 10, own representation based on expertOn Group (2010)).

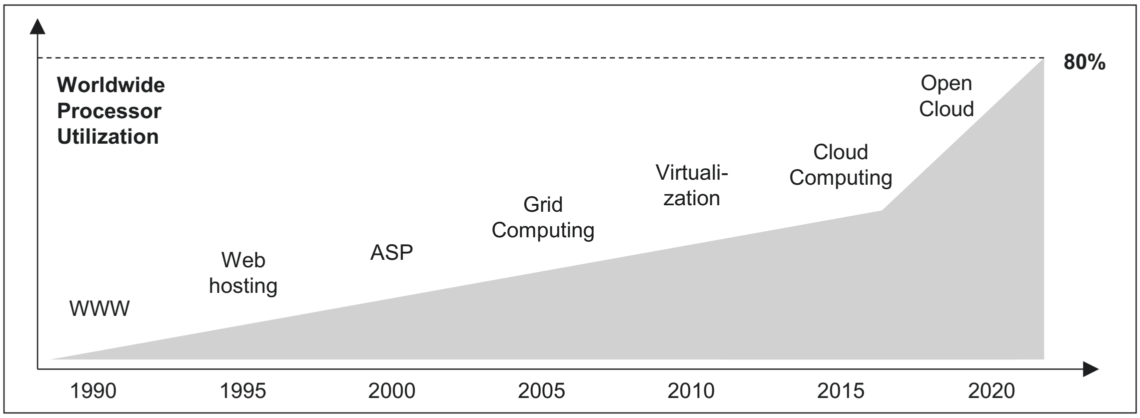


Figure 10: Technological Evolution of Cloud Computing

With the cloud computing concept, the range of services is no longer limited to a specific service level such as infrastructure (grid computing) or applications (ASP); it includes now computing power, storage, platforms, software and other resources “as a Service” (Mell and Grance, 2011). These services are arranged hierarchically on different cloud service levels (Weinhardt *et al.*, 2009): The foundation is Infrastructure as a Service (IaaS) as the provisioning of virtualized server, storage or network resources. Based on the infrastructure, the Platform as a Service (PaaS) provides a development environment and development tools to run code and create software. On top of this, Software as a Service (SaaS) is the provisioning of standardized web applications. Some researchers proposed further service levels such as Business Process as a Service (BPaaS) that provides complete virtualized business processes (Loebbecke *et al.*, 2012). Depending on the specific service level, the responsibility for the different technology layers in providing a service is assigned to the provider or to the customer (see Figure 11, own representation).

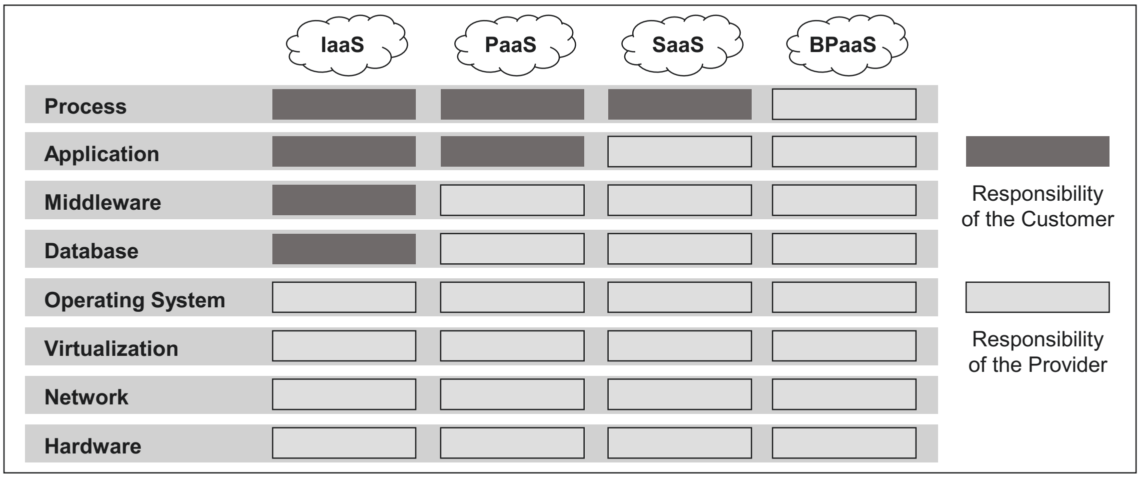


Figure 11: Areas of Responsibility in the Service Levels of Cloud Computing

Within the **IaaS** field of application, the services consider the concrete hardware such as storage, servers or networks but also additional managed services for the construction, management and security of cloud infrastructures (Mell and Grance, 2009; Leimeister *et al.*, 2010; Bhardwaj *et al.*, 2010b):

» Compute as a Service: Virtualized servers are rented via the internet and connected to the on-house hardware and software to process the regular workload or load peaks. This case saves expenses for new server infrastructure or room capacities.

» Storage as a Service: Virtualized storage components used for storage expansion, backup, and data archiving. These ubiquitous storage resources can be accessed from any device.

» Network as a Service: The high internet traffic of data with cloud services seeks higher bandwidth or intelligent transfer techniques such as Content Delivery Networks (CDN) to decrease the access, upload, and download times (Gagliardi *et al.*, 2007; Marinescu, 2013).

» Managed Services: These standardized cloud services comprise hosting, private network construction, security services, and remote support with a central cloud administration of the services.

The **PaaS** services provide programming platforms and tools to develop applications and test code (Mell and Grance, 2009):

» Development Environment: The provisioning of development environments via the internet offers a setting to test and run applications as a cloud software.

» Development Tool: Besides the development environment, the provisioning of development tools supports the distributed development of software and decreases its developing time.

The **SaaS** level of application provides applications that run on resources in the internet while the customers only have access via the browser but no control over the software (Mell and Grance, 2011; Bhardwaj *et al.*, 2010a). Installation, maintenance, and updates are not in the duty of the customers anymore. Office applications as well as collaboration and communication software are part of this service level and allow a ubiquitous access from everywhere and any device. Special business applications, such as for e.g. customer relationship management (CRM), financials, project management, and e-commerce software are also provided as cloud software (Buxmann *et al.*, 2008; Dubey and Wagle, 2007).

The **BPaaS** field of application describes the processing of basis business processes based on SaaS. This promotes consistent processes in the company and leverages automation, standardization, and repeatability. Furthermore, BPaaS have well-defined APIs and can be connected to other software in the cloud (Loebbecke *et al.*, 2012).

2.1.3 Revolutionary Service Concept

The cloud computing idea is not only a new technological development such as former concepts of cluster and grid computing. It dramatically changed the business models and customer orientation on the providers' side (Sadashiv and Kumar, 2011). Virtualized IT resources and services are provided via a network, scale with the customers' demand and need to be paid on consumption basis. For the customers, resources are available to process peak loads and are free of additional costs in times with lower demands. The processing activities take place beyond the own device so that small devices such as smartphones or tablets can be equipped virtually with big storage. Additionally, computers do not need to be updated on the hardware side. For instance, computers of older generations or less equipped are able to cut or edit high definition videos. This revolutionary change describes the provisioning of IT resources and services as a standardized (Chou, 2009) commodity that has similarities with the provisioning of water and electricity (Buyya *et al.*, 2009). For example, in the early 20th century, private power generators were replaced by flexible and needs-based electric power out of the socket by the power supply system.

The cloud service concept was described with five characteristics that address technical and organizational aspects (Mell and Grance, 2011):

» The **on-demand self-service** characteristic stands for an automated way for the customers to compose, book, and set up a service by themselves without any direct interaction or negotiation with the service provider. To ensure this characteristic, the providers need to establish interoperability between services and portability of data via standardized interfaces (Edmonds *et al.*, 2012). Furthermore, standardized service level agreements (SLAs) are required to realize the on-demand purchase of services without wasting time in complex SLA negotiations (Dillon *et al.*, 2010). Multilevel service-based SLAs are the most standardized solutions at a comparatively high level of individualism. Such SLAs provide the same options for all customers but offer different levels of service quality and range. An administration tool for the customers supports the self-service of the purchasing of the cloud services.

» The **broad network access** is the basis for ubiquitously obtaining and using cloud services on any devices via standardized interfaces. The basic condition is network access to the cloud services. No specific middleware is needed for the operation of such a cloud service. The service is running on resources in the internet and the standardized access portal is a browser (Hayes, 2008), web service or an application programming interface (API).

» The **resource pooling** describes virtual addition of resources of the provider's cloud services in a shared resource pool to serve multiple customers and optimize the efficiency of the resource allocation. Precondition for resource pooling is the virtualization concept abstracting logical systems from the physical implementation (Xing and Zhan, 2012). Based on virtualization, a multitenant architecture is designed to virtually partition its resources, data and configuration (Dillon *et al.*, 2010). A single instance of a cloud service is able to serve multiple tenants and each tenant works with a customized virtual application instance. A sound security management prevent exploits or attacks between the multiple tenants (Calero, Jose M. Alcaraz *et al.*, 2010). Extensive computations and large amounts of requests are distributed across multiple concurrent systems (load balancing). The desired effects are a more flexible deployment and higher capacity utilization. In certain circumstances, the location of the resource pool may be relevant to the customers, so that several vendors, such as Amazon, provide a specific selection of the resource location.

» The **rapid elasticity** comprises dynamic composition of the resources of the services, which can be scaled up and down flexibly and automatically according to customers' needs (Dillon *et al.*, 2010). Again, to realize the flexible scalability of IT resources, virtualization is a basic requirement (Xing and Zhan, 2012). The higher the fragmentation ability of a service, the more flexible is the elasticity of the service volume (Sridharan *et al.*, 2011). Computation intensity as well as transaction frequency are influencing factors of the elasticity.

» The **measured service** characteristic is the basis for a transparent cost allocation. The customers' usage of the cloud service is metered, monitored, and reported with a monitoring system (Foster *et al.*, 2008) to provide transparency and usage-based accounting for the customers. The precondition for monitoring is an extensive measuring of the resource consumption. Hence, a basic characteristic for a cloud service is the simple control of the offered services. To provide the customer an overview about ordered services and consumed resources, a monitoring tool with a dashboard for all important performance indicators should be part of the cloud service. Based on events in the cloud, a reporting service signalizes events of the cloud service to the customer and gives an overview about the service. This characteristic builds on the measuring and monitoring system of a cloud service. Regarding the flexible accounting, cloud services are usually characterized with a pay-per-use accounting (Mell and Grance, 2011; Weinhardt *et al.*, 2009; Armbrust *et al.*, 2010). A billing of infrastructure resources per hour or data transactions as well as software rates per month avoids high initial costs for licenses or infrastructure. Due to the transparent and measured character of cloud services, auditing systems can easily evaluate the fulfillment of requirements and guidelines to promote the customers' trust in a provider.

2.1.4 Cloud Deployment Models

Beyond the described service levels and the five essential characteristics, cloud services can be provided in four different deployment models: public, private, hybrid and community cloud models (Mell and Grance, 2011; Weinhardt *et al.*, 2009).

The **public cloud** computing aims for an absolutely "open cloud" vision with unrestricted load balancing of highly standardized services on virtualized and multitenant IT resources. With these conditions, public cloud services can reach the highest economies of scale and scope and serve for the most saving in energy or administration costs (Armbrust *et al.*, 2010). Within this deployment model, the *open cloud* and the *exclusive open cloud* can be distinguished (Deussen *et al.*, 2010). While the *open cloud* includes standardized services with general terms and conditions (GTC), the *exclusive open cloud* allows individually negotiated SLAs.

Private clouds are hosted and/or managed for single tenants and maintain all data under the legal control of the organization to reduce risks (Jamil and Zaki, 2011). This allows high individuality and control within the cloud service. The benefits for security, trust, and compliance increase (Dillon *et al.*, 2010; Subashini and Kavitha, 2011), while the economies of scale and the cost savings decrease. Three sub categories can be distinguished depending on the location and management of the infrastructure resources. The *corporate cloud* is a private provisioning of cloud services with an in-house processing and internal management. The *managed cloud* describes cloud services that run on internal infrastructures with an external management by a third party. Within an *outsourced cloud*, a third party vendor performs the hosting of the infrastructure as well as the management of the cloud service (Deussen *et al.*, 2010).

A **hybrid cloud** approach aims to combine the advantages of public and private clouds and is a merger of two or more clouds that can be private, public, and community clouds (Dillon *et al.*, 2010; Deussen *et al.*, 2010). Critical data and core activities will be controlled on-premise within a private cloud environment while uncritical data and peripheral business activities can be outsourced to public clouds (Dillon *et al.*, 2010). The importance of standardization and interoperability between different cloud services increases with this cloud model.

The purpose of a **community cloud** is to find another approach to combine the advantages of the public and private cloud deployment models. It addresses companies with the same needs, legal requirements, goals or the same data to cooperate on a shared IT resource pool (Briscoe and Marinos, 2009b). They can increase their benefits of scale and gain cost saving but also ensure their security within the restricted private cloud environment (Subashini and Kavitha, 2011). Similar to the private cloud sub categories, different types of hosting of the infrastructure and its management are utilized. An *internal community cloud* describes a merger of different companies with their private clouds that establish a shared resource pool and internal management without depending on third party vendors (Briscoe and Marinos, 2009a). These provider-based communities are addressed in the literature also with the concept of inter-clouds (Grozev and Buyya, 2014; Aoyama and Sakai, 2011). A *managed community cloud* replaces the internal management by an external third party management (Grozev and Buyya, 2014). *Outsourced community clouds* describe an external but restricted resource pool that is managed by a third party for a community of customers (Mell and Grance, 2011).

In summary, all the cloud deployment models have different characterizations and varying priorities for trust and security or economies of scale and flexibility (see Figure 12, own representation based on Deussen *et al.* (2010)).

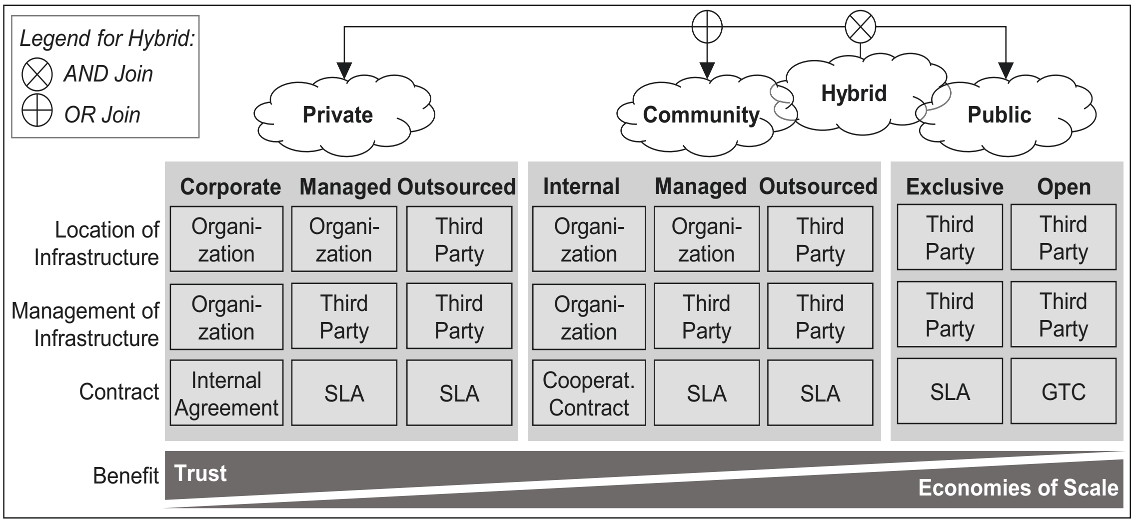


Figure 12: Comparison between the Cloud Deployment Models

2.1.5 Cloud Service Providers

The actors that are involved in cloud services are the providers that offer the service and the customers that use it. Especially on the provider side, new roles appear through cloud computing. Due to the influence of the service orientation and high standardization in cloud computing, the traditional value chain of IT service providing splits into modular services (see Figure 13, own representation). This gives high potential for third party solution providers that address only single parts of the value chain (Buyya *et al.*, 2009).

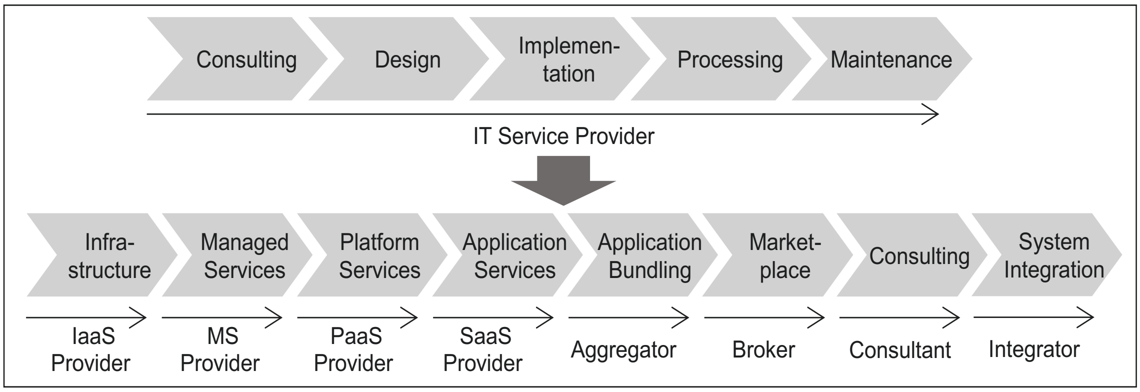


Figure 13: Separated Provider Roles in the Cloud Service Value Chain

A cloud provider is a company that provides cloud services to customers. Cloud providers fill various roles (Leimeister *et al.*, 2010; Buyya *et al.*, 2009; Böhm *et al.*, 2010):

» Infrastructure Provider: Provision of virtualized hardware such as servers, storage, network resources.

» Managed Service Provider: Management of cloud infrastructures and provisioning of security or support services.

» PaaS Provider: Provision of a development and runtime environment for the development, test, and processing of software.

- SaaS Provider: Offering, processing, and maintaining of cloud software that customers can use online.
- Aggregator: Aggregation of different modular services into a package, addition of an extra value or categorization and comparison of existing cloud services.
- Broker: Mediation between other cloud providers and customers, establishment of a market place with supporting services such as billing.
- Consultant: Provision of specific knowhow and expertise to identify the potentials and requirements for a customer company to migrate into the cloud (Jeffery *et al.*, 2010).
- Integrator: Support of customers in the implementation of cloud services and the preparation and migration of existing IT systems.

There are strong technical and organizational interdependencies between all roles and service levels. In cloud provision, the linear value chain is modified to a global, complex, and dynamic value network (see Figure 14, own representation based on Leimeister *et al.* (2010)).

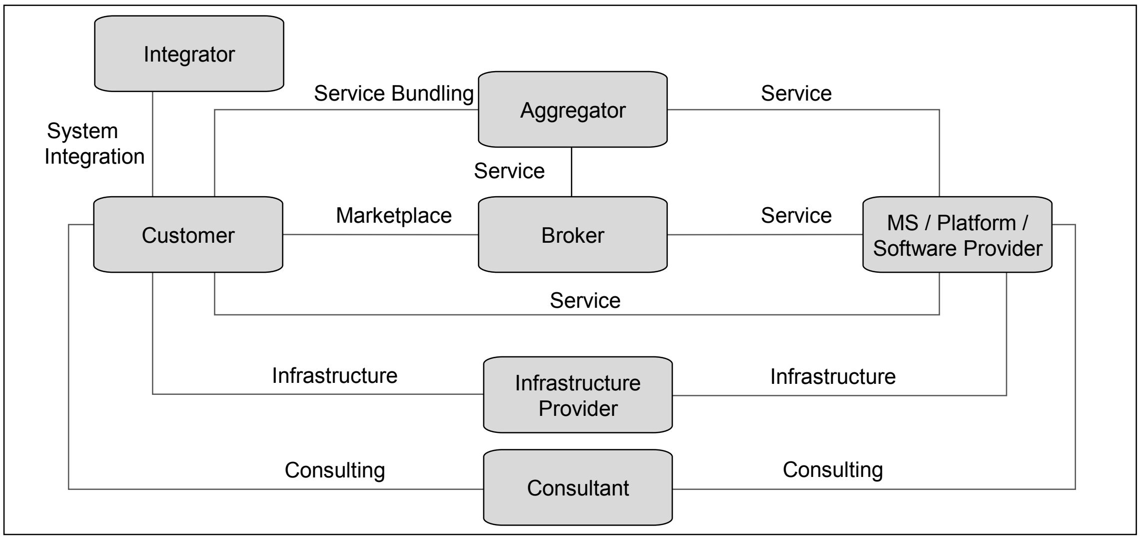


Figure 14: Value Network between Cloud Service Provider Roles

2.2 Cooperation

The strategic form of economic organizations is primarily dominated by competition (Porter, 1980; Lado *et al.*, 1997; Moore, 2006). However, the alternative paradigm of cooperation can increase the success of the participating organizations compared to the competition model (Uzzi, 1996; Rosenfeld, 1996; Alvarez *et al.*, 2009; Hinterhuber and Levin, 1994), e.g. through knowledge transfer (Tsai, 2001) or common resource utilization (Clemons and Row, 1992). The next section gives an overview on cooperation theories, cooperation characteristics and the cooperation concept within cloud computing.

2.2.1 Cooperation Theories

A cooperation network is a collaborative form of economic organization aiming at mutual advantages in external competition through internal cooperation (Borchert and Urspruch, 2003; Uzzi, 1996; Thorelli, 1986; Hunt *et al.*, 2002). This form can be classified between *market* (external procurement of services) and *hierarchy* (in-house production of services) (Oxley, 1997; Powell, 1990; Thorelli, 1986). Table 3 shows an overview of the key differentiation features of the three forms (own representation based on Powell (1990) and Moore (2006)).

Table 3: Key Differentiation Features of Organizational Cooperation Forms

Key Features	Hierarchy	Network	Market
Behavior	Full cooperation	Co-opetition	Full competition
Normative basis	Employment relationship	Complementary strengths	Contract / property rights
Communication	Routines	Relational	Prices
Conflict resolution	Administrative fiat	Norm of reciprocity	Haggling
Flexibility	Low	Medium	High
Commitment	Medium to high	Medium to high	Low
Climate	Formal, bureaucratic	Mutual benefits	Precision, suspicion
Actor choice	Dependent	Interdependent	Independent
Ideal	Perfect control of tasks	Perfect co-evolution of innovation	Perfectly transparent transactions for contributions

Cooperation theories describe why business organizations cooperate in particular. There exist various decision bases for a preferred action within a network or community compared to a simple competition in the market or a full integration as a hierarchy model. Many economic and psychological theories examined the decision criteria (Uzzi, 1996; Lado *et al.*, 1997). These theories were applied to explain specific cooperation issues, e.g. with the transaction cost theory (Clemons and Row, 1992) or a mix of the resource-based view, game theory and socioeconomics theory (Lado *et al.*, 1997). The observed theories and their related concepts are briefly described within the next sections.

The **New Institutional Economics Theories** are a further development of the neoclassic equilibrium theory indicating a perfect market between supply and demand. In contrast to the traditional theories, the efficiency of hybrid cooperation types between market and hierarchy is analyzed (Williamson, 2000; Uzzi, 1996).

» Transaction Cost Theory: This theory focused on costs of transactions (exchange of products, services and rights) and provides an approach to determine the optimal type of cooperation (hierarchy, network, market) for a specified situation with the goal to minimize the transaction costs (Coase, 1937; Möller, 2006; Williamson, 1979, 1985). The basis for the cost report is provided by the estimation of the asset specificity and the uncertainty of a service (Williamson, 1985). While highly specific and uncertain services should be provisioned internally and low specific services can be purchased externally, networks can profit with middle specific and middle uncertain services. Additionally, an increasing number of similar transactions, typical for a network, allows cost reductions through economies of scale and scope (Ebers and Gotsch, 1995).

- Principal Agent Theory: This theory is about the interaction and the information asymmetry between an instructing client (principal) and a qualified supplier (agent) (Laffont, 2003). The agent has an opportunistic behavior and can use this information advantage for his own utility maximization that will negatively affect the utility level of the principal (Laffont, 2003; Pratt *et al.*, 1991; Möller *et al.*, 2005). To avoid negative consequences of this information asymmetry, the principal spends agency costs to monitor the activities of the agent. If all participants within a cooperative network have equal rights, interdependencies will prevent individuals to increase the own utility level at the expense of the other members. Therefore, communities or networks have a high trust level between the principal and agent and cause lower agency costs (Möller, 2006).
- Property Rights Theory: This theory assumed that the asset value and activities of economic actors base on the distribution of property rights and the related incentives (Demsetz, 1967). Property rights include the usage, modification, acquisition, and disposal of assets. Compared to other cooperation models, network cooperation can decrease the transaction costs and external effects (Möller, 2006).

Explanatory approaches of the **Strategic Research** indicated that the formation of networks is a strategic decision regarding competitive advantages and success potential (Möller, 2006). The following key methods were distinguished:

- Market-Based View: This approach explains a network cooperation model with the focus on the firm's market power by establishing barriers to market entry (Makhija, 2003; Srivastava *et al.*, 2001).
- Resource-Based View: In contrast to the external market-based view, the resource-based view justifies the formation of a network with an optimized use of internal resources. The possession of significant resources (tangible and intangible) is the basis for success (Wernerfelt, 1984). In general, resources are rare and distributed unevenly across the companies.
- Competence (Capability)-Based View: Competences describe the optimal use of resources in a company. The competence-based view justifies a network with the smart combination of available resources to achieve competitive advantages (Möller, 2006). The jointly planning, management and monitoring in a network reduce the operating expenses and ensure an optimal use of the resources (Wernerfelt, 1984).
- Knowledge-Based View: This approach considered the knowledge resource as a competitive advantage (Grant, 1996). A network optimizes the intensity, structure and process intelligence of special knowledge. The members have access to the specific knowhow of each other. Knowledge alliances are established and new process knowledge or common standards can be developed (Möller, 2006).

Organization Theories analyze the configuration of the organizational structure to explain the development of different levels of cooperation (Pfeffer and Salancik, 1978).

» Resource Dependence Theory: Similar to the resource-based view, this theory assumed that resources are rare and trading resources will induce dependencies. The degree of dependencies is determined by the uniqueness, the availability, the importance, and the substitutability of the resource (Möller, 2006; Pfeffer and Salancik, 1978). By building a network, the loss of autonomy decreases and occurring interdependencies equate the strength of all members (Miroschedji, 2002). This enhances the trust and increases the risk tolerance in a network.

» Inter-Organizational Relations Theory: This approach postulated that the development of a network is not intended, but grows with the trading of more complex goods and services (Evans and Yen, 2006). Interdependencies and relationships of trust lead to a mutually adaptation of the partners. The means of control of the resulting network are limited (Möller, 2006).

The **Co-opetition Theory** is based on an artificial word that merges the concepts of cooperation and competition. It analyzed the inter- (and intra) organizational economic benefits of the synergies in this combination (Bengtsson and Kock, 2000; Brandenburger and Nalebuff, 1997): "The advantage of coopetition is the combination of a pressure to develop within new areas provided by competition and access to resources provided by cooperation" (Bengtsson and Kock, 2000).

The **Game Theory** analyzed economic behavior and strategy decisions of market players in single and repeated games (Axelrod and Hamilton, 1981; Neumann and Morgenstern, 1944). Players can choose their strategy between cooperation, competition or defection to maximize their own profit. The Nash equilibrium describes a situation, where no member can change its strategy without getting worse in profit. Whereas, the Pareto equilibrium is the situation with the highest overall profit, which is not stable because another member can defect this situation to reach a higher individual profit ("prisoners' dilemma"). Mutual network cooperation with incentives or penalties can ensure this higher economic benefit for all players compared to competition or unilateral defection (Brandenburger and Nalebuff, 1997; Lado *et al.*, 1997).

Regarding the **Evolution Theory**, individuals aim at a balance of their ultimate utility (Margolis, 1984). They can reach this with the Darwinian allocation rule (Darwin, 2009) that makes people wanting to contribute a high share of benefit to a group to increase the community's commitment in allocating beneficial situations in future.

Socioeconomic influences induce that people do not act in a purely rational behavior to maximize their own utility but are influenced by the social system (Granovetter, 1983; Hofstede and Hofstede, 2005; Uzzi, 1996). Their decisions lead to an enhancing of the individual as well as the collective interests (Margolis, 1984).

All theories substantiate cooperative behavior and show the value of networks. The different views are summarized in Table 4.

Table 4: Value of Cooperation in Network Theories

Theory	Cooperation Value in the Network
Transaction Cost Theory	A network decreases transaction costs with middle specific and middle uncertain services as well as a high number of similar transactions.
Principal Agent Theory	A network establishes interdependencies through equal rights between client and supplier, which cause a high trust level and lower agency costs.
Property Rights Theory	A network decreases transaction costs and external effects.
Market-Based View	Network cooperation establishes barriers to market entry.
Resource-Based View	Network cooperation optimizes the access and usage of rare resources.
Competence-Based View	A network reduces the operating expenses through the jointly planning, management and monitoring as well as an optimal use of the resources.
Knowledge-Based View	A network optimizes the access, intensity, structure, and process intelligence of special knowledge and enables the development of new process knowledge or common standards.
Resource Dependency Theory	Network cooperation causes interdependencies that equate the strength of all members and enhances the trust and risk tolerance regarding resource dependencies.
Interorganizational Theory	A network grows with the trading of more complex goods and services and leads to interdependencies and relationships of trust between the partners.
Co-opetition Theory	A network of cooperation and competition leads to a high rate of innovations supported by an enhanced access and usage of resources, knowledge or capabilities.
Game Theory	Network cooperation can ensure higher economic benefits within an unstable Pareto equilibrium.
Evolution Theory	Cooperative behavior can increase the moral obligation and commitment of the community regarding future group interests.
Social influences	Network cooperation can induce social influenced behavior, which avoids destructive decisions or strategies.

2.2.2 Cooperation Characteristics

Various academic authors addressed the definitions of a cooperative network and revealed diverse characteristics that describe different types in detail. These considered characteristics are the following:

» Number or parties: By definition, at least three participants are required to build a network (Borchert and Urspruch, 2003; Blecker and Liebhart, 2006). A maximum number is not fixed, but the administration effort is exponentially increasing with a higher number of members (Provan and Kenis, 2008).

» Relations: A cooperation network is a construct of economic or political relations between legally independent individuals or organizations (Harland, 1996; Borchert and Urspruch, 2003; Blecker and Liebhart, 2006).

» Company size: A network or a community can be established by large, medium, or small companies, or just single individuals (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003). Primary medium- and small-sized members profit from network relations (Rosenfeld, 1996). Large organizations often have enough own resources to compete in the market.

» Branches: Networks can be particularly valuable in specific branches such as government, healthcare, financials, logistics, education, and gaming (MarketsAndMarkets, 2013).

- Value added stage: Cooperation can be detected on a horizontal (same stage), vertical (up- or downstream stages) or lateral level (no correlation of stages) (Möller *et al.*, 2005). The community members act on a horizontal level e.g. when they collaborate to extend their resource capacities. A vertical cooperation occurs when the members collaborate to get access to related but not available resources or services until now. Usually participants with the same needs or interests collaborate; therefore, a lateral cooperation is rare.
- Degree of cooperation: This characteristic varies between the both opposite extremes of no cooperation (market, external procurement of services) and full cooperation (hierarchy, in-house production of services) (Oxley, 1997; Powell, 1990; Thorelli, 1986).
- Level of participation: This characteristic describes the participation of a company within the network. The entire company, individual areas, or just a few employees can be part of the network (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003).
- Degree of activity: An active network occurs when the partners conjointly operate a defined order for a customer; otherwise, it is a passive network (Borchert and Urspruch, 2003; Evans and Yen, 2006).
- Relationship intensity: The binding between the members of the network can consist of verbal agreements, a written contract or capital equity (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Laffont, 2003; Möller, 2006; Pratt *et al.*, 1991).
- Development: A network can be developed ad hoc or it grew over the course of time (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Evans and Yen, 2006).
- Temporal existence: This characteristic differentiates between a permanent network (unlimited in duration) and a temporary network (limited in duration) for a fixed period of time or the completion of a specific task (Borchert and Urspruch, 2003).
- Cooperating roles: The cooperating members can be customers (similar to principal), providers (similar to agent) or a mix of both (Pratt *et al.*, 1991).
- Competencies: Companies in networks can cooperate in different areas such as sourcing, research and development, supply, production, distribution, and marketing (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; MarketsAndMarkets, 2013; Bengtsson and Kock, 2000). Activities at the value creation side have higher relevance in networks than on the value delivery side (Brandenburger and Nalebuff, 1997).
- Identity: In networks, a common identity can be established by a uniform public appearance or the individual members keep their own identities (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003).

- » Management: Regarding the governance, an internal and an external management can be distinguished (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003). An external broker manages the community without participation in the network. This type of management induces a loss of control for the community members.
- » Coordination mechanism: The management of the community is executed with a focal (centralized) organization or a polycentric (decentralized) leadership (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003).
- » Geographic distribution: The geographic localization and distribution of the network members can be regional, national or international (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Hofstede and Hofstede, 2005).
- » Type of service: Regarding the transaction intensity within a community cloud, batch (OLAP) or interactive (OLTP) services can be distinguished (Grozev and Buyya, 2014).

2.2.3 Cooperation in Cloud Computing

Cooperation within cloud computing is described with the community cloud deployment model (Mell and Grance, 2009) (see section 2.1.4). Companies with the same needs, legal requirements, goals or the same data can cooperate and operate on a shared IT resource pool without dependencies on third party vendors (Briscoe and Marinos, 2009b). This is especially valuable for small and medium-sized companies that do not benefit from high economies of scale in serving their customers.

Since 2010, the community cloud concept was mentioned as a highly potential deployment model (Butler, 2012) that is "able to meet specific regulatory compliance regimes, satisfying audit requirements, and meeting required service level objectives such as response time" (Haff, 2010). Following the research and consulting institute Gartner, the community cloud concept has reached the peak of the cloud computing hype cycle in 2013 (Gartner, 2013b). Forecasts for community clouds predict a market increase by a factor of five from 2013 to 2018 (MarketsAndMarkets, 2013). Government, healthcare and financial sectors will show the earliest adoptions (Haff, 2010). The community cloud approach can enrich the IT industry with innovative business models but the adoption process is slow and it is barely focused in theory and practice so far (Khan *et al.*, 2014).

Two different points of view for a community cloud model have been stated in the literature:

- » Customer-based community cloud: This deployment model described cloud services "for exclusive use by a specific community of consumers from organizations that have shared concerns" (Mell and Grance, 2011).
- » Provider-based community cloud: This deployment model focused on a cooperative value generation of cloud providers based on their merged resources to profit from a major resource pool without dependencies on third party vendors or additional acquisition (Briscoe and Marinos, 2009b; Gall *et al.*, 2013).

The implementation of a customer-based community cloud usually bases on a centrally shared service center or third party provider. The resources are bundled physically in a central resource pool and managed centrally by one cloud provider. Dependencies on the provider are high and the failure safety is decreasing (Walser and Brian, 2013). However, the centralized administration, data, and provisioning to all stakeholders means advantages for the enforcement of existing common rules and standards as well as the reduction of administration costs.

The typical implementation of a provider-based community cloud is a decentralized peer-to-peer network (Briscoe and Marinos, 2009b). A significant advantage of this architecture is the failure safety in contrast to a central operation. In a peer-to-peer-network, the data is stored locally. This is unsuitable for a customer-based cloud with the same data basis for knowledge sharing or a central administration of the services, but optimal for resource utilization in a provider-based community cloud (Buyya *et al.*, 2010). The management of this network can be centralized (broker) (Villegas *et al.*, 2012) or decentralized (Walser and Brian, 2013).

Community clouds overcome the lack of scalability and resource efficiency of private clouds as well as the loss of trust with public cloud services (Briscoe and Marinos, 2009b; Repschläger *et al.*, 2011; Liang, 2012). Especially small cloud service provider can increase their ability to compete in the cloud market (see Figure 15, own representation) by an optimal resource distribution in a secure network.

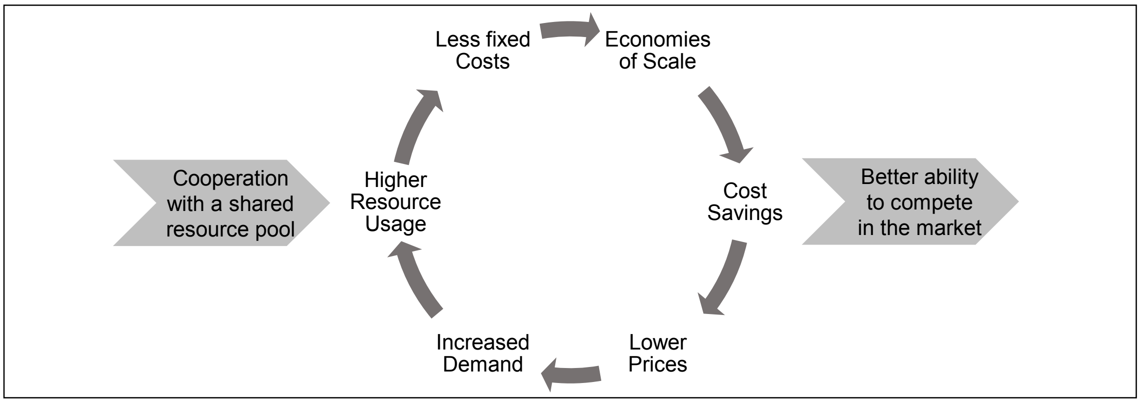


Figure 15: Self-Enhancing Process of Cloud Cooperation towards Increased Competitiveness

On the technical level, cooperation in cloud computing is not a new concept and load balancing in networks was already addressed within the 1990s (Schaar and Bhuyan, 1991). The grid computing concept was the predecessor of cloud computing and is the infrastructure basis of cloud services. It describes a computing system that dynamically interconnects distributed resources to work on a single large scale task (Chetty and Buyya, 2002; Foster *et al.*, 2008; Wang and Laszewski, 2008). While the cooperation model of a grid is more project oriented, the cooperation in cloud business models follows an entrepreneurial vision (Sadashiv and Kumar, 2011). In this context, cloud computing is service oriented with user-centric functionalities, while grid computing is rather application oriented (Foster *et al.*, 2008; Wang and Laszewski, 2008; Vaquero *et al.*, 2009). With the increased virtualization and business model focus, cooperation activities in cloud computing increase the resource utilization compared to grid structures (Saovapakhiran and Devetsikiotis, 2011).

The grid paradigm as technology of cloud cooperation and the question how cloud services make use out of this infrastructure basis is well addressed in the literature (Wang and Laszewski, 2008). Therefore, technical resource allocation measurement and the management of common quality of service (QoS) (Buyya *et al.*, 2010; Wei *et al.*, 2010) is not part of this thesis that concentrates on the business level.

2.3 Business Models

In the past, individual companies in mature industries differed only marginally. Their business models converged to an industry standard model (Staehler, 2001). The increased market saturation, the trend towards niche markets, and eminently the new digital economy in the 1990s (Cohen *et al.*, 2000; Gordon, 2000) enabled by the internet, increasingly induced more complex and differing businesses. Accordingly, the business model concept experienced a genuine renewal. As basis for the description of business model changes within this thesis, business models and their components are defined in the next sections.

2.3.1 Business Model Definition

By its definition, every company has a business model. It is a model-based, i.e. simplified and aggregated picture or description of a business, of "what a company is doing in order to create and commercialize value" (Burkhart *et al.*, 2011) (see also Osterwalder *et al.* (2005), Wirtz (2010), and Amit and Zott (2001)). A company can have several business models for different business fields (Grünig and Kühn, 2015). In this thesis, the focus was laid on the cloud business with the strategic orientation towards the cloud market.

The objective of a business model is to describe, predict and handle the following issues (Staehler, 2002):

» To understand the appreciation of an existing business,

» to identify weaknesses to be tackled in order to achieve an improvement of the business, and

» to systematically evaluate new business ideas with their competitive advantages and success probabilities.

Business models are based on many different definitions and concepts; a widely accepted approach is still missing in science and practice (Burkhart *et al.*, 2011; Weiner *et al.*, 2010; Lambert and Davidson, 2013; Zott *et al.*, 2011). Many researchers presented various definitions for the business model concept from different perspectives, often applying a component-based view. Miscellaneous classifications of these definitions were given by several researchers (Shafer *et al.*, 2005; Al-Debei *et al.*, 2008; Burkhart *et al.*, 2011; Zolnowski and Boehmann, 2011; Zott *et al.*, 2011). Basic business model theories with their sub models are depicted in the Annex (see Figure 66).

A comprehensive literature analysis (Labes *et al.* (2013b), see section 3.1) summarizes these classifications with up to 30 considered definitions and revealed eight common components as basis for business model analyses. In the following, these business model components are introduced in detail.

2.3.2 Business Model Components

A business model comprises three different parts to be considered with respect to value: "Value creation", "Value Proposition", and "Value Delivery" (see Figure 16, own representation). At the "Value Creation" side of a business model, internal capability factors, such as technologies, resources, skills and activities as well as an external supplier network are the components. The use of these factors results in costs. The centered "Value Proposition" defines the offering factors by giving information about the product and its unique selling proposition in the scope of the business strategy (Zott and Amit, 2008), which is aligned with the corporate strategy (Beats, 1992). The "Value Delivery" part comprises internal delivery aspects such as the communication or distribution channels, and external market factors such as targeted customer segments. The value capturing is described by the revenue block that can be compared with the costs to calculate the profit as financial difference between both blocks.

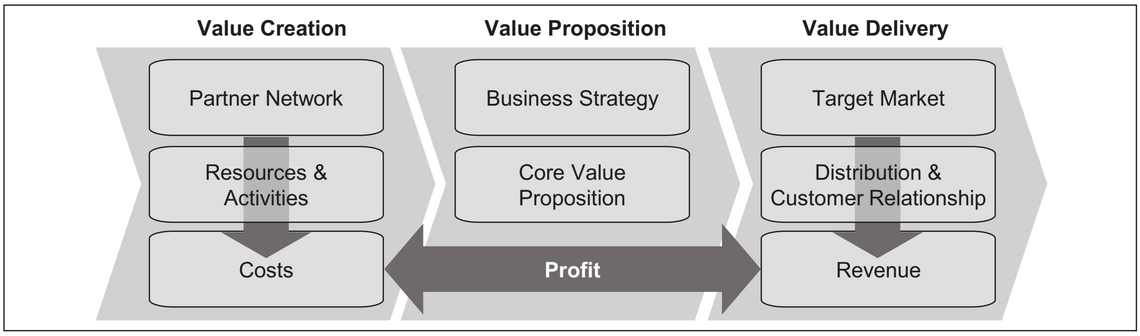


Figure 16: Components of a Business Model

The **partner network** is the supportive market environment for a company in the value creation process. A company defines number and quality of its partners (e.g. suppliers, business, or customers). The value added principles regarding the partner selection has to be defined, e.g. the value adding stage (horizontal, vertical, lateral) and type (complementary, substitutive, or similar) of the partners. The cooperation intensity towards the partners is a relevant parameter (integrated ecosystem, strategic alliance, loose cooperation, or acquisition).

The component of **resources and activities** describes the concrete value generation. A company positions itself into the value chain (provider, aggregator, integrator, or consultant). To meet this role it has to figure out the specific resources that are the input for the creation process that transform these resources into a product or service. Furthermore, it is relevant do define which capabilities and knowhow are used in combination with which activities to transform the resources (Porter, 1985).

The **cost** component defines and calculates the costs that are occurring with the value creation process. This comprises cost structures such as initial investments, the creation process, the operation process, maintenance, personnel costs, or partner-based costs. Especially with dynamic new business models and shortened product or service lifecycles (Mach and Schikuta, 2011), an analysis of the total cost of ownership (TCO) (Li *et al.*, 2009) will help to develop this component in-depth.

With the **business strategy**, the company needs to determine the economic objectives within the given market situation and the legal framework (Shafer *et al.*, 2005). A detailed set of rules is fundamental for the business strategy to control the specific business unit in compliance with the corporate strategy that is oriented towards generic market strategies (Porter, 1998).

The **core value proposition** describes the core product or service that a company is providing. It also comprises the product system where the core product is integrated in and the range of product systems as well as additional complementary services. All these considerations finally direct towards an emotional customer experience.

With the **target market**, a company needs to specify the intended market (e.g. mass, branch, niche) (Porter, 1998). With customer analyses, the high-value customers can be determined. An integrated value system of products or services, for precise selected customer groups and prices can reach higher revenue streams (Anandasivam and Premm, 2009; Koehler *et al.*, 2010).

The component of **distribution and customer relationship** defines the channels for the communication to the customers in the target market and the distribution channels to transfer the value (e.g. shop, franchise, e-commerce, web services). Furthermore, a company needs to address the customer relationship and describe how they plan to establish customer loyalty (e.g. transparent SLAs).

The **revenue** component describes the considered revenue models of the business. A company needs to define how it wants to capture the value. Various differentiation criteria for the accounting of flexible products and services can be found within the literature (Gull and Wehrmann, 2009; Sotola, 2011). Payment models distinguish e.g. between direct or indirect revenue streams, transaction dependent or independent payments, fixed or variable prices, and one-time-charge or periodic payments. The final revenue model should consider interdependencies between the different payment methods (Osterwalder *et al.*, 2010).

These business model components were combined with the cloud computing concept to develop an analysis unit for cloud business models (see section 3.2).

3 State-of-the-Art in Cloud Business Models

This chapter comprises four scientific publications answering the research questions A1 to A4 focusing on cloud business models and their success. The publications are given as sections of this chapter.

In the beginning, the first section serves with an intensive literature analysis of the related work in cloud business models and discovers the state-of-the-art in literature with its focuses and gaps.

Based on the literature results, the second section shows the development and evaluation of a business model framework with 103 characteristics. This framework serves as analysis unit for cloud business model in practice. Within a first study of 29 business models, common patterns of combination in the characteristics were derived.

The third section describes a literature analysis of success factors for cloud business models and performs an intensive study of 45 business models in practice regarding indicators for success to find success-related business model characteristics that operationalize the revealed success factors in the literature.

Finally, the fourth section deepens the analysis of successful cloud business models and evaluates the findings with interviews of 12 cloud experts to conclude with recommendations for action.

Table 5: Publications in the State-of-the-Art Chapter

Section	Title	Published	Reference
3.1	A Literature Review of Business Models in Cloud Computing (origin: German)	Proceedings of the 11th International Conference on Wirtschaftsinformatik (WI 2013)	(Labes *et al.*, 2013b)
3.2	Common Patterns of Cloud Business Models	Proceedings of the 19th Americas Conference on Information Systems (AMCIS 2013)	(Labes *et al.*, 2013a)
3.3	Success Factors of Cloud Business Models	Proceedings of the 23rd European Conference on Information Systems (ECIS 2015)	(Labes *et al.*, 2015)
3.4	Successful Cloud Business Model Types	International Journal of Business & Information Systems Engineering (BISE 2016)	

3.1 Literature Review of Business Models in Cloud Computing

Table 6: Details of Publication No. 3.1

Title	**A Literature Review of Business Models in Cloud Computing (origin: German)**
Authors	Stine Labes, Koray Erek, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	Proceedings of the International Conference on Wirtschaftsinformatik (WI 2013)
Abstract	In recent years cloud computing has established itself as a familiar topic in the IT branch and many corporations are migrating their traditional IT business to cloud services. The effects of the most recent progress of cloud services on the business models of the corporations are unclear and this opens a research gap. The present paper analyses existing literature on business models in cloud computing and derives influences on traditional business models and theories. In addition, it first presents fundamental components of existing business model theories. For identifying the influences on the components of traditional business models in the focusing of cloud businesses, an extensive literature search (70 specialist journals, six conferences and four databases) has been carried out. Based on the findings of a comprehensive analysis of the literature, consequences for cloud business models are recognized. Further, the coverage of business model components in cloud-referenced articles in the scientific literature is discussed. Finally, further research directions are inferred.
Keywords	Cloud Computing, Business Models, Literature Review
Link	http://aisel.aisnet.org/wi2013/28
Version	Postprint in dissertation publication

3.1.1 Introduction

A business model (BM), in accordance with the meanings of the two compounded concepts, is an abstract pattern of an existing business or corporation (Stachowiak, 1973). After the BMs of corporations in mature industries had become more and more similar, by the turn of the century (Staehler, 2001) complex and varied models are now emerging as a result of the influence of the internet. In the new business structures of information technology (IT), cloud computing (CC) is perceived as a key technology. Many providers follow this trend and migrate their traditional business to a cloud business. The adoption of CC will reduce the heterogeneity of IT and lead to changes in the BMs of cloud service providers (PAC, 2012; Pueschel *et al.*, 2009; Weinhardt *et al.*, 2009). Against this background, the question arises, what consequences these changes in existing frameworks for BMs will have and how can this research gap be suitably addressed. For this purpose, we address the following research questions, taking into account existing BM theories:

(1) What are the fundamental building blocks of classical BM theories?

(2) What consequences does cloud computing have for the traditional BM elements?

(3) What future research and action fields result in the area of cloud BMs?

The article is thus structured as follows: Firstly, different BM theories are presented, combined with each other and integrated in order to derive fundamental building blocks. The results of the following analysis can be structured along these building blocks, for answering the second research question. A detailed literature search follows with whose help the characteristics of the individual BM building blocks for the cloud domain are identified and peculiarities accentuated against classical BMs. Finally, we identify further research directions, based on the coverage of the building blocks with reference to the literature.

3.1.2 Literature Review

The preparation of a literature overview is the method of choice in order to determine the state of research at the beginning of a research project (Baker, 2000). This avoids redundant investigations and leads to important contributions in the research field (Baker, 2000; Vom Brocke *et al.*, 2009). The literature analysis in this article summarizes research work with reference to BMs in CC and serves to inform the reader (Webster and Watson, 2002). For the analysis we employ a method based on the five-step conception after Vom Brocke *et al.* (2009) (see Figure 17).

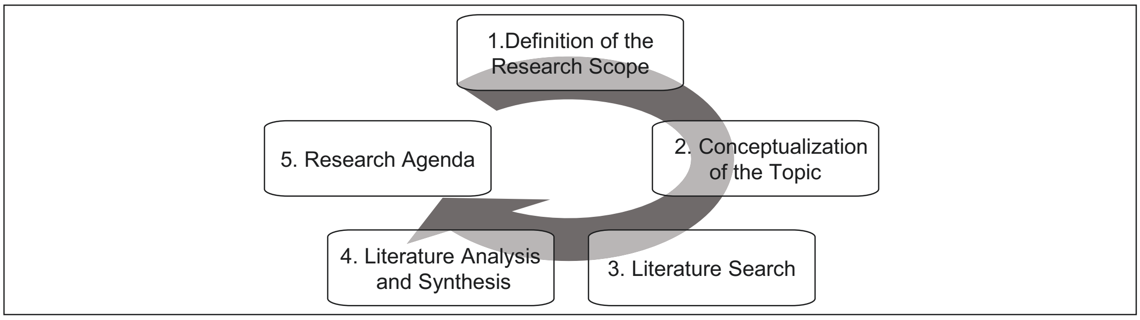


Figure 17: Research Approach for the Literature Analysis

Definition of the Research Scope

Within the framework of our article, we concentrate on the collection and systematization of research works in the field of BMs in CC and analyze changes for cloud businesses. For the visual presentation of the research scope a taxonomy with six features, after Cooper (Cooper, 1988), is suggested as a proven means (Randolph, 2009) (see Figure 18, grey highlighted fields).

Characteristics		Categories			
1	Focus	Research Outcomes	Research Methods	Theories	Practices and Applications
2	Goal	Integration	Criticism	Identification of Central Issues	
3	Perspective	Neutral Representation	Espousal of Position		
4	Coverage	Exhaustive	Exhaustive with Selective Citation	Representative	Central or Pivotal
5	Organization	Historic	Conceptual	Methodological	
6	Audience	Specialized Scholars	General Scholars	Practitioners or Policymakers	General Public

Figure 18: Conceptualization of the Topic

Conceptualization of the Topic

With the examination of the influence of CC on BMs, two not clearly understood concepts are combined. As an introduction to the subject matter and for the facilitation of a consensus, an overview of the two constructs is therefore initially given.

Business model. By definition, every business has a business model. It depicts an exemplary, i. e. simplified and abstract picture of the business and of what a company does, in order to create and deliver added value (Burkhart *et al.*, 2011) (see also Osterwalder *et al.* (2010) or Wirtz (2010)). The goal of a BM is the formation of a basis for the following aspects (Staehler, 2001): an understanding of the value of an existing business; recognition of some weaknesses with the goal of optimization; and the systematic evaluation of new business ideas with their competitive advantages and success probabilities.

The definition and conceptual design of a BM can be visualized in many different ways, but there is a lack of a commonly accepted approach in scholarship and practice (Alt and Zimmermann, 2001; Popp *et al.*, 2013; Scheer *et al.*, 2003; Seppaenen and Maekinen, 2005; Weiner *et al.*, 2010; Wuestenhagen and Boehnke, 2006). Many researchers present various definitions of the BM concept from a variety of perspectives. Among the different perspectives, especially the component-based approach has established itself and will thus be further pursued. For achieving a common understanding of the concept, various authors compared up to 30 BM definitions and aggregated them to resulting components (see Figure 19, left). We consider the most current authors of summaries of different BM definitions and unify their resultant components of a BM to propose eight building blocks of a BM (see Figure 19, right). We use these building blocks as a guideline for the subsequent literature analysis. According to the considered authors, these building blocks have the following meaning in a BM: The central building block is the “Value Proposition”, a performance promise that is offered within the framework of a “Business strategy”. On the “Value Creation” side, this value is generated by means of diverse cost inducing resources and activities as well as being supported by a network of partners and suppliers. On the “Value Delivery” side, this service is distributed to the target market via distribution channels and revenue streams.

Authors	No.	Resulting Components	
Shafer et al., 2005	12	• Strategic Choices • Create Value	• Value Network • Capture Value
Al-Debei et al., 2008	17	• Value Proposition • Val. Architecture	• Value Network • Value Finance
Zolnowski et al., 2011	14	• Value Proposition • Value Appropriation • Funding & Costs • Customers • Networks & Activities	• Technologies, Resources, Skills • Strategy, Scope, Sustainability & Leadership • Value Flow • Legal Aspects
Burkhart et al., 2011	30	• Offering Factors • Market Factors • Internal Capability Factors	• Competitive Strategy Factors • Economic Factors • Personal Factors

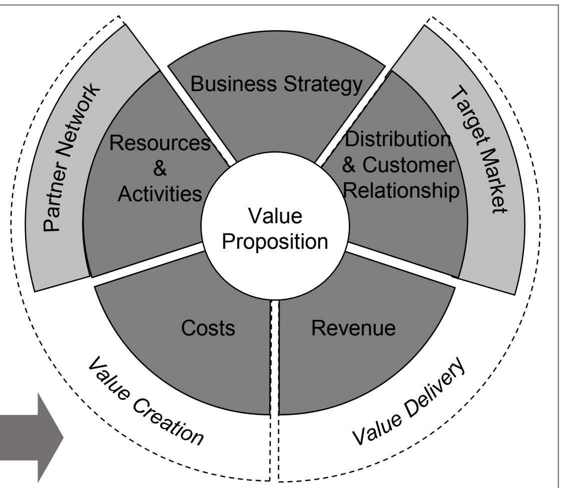


Figure 19: Aggregated Business Model Components

Cloud computing. CC describes the scalable and elastic provision of IT resources via the internet (Mell and Grance, 2009, 2011). These resources include, for example, computing capacity, database, programing platforms and software. The scalability of the service means that it can be adapted according to demand and that the service recipient is charged for the costs of the actual consumption. The service is elastic, as a common pool of resources is shared by the users and maximum efficiency of resource distribution is thus assured (Mell and Grance, 2009). The National Institute of Standards and Technology

(NIST) summarizes the description of CC with five characteristic features (Mell and Grance, 2011): (1) Broad Network Access, (2) Rapid Elasticity, (3) Measured Service, (4) On-Demand Self-Service, and (5) Resource Pooling. Furthermore, the service spectrum of CC is available on three hierarchic service levels (Mell and Grance, 2011): "Software as a Service" (SaaS), "Platform as a Service" (PaaS) and "Infrastructure as a Service" (IaaS). Additionally, the provision of cloud services can be divided into four different models, dependent on the use of public (internet) or private (intranet, virtual private networks / VPN) network structures: Public, Hybrid, Community and Private (Weinhardt *et al.*, 2009; Mell and Grance, 2011).

Literature search

The third step in the five-step concept after Vom Brocke *et al.* (2009) is the search of relevant literature. For identifying this relevant literature, an extensive search of literature was carried out, during which 70 academic journals, six conferences, and four databases were searched through.

The choice of the journals is based on the journal ranking of the Association for Information Systems (AIS) in order to obtain articles from highly valued journals. In the time span from January 2002 to May 2012, all journals with an average ranking (Average Rank Point / ARP) lower than or equal to 30 were searched. In addition, five conferences with connections to the AIS and one additional conference were analyzed. The articles were chosen according to title (hits) and their abstracts examined for a reference to business model in CC. The search yielded 13 relevant articles in the journals and ten in the conference papers (see Figure 20). The remaining 46 journals within the ranking interval, and not shown in the illustration, contained no hits.

To extend the search, we carried out a key word search for the time interval from January 2002 to May 2012 in the following databases (Vom Brocke *et al.*, 2009): AISeL, EBSCO (Business Cource Complete), Science Direct (Business Management and Accounting; Computer Science) and IEEE Xplore (Communication, Networking & Broadcasting; Computing & Processing). The following key words were derived from the result of the conceptualization (Section 2.2) and sought in the titles, key words and abstracts of the articles: "cloud computing" in connection with "business model", "strategy", "value proposition", "network", "activities", "resources", "market", "distribution", "revenue" and "costs". We sorted the database results according to relevance and analyzed the first 100 hits in each case. We used an individual evaluation of the titles and abstracts as well as a screening of the whole articles in order to filter out the relevant articles. Because of the overlapping of articles between the search in the journals and conferences as well as the database search, we counted only newly found articles. The database search led to 30 further articles (see Figure 20).

Based on the articles found so far, we extended the search again by a forwards search (author-based) and a backwards search (reference-based) and this led to an additional 22 articles. In total, the literature search yielded 75 relevant articles in the area of BMs in the cloud (see Figure 20).

	Abbr.	Name	ARP	Hits	relevant
Journals	JMIS	Journal of Management Information Systems	4,86	1	0
	HBR	Harvard Business Review	8,00	1	0
	DSS	Decision Support Systems	10,67	3	2
	IEEESw	IEEE Software	11,00	5	0
	ACMTrans	ACM Transaction (various)	13,00	3	2
	JCSS	Journal of Computer and System Sciences	13,00	2	0
	IEEETSMC	IEEE Transaction on Computers	14,00	6	0
	CAIS	Communication of the AIS	14,00	1	1
	JAIS	Journal of the AIS	17,75	3	1
	IEEETC	IEEE Transaction on Computers	18,00	2	2
	IEEEComp	IEEE Computer	18,17	2	0
	COR	Computer and Operations Research	20,50	1	0
	HCI	Human-Computer Interaction	20,67	1	0
	CMR	California Management Review	21,00	1	0
	JSIS	Journal of Strategic Information Systems	22,57	6	1
	BH	Business Horizons	25,00	1	0
	IEEETKDE	IEEE Transaction on Knowledge and Data Engineering	25,00	1	0
	JDA	Journal of Database Administration	25,00	2	0
	IBMSJ	IBM System Journal	26,00	2	1
	JITTA	Journal of Information Technology Theory and Application	26,00	1	0
	WIRT	WIRT Wirtschaftsinformatik	28,00	4	3
	ESA	Expert Systems with Applications	29,00	1	0
	ISM	Informations Systems Management	29,00	1	0
	DB	Database	30,00	1	0
		Total		52	13
Conferences	AMCIS	Americas Conference on Information Systems		4	1
	ICIS	International Conference on Information Systems		4	2
	ECIS	European Conference on Information Systems		3	3
	MCIS	Mediterranean Conference on Information Systems		6	2
	PACIS	Pacific Asia Conference on Information Systems		3	2
	WI	Wirtschaftsinformatik		2	0
		Total		22	10

Key Words	AISeL		EBSCOhost		Science Direct		IEEE Xplore	
Cloud Computing +	Hits	New	Hits	New	Hits	New	Hits	New
• Business Model	8	1	60	2	24	3	229	5
• Strategy	6	0	211	0	38	0	203	1
• Value Proposition	0	0	4	0	0	0	1	0
• Network	4	1	418	1	98	0	999	0
• Activities	0	0	57	0	22	0	88	1
• Resources	17	2	343	0	145	0	1.373	1
• Market	12	2	288	0	22	1	157	0
• Distribution	1	0	40	0	35	1	186	2
• Revenue	5	0	99	2	4	0	45	0
• Costs	12	2	529	0	99	1	707	1
Sum New	8		5		6		11	
Total	30							

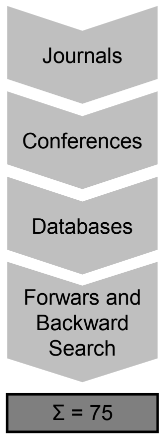


Figure 20: Results in the Literature Search

Literature analysis and synthesis

We analyzed the identified literature in detail and allocated it to the components of a BM. Alongside the parts of a BM presented earlier - "Business Strategy", "Value Creation", "Value Proposition" and "Value Delivery" - the corresponding literature is systematically assembled. In the process, general results for cloud-BMs are first presented and the special features are formulated in the individual building blocks, in order to address the second research question.

General Result for Cloud Business Models. Some research results draw upon the holistic BM conceptualization for their approach and posit classifications and frameworks for cloud BMs, but most of these approaches describe BMs in the cloud only very superficially and seldom with complete coverage of all building blocks of a BM. The various approaches are briefly presented in the following.

Stuckenberg *et al.* (2011) applied an analysis methodology of a BM along with Osterwalder's "Business Model Canvas (Osterwalder *et al.*, 2010) and highlighted very general effects of SaaS on BMs.

The same approach was used by Nüesch and Back (2011) to determine the potential effects of Web 2.0 principles on internet-based BMs. Web 2.0 applications fall into the SaaS area, so the observed effects are relevant in the cloud area as well.

Weinhardt *et al.* (2009) presented a general "Cloud Business Model Framework". They used a three-level-model analogous to the service levels in CC: infrastructure, platforms and applications. Each level describes two types of services, which each present a single BM.

Chou (2009) presented seven BMs for cloud software providers that are oriented mainly towards the software level. Proceeding from the traditional software business, he describes the models and their transitions.

Different types of BMs can be derived from a distinction of classification criteria. The Jericho Forum proposed a "Cloud Cube Model" (CCM) with three qualitative dimensions, which reflect the degree of provisioning (Dobeson and Jericho Forum members, 2009). Building upon this, Chang *et al.* (2010b) identified eight types of BMs that they classified using the CCM and they discussed strengths and weaknesses for each type. In addition to this, Chang *et al.* (2010a) proposed the Hexagon Model (HM), which enhances the previous qualitative considerations for a cloud BM with quantitative aspects.

Business strategy. IT service providers can use various strategies to promote the formation and development of cloud BMs in an entrepreneurial context. Su (2011) determined four categories of cloud provider strategies, which differ in two dimensions: the organizational focus (individual organization or inter-organizational area) and organizational process (alteration of existing structures or creation of new institutional agreements). These strategies are a very general consideration and can also be applied without a cloud focus.

Value Creation. On the value generating side of the provider, business partner relationships are considered as well as activities and resources that are needed for the creation of the value proposition and finally costs that are caused by these aspects.

With reference to partner **networks** of a business, many and varied roles are integrated with each other in CC. The increasing standardization of service provision in the cloud facilitates the realization of a multiplicity of BMs that is based on other cloud services. Providers of cloud services form the basis for market places or for aggregators that subsume extrinsic services and add an ancillary use. Consultants support businesses in the choice and operation of cloud services and integrators help to implement the services in the business (Jeffery *et al.*, 2010). Leimeister *et al.* (2010) presented these relationships in a "Value Network of Cloud Computing" (VNCC), which depicts the traditional value creation chain as a value network. Fang *et al.* (2010) also analyzed BMs based on the value network in the cloud and developed a corresponding structure model. A further partner aspect was given by Hwang *et al.* (2011). They proposed a division between storage and encryption service for secure storage services. Beyond this storage scenario, a general division between cloud and security service as part of a cloud BM is conceivable in order to heighten data protection in the cloud.

With regard to **activities** of cloud providers, Fang *et al.* (2010) summarized various cloud conceptualizations and identified important activities to do with the provision of a cloud service. A fundamental activity of a cloud provider is the measurement and supervision of the consumption of resources in order to guarantee use-based billing. Further to this, detailed capacity planning is required in order to allow for potential demands of future usages. For the realization of the on-demand approach of CC, standardized service level agreements (SLAs) need to be formulated between providers and users (Fang *et al.*, 2010). For the promotion of standardization, Maurer *et al.* (2012) presented a novel approach of adaptive SLA comparison, based on publicly accessible SLA templates. With cloud services, the complete operation and all servicing are the responsibility of the provider of the services (Buxmann *et al.*, 2008; Cusumano, 2007). To this belong especially administration tasks of IT, e.g. implementations, data migrations, actualizations, and security upgrades. The management and reduction of risks and compliance effort are addressed by Martens and Teuteberg (2011), with their presentation of a reference model which supports businesses in these tasks. The increased focus on data and their collection in the internet requires activities such as database management and data analysis in order to process the large amounts of data and to create added value for the consumer (Chen *et al.*, 2011). In cloud BMs especially the observation of security and data protection principles are always in the foreground (Ramireddy *et al.*, 2010). In general, data protection is less concretely pursued than security and the smaller the provider of cloud services is, the smaller is the extent of its security measures (Ramireddy *et al.*, 2010).

Infrastructure providers work on hardware **resources** from their own server farms (e.g. storage, servers and network). Besides the hardware resources, software components (e.g. firmware or a management tools) are necessary in order to provide virtual machines (Fang *et al.*, 2010). With cloud services on the platform or software level, resources are runtime environments, developmental tools and further applications. Probably the most important resource for cloud services is a broadband internet connection via which sub-contractors are integrated and which provides the basis for the dissemination of the cloud service. In CC there are theoretically no limitations of the location of resources, so that more clients can be served (Weinhardt *et al.*, 2009; Kambil, 2009). More clients generate a higher volume of data and many applications in the cloud are based on large amounts of data. Consequently, data as a resource in the cloud increase in importance as well.

Existing methods of **cost** analysis of traditional BMs are based on fixed costs and long life cycles of the products. The elastic use of resources in the cloud and shortened product life cycles require adaptation of the cost models (Mach and Schikuta, 2011). With usage of other cloud services for the own value generation, a provider must integrate a costing model that observes pay-per-use billing of CC. Calculation of costs in the cloud is thus very complex and should include the total costs of ownership (TCO) as well as usage-dependent costs (Li *et al.*, 2009). Li *et al.* (2009) developed a calculation model for this type of costs and presented a cost calculation and analysis tool. Mach and Schikuta (2011) developed a further cloud costing model that describes not only fixed, but also variable costs for BMs in the cloud environment. Martens *et al.* (2012) described nine types of costs in CC and present a TCO model that also promotes consciousness of indirect and hidden costs in the cloud and leads to cost savings (Caplan *et al.*, 2011).

Value Proposition. The value of cloud services is based on the promises of a cloud environment consisting of ubiquitous (network based) access to and exchange of data as well as access to cost-efficient infrastructures and applications (Goodburn and Hill, 2010). Cloud services are standardized services that are obtainable by the mass market. The high degree of standardization of services awakens in the client the demand for possibilities of individualization, which manifests itself e.g. in a need for limitation of the location of physical resources. Further, benefits of cloud services are continual improvement as well as independence of platforms and infrastructures. With SaaS, the involvement of the client can be an important factor for the value creation (Clark, 2010), as the value of a collaboration software increases proportionately to the size and the dynamics of the data to be managed (O'Reilly, 2007).

Value Delivery. On this side, we consider the target clients of the value proposition as well as the distribution model and the revenue that it generates.

In a **market** with limited resources, cloud providers can achieve higher income through precise choice of target clients and matched pricing (Anandasivam and Premm, 2009). Because providers theoretically have access to an unlimited pool of resources in CC, cloud services can cater for the broad mass of clients. Differentiation between private and business clients is still very sensible (Koehler *et al.*, 2010). Since the advent of Web 2.0 services, the client is often part of the value creation (e.g. Facebook) (O'Reilly, 2007), so a cloud BM should increasingly focus on client relations (Clark, 2010). Transparent presentation of data processing in the cloud promotes trust in the provider and SLAs communicate corresponding standards to the client (Fang *et al.*, 2010). Ko *et al.* (2011) proposed a framework for liability and trust which focuses on the components security, privacy, responsibility and auditability. Martens *et al.* (2011) developed a maturity model for the client to enable appropriate assessment of services. With this model, providers can also evaluate the quality of their own services. For increasing trust, providers should avoid a lock-in effect (Weinhardt *et al.*, 2009). The use of and the adherence to standards ensure interoperability and allow the client an unlimited choice of services as well as providers.

The **distribution path** of cloud services is a network infrastructure (intranet or internet). Users of cloud services (consumers or businesses) work with web or programming interfaces. They administer virtual machines, develop code or use applications (Fang *et al.*, 2010) without using their own resources, except for accessing the network via which the services are distributed.

With **revenues** in cloud computing, price setting changes from fixed prices to variable pay-per-use charging (Sotola, 2011; Gull and Wehrmann, 2009). In current revenue models, licenses are linked to individual machines or users. New revenue models are required for use-dependent licenses, sanctions and prices for cloud services (Weinhardt *et al.*, 2009). Anandasivam and Premm (2009) aimed at a solution of the problem and compared static pricing and dynamic price setting. In the area of PaaS, Eurich *et al.* (2011) identified eight potential income sources for supporting various strategies. Sotola (2011) assembled various billing criteria on all three levels of cloud services and offered a price model for the cloud. Pueschel *et al.* (2009) proposed a special pricing mechanism for increasing revenues in the cloud. A further revenue factor in the provision of cloud services is the realization of scaling effects, when extensive investments and operating costs can be allocated to a larger number of units (Leimeister *et al.*, 2010; Kambil, 2009; Mach and Schikuta, 2011; Greenberg *et al.*, 2009).

Research Agenda

In summary, we can synthesize the results of the literature review into the building blocks of a BM as follows (see Figure 21). The findings from the literature show that no article deals with cloud BMs in a holistic approach (coverage of all building blocks in sufficient depth). Every building block of a cloud BM has been treated up to now only individually or superficially.

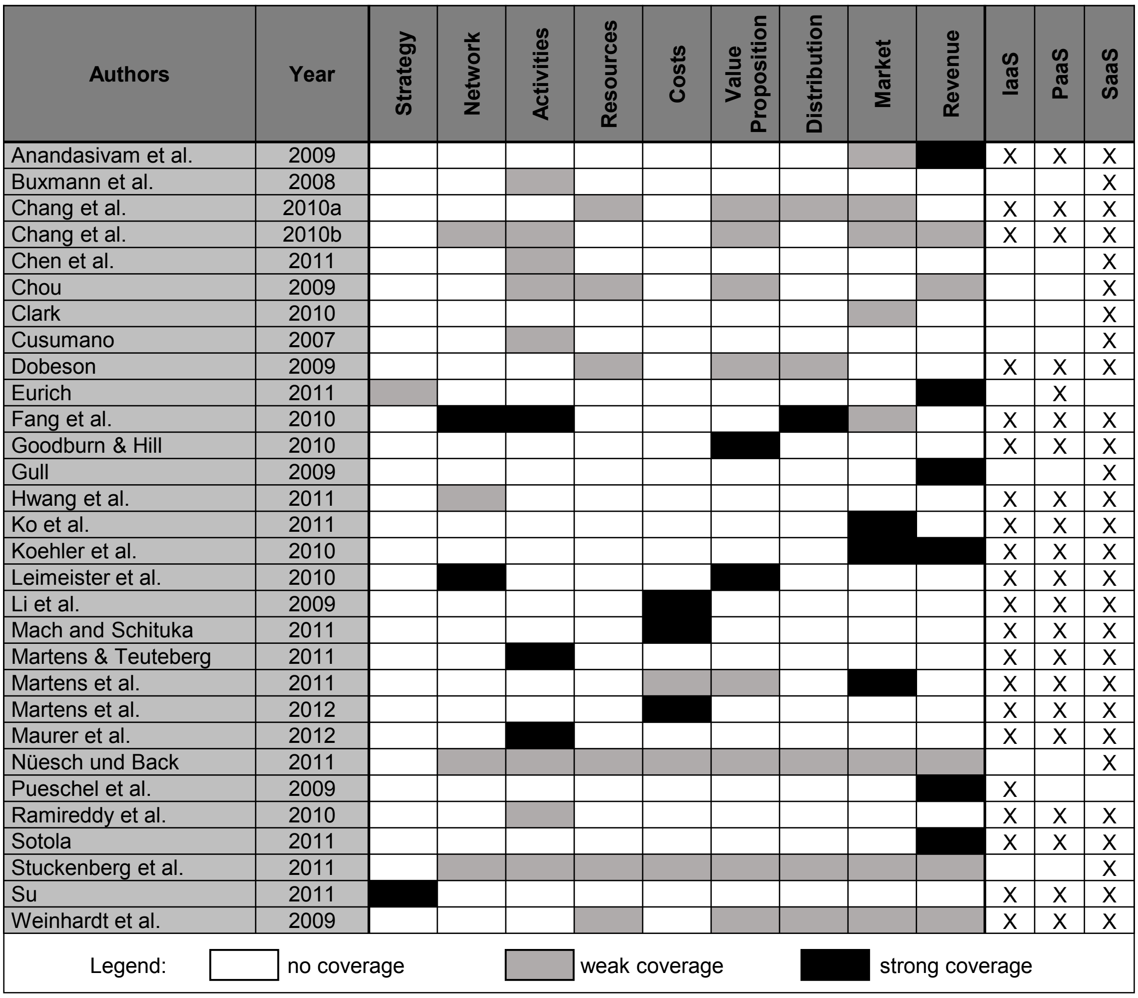


Figure 21: Overview on the Literature Coverage

The issue of revenue generation emerges with special intensity in the literature, which leads to the hypothesis that revenues change especially in the cloud. Besides that, the literature search has shown that in CC interconnectedness between providers is an increasingly relevant aspect. The area of strategy has been underrepresented to date in the literature, which possibly reveals a research gap or indicates that there are no strategic differences within CC. The coverage of cloud levels (IaaS, PaaS and SaaS) is uneven, where especially the high number of literature results with a software focus stands out. This can imply that there is a higher need for research on the SaaS-level, which is caused by the complexity and variability of potential software applications. Analogous to the formulated findings, the evaluation of the literature leads to potential future research directions, which we can sketch out with the following research questions:

1. What effects does revenue generation have on the success of cloud business models in comparison with classical models?
2. What success factors does a partner network offers in cloud business and what dependencies arise from this?
3. What are the differences in the formulation of a strategy between a cloud business and a classical business?
4. What relations exist between cloud strategies and the service levels, provisioning models or role concepts?
5. How do cloud business models differ on the three levels IaaS, PaaS and SaaS?

3.1.3 Conclusion

In the era of CC, the evaluation of existing BMs as well as the weighing up of new business model concepts is required. The authors take the first step in this direction with the present investigation. We evaluated general theories of the business model concept, in order to answer the first research question (What are the fundamental building blocks of classical BM theories?). This yielded as a result the eight building blocks network, resources and activities, as well as costs on the value creation side, strategy and value proposition at the center of a BM and on the value delivery side the target market, distribution, and revenues.

Based on an extensive literature search, we created a structured overview that addressed the second question (What consequences does cloud computing have for the traditional BM elements?) The areas of revenue, strategy, networks and SaaS especially stood out through proportional over- or underrepresentation.

Future research fields can be derived from the ascertained conspicuous results, allowing an answer to the third research question (What future research and action fields result from this in the area of cloud BMs?)

Some limitations of the investigation in the present article need to be considered. We focused on component-based approaches and neglected other perspectives on a BM. While we carried out a search in 70 journals and six conferences independently of key words, the remaining results of the data bank search are limited by the choice of key words. By extending the list of key words, the literature findings could be broadened. Finally, one can assume a slight subjectivity in the selection process for the literature reviewed.

3.2 Cloud Business Model Analysis Unit

Table 7: Details of Publication No. 3.2

Title	**Common Patterns of Cloud Business Models**
Authors	Stine Labes, Koray Erek, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	Proceedings of the Americas Conference on Information Systems (AMCIS 2013)
Abstract	Cloud computing has been established as a significant topic in the information technology (IT) industry, especially since cloud services are expanding in the portfolios of IT service providers. New businesses emerged to provide cloud services and established businesses extend their traditional business with aspects of cloud computing. The contribution of this paper is how the cloud focus influences the IT service provider's business model. Based on an extensive literature analysis and synthesis, the characteristics of a cloud business model are transferred into a structured research framework with 103 design features. Subsequently, cloud business models of 29 selected IT service providers are analyzed and matched with the framework. With the help of a cluster analysis, four common patterns of combination are identified for cloud business models. Finally, these patterns will be evaluated with respect to critical success factors and to issue recommendations for action.
Keywords	Cloud computing, business model, pattern, framework
Link	http://aisel.aisnet.org/amcis2013/eBusinessIntelligence/GeneralPresentations/8/
Version	Postprint in dissertation publication

3.2.1 Introduction

In the past, individual companies in mature industries differed only marginally, so their business models converged to an industry standard model (Staehler, 2001). The increasing market saturation as well as the trend towards niche markets, but eminent the diversity of business models enabled by the internet, induce more and more complex and differing business models. In these complex digital business structures and value networks cloud computing is perceived as a key technology and well-known business concept. Today, many newcomers in the IT market launch a cloud business and provide IT services on a cloud technology basis. Progressive vendors of traditional IT services extend their business and get their IT services ready for the cloud. Due to the character of cloud computing, the business model of a cloud service provider (CSP) will change (PAC, 2012; Pueschel *et al.*, 2009; Weinhardt *et al.*, 2009). For instance, by selling on-demand services the description of generating revenue has to be considered more explicitly in contrast to traditional goods and services. For this field of interest, we concentrate our research on the cloud provider's perspective and address the following research questions:

(1) What is an appropriate framework to analyze cloud providers' business models?

(2) Which common cloud business model patterns are successful?

(3) Which recommendations for cloud service providers can be derived?

Consequently, this paper's contribution is threefold: First, a structured business model framework is constructed based on a previous literature research. Afterwards, the business models of selected CSPs are analyzed and classified using this framework. Statistical methods determine promising patterns of combination. The patterns can be interpreted as typical characteristics of successful cloud business models. Finally, we draw conclusions and evaluate the analysis results regarding recommendations for action.

3.2.2 Theoretical Foundations

This research project examines an interdisciplinary topic and proceeds at the interface of business and computer science. For this purpose, the two combined topics cloud computing and business model theory will be introduced briefly.

Cloud Computing

In accordance with the cloud computing concept, scalable resources (e.g. networks, servers, storage, applications and services) can be rented on-demand via internet without the need for long-term capital expenditures and specific information technology (IT) knowledge on the customer side. It is possible to obtain virtual images of complete software applications or IT infrastructures. Cloud computing consists of three service layers, which are based on each other: “Software as a Service” (SaaS), “Platform as a Service” (PaaS), and “Infrastructure as a Service” (IaaS). Furthermore, cloud services can be implemented roughly as four provisioning models concerning the opening to a publicly accessible network (internet): public, hybrid, community, and private (Mell and Grance, 2009; Weinhardt *et al.*, 2009) (see Figure 22).

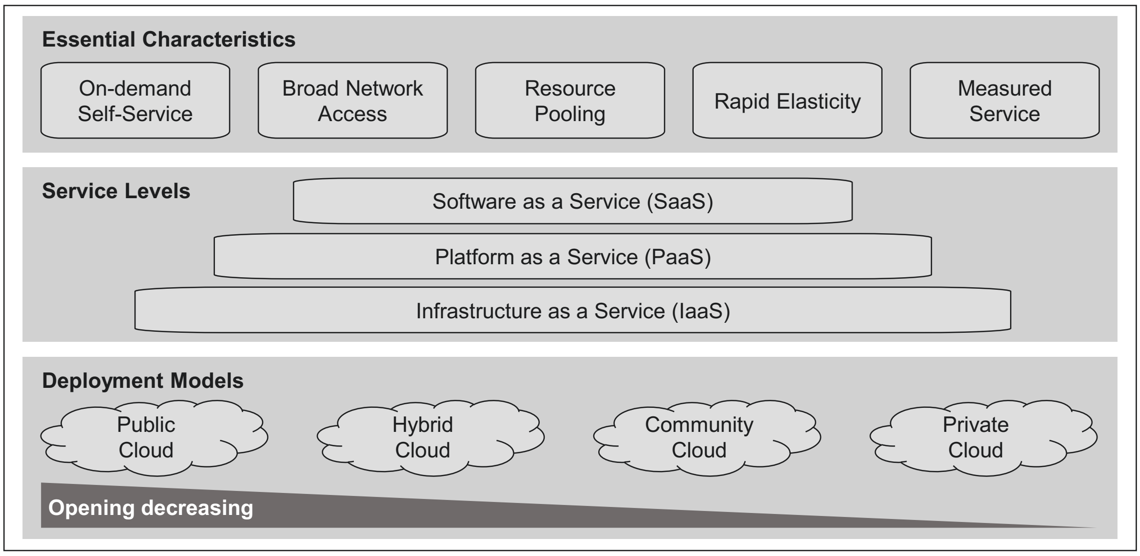


Figure 22: Cloud Computing Basics

Business Model

By its definition, every company has a business model. It is a model-based, i.e. simplified and aggregated, picture or description of a business – of “what a company is doing in order to create and commercialize value” (Burkhart *et al.*, 2011) (see also Osterwalder *et al.* (2010) or Wirtz (2010). The objective of a business model is to set a foundation for the following issues: understanding the appreciation of an existing business; recognizing own weaknesses to achieve the improvement of the business; and systematically evaluating new business ideas with their competitive advantages and success probabilities (Staehler, 2001).

The definition and conceptualization of a business model can be concretized in many ways. A widely accepted approach is still missing in science and practice (Alt and Zimmermann, 2001; Burkhart *et al.*, 2011; Popp and Meyer, 2010; Scheer *et al.*, 2003; Seppaenen and Maekinen, 2005; Weiner *et al.*, 2010; Wuestenhagen and Boehnke, 2006). Many researchers presented various definitions for the business model concept from different perspectives, often considering a component-based view. Bringing these definitions to a common denominator means to unify numerous varying components in a large number of different definitions. Miscellaneous classifications of these definitions are given by several researchers (Shafer *et al.*, 2005; Al-Debei *et al.*, 2008; Burkhart *et al.*, 2011; Zolnowski and Boehmann, 2011). Within previous research (Labes *et al.*, 2013b), we analyzed these classifications with up to 30 considered definitions. With respect to a comprehensive approach, we aggregated them again to the following business model components (see Figure 23, Labes *et al.* (2013b)), we will use as basis for the later analysis.

Following our comprehension, a company can have several business models for different business fields. Each business field has its own business strategy (in compliance with the corporate strategy) – in our case, it is the cloud business with the strategic orientation towards the cloud market. At the "Value Generation" side, internal capability factors, such as technologies, resources, skills and activities as well as an external supplier network are incorporated. The use of these factors results in costs. The centered "Value Proposition" defines the offering factors by describing the product and its unique selling proposition. The "Value Distribution" side comprises internal delivery aspects such as the communication or distribution channel, and external market factors such as targeted customer segments. The value capturing is described by the revenue block. These general components are the basis for the structured business model framework, which is used to analyze the cloud business models.

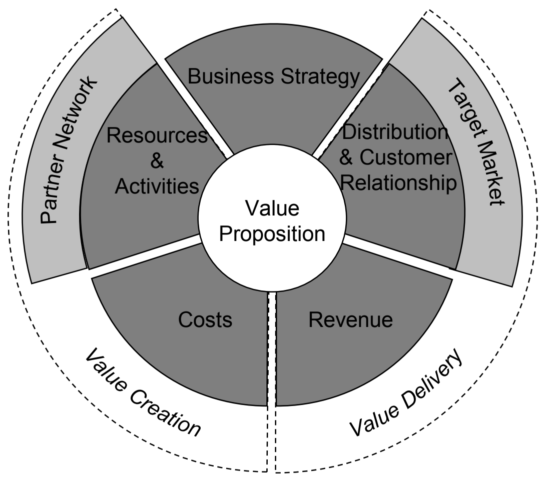


Figure 23: Business Model Components

3.2.3 Research Approach

This research applies a multi-method approach with theoretical and practical implications. The research work consists of two complementary parts: (1) the theoretical development of the business model framework as the basis for the analysis, and (2) the quantitative deduction of common patterns. While the first part is based on the design science discipline (Hevner *et al.*, 2004), the second part complements this with elements of the behavioral science paradigm (Kaplan, 1964).

In the theoretical part, the method of reference modeling (Wilde and Hess, 2007) is used, to combine deductive and inductive elements in order to build a design outline for the business model template. In previous research, a comprehensive literature analysis about cloud computing and business models (Labes *et al.*, 2013b) present the deductive basis for this framework. With reflection of existing cloud business models, the framework is completed with design features inductively. In addition, the framework has been evaluated in interviews with academic cloud experts and discussed in two workshops with IT practitioners. The resulting morphological box is used as analysis basis for the second research part (see Figure 24).

The practical part of the research is the quantitative evaluation in form of a cross-sectional analysis (Wilde and Hess, 2007) of existing cloud business models. Meanwhile, there exist hundreds and thousands of cloud business models on the global cloud market. For the initial analysis, internet rankings of cloud services were considered to determine well-known CSPs. 29 service providers with their cloud business model were selected. Every examined business model is analyzed using the morphological box. The characteristics of the design features are encoded using a dual control principle. Finally, the coded business models are processed with statistical methods that reveal common patterns in cloud business models (see Figure 24).

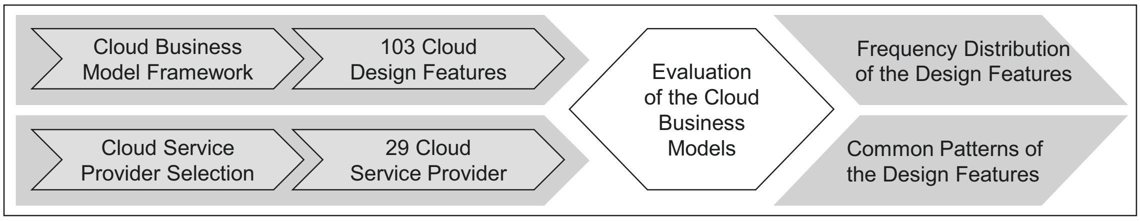


Figure 24: Research Approach

Cloud Business Model Framework

As a foundation to conduct the business model study we present the structured business model framework, classified as a morphological box (see Figure 25). The categories are the basic components of a business model, as they are introduced in the theoretical foundations. The sub-categories and design features are the result of previous research (Labes *et al.*, 2013b) as well as various discussions and workshops with cloud academic cloud experts and related IT service providers. The design features in the morphological box show the possible options to "assemble" a business model. A detailed explanation for each of these business model characteristics is given in Annex (see Table 29).

» **Business Strategy**: This component deals with the strategic alignment and goals of a business (Shafer *et al.*, 2005), in our case the cloud business. IT service vendors "employ different strategies to leverage and shape the formation and evolution of the global cloud computing market in a highly entrepreneurial fashion" (Su, 2011). Four categories of cloud strategies were determined in the literature: (1) Market adaption as a strategy of a single company which adapts to the cloud market; (2) Market design, a strategy for a single company which forms the cloud market with new institutional arrangements; (3) Market diffusion as a strategy for the inter-organizational field adapting the market; and (4) Market co-construction,

Category		Sub-Category	Design Feature							
Business Strategy		Market strategy	Market adaption	Market design	Market diffusion	Market co-construction				
		Market entry	New in market	Market expansion	Knowhow transfer					
		Diversification	Horizontal	Vertical	Lateral					
Value Proposition		Core product („as a Service“)	Storage service	Computing service	Network service	Development environment	Develop-ment tool	Software service	Business process	
		Product system (PS)	Database service	Search service	Billing service	Messaging service	Data processing	Adminis-tration	Market place	
		PS width	Manifold width	Limited width						
		PS depth	Manifold depth	Limited depth						
		Add. services	Integration service	Consulting service	Human resource	Individual Support				
		Provisioning model	Private	Community	Hybrid	Public				
		Emotional cust. experience	Consoli-dation	Structu-ring	Standar-dization	Flexibility	Scalability	Cost savings	Time savings	Sustain-ability
Value Creation	Partner Network	Cooperation intensity	Ecosystem	Strategic alliance	Loose cooperation	Purchase				
		Partner type	Technology	Business	Consulting					
		Business field	Complementary	Similar	Substitutive					
	Resources & Activities	Resources	Hardware resource	Software resource	Network resource	Data / content	Knowhow resource	Human resource		
		Activities	Production activities	Aggregation activities	Aggregation with Add-on	Comparison & Categorization	Integration activities	Consulting activities		
	Costs	Primary costs	Initial costs	Fix operational costs	Variable operat. costs					
Value Delivery	Target Market	Market focus	Mass market	Branch market	Niche market					
		Customer focus	Major enterprises	SME	Start-ups	Public sector	Consumer			
	Distribution & Customer Relation-ship	Communic. channel	Internet connection	Telephone line	Print media	Personal interaction				
		Distr. channel	Web interface	Mobile	On-site					
		Customer relationship	Self service	Online profile	Community	Support	Monitoring	Transparent SLA		
	Revenue	Primary rev.	Main service	Supplementary service						
		Customer payment	One-time charge	Subscription	Reser-vation	Pay-per-Use	Spot	Free		
		Partner payment	Sponsoring	Advertising	Commission	Share of turnover	Membership			

Figure 25: Cloud Business Model Framework

also for the inter-organizational purpose, but shaping the market with a mobilized set of actors (Su, 2011). Other characteristics for the strategy block are the qualification for the cloud market entry and how the cloud business is related to current or previous business activities.

» **Value Proposition**: The value proposition is an integrated service system to fulfill the customer's needs. Following the approach of Belz (1997), a service system consists of seven levels, from the core product up to individual emotional customer experience. We modified this approach properly to cloud business models, used them as sub-categories, and assembled the sub-categories with concrete design features. The core product or service of a cloud business is integrated in a cloud product system. The range of this product system is considered in width (entire spectrum of the services) as well as in depth (variety of services with the same focus). Additional services complete the cloud service. The cloud service can be provisioned in the four basic deployment models (see theoretical foundations of cloud computing). The integrated service system focuses on different emotional customer experiences.

» **Value Creation**: In the cloud business, diverse CSPs are integrated in a partner value network (Leimeister *et al.*, 2010). The partner network can be described by the intensity of cooperation between the business and the partners. These partners complement the existing knowhow and resources in different business fields and value chain levels to extend the product portfolio or to ensure the availability, quality, and scalability of a cloud service. To create the value proposition, some typical cloud resources are processed with cloud specific value activities. The cloud service can be an own production completely or is built by aggregating existing services, possibly extended by an own add-on. Furthermore, the cloud service can consist of comparing and categorizing activities, integration assistance or consulting services (Jeffery *et al.*, 2010). Finally, the value creation and value proposition elements result in costs. In the cloud value network, costs are shifting from classical fixed to usage-dependent costs and require a consideration of the total cost of ownership (Li *et al.*, 2009; Mach and Schikuta, 2011).

» **Value Delivery**: Studies reveal that a precise selection of consumers and appropriate pricing can gain higher revenue (Anandasivam and Premm, 2009). The target market can be divided in the general market focus (Porter, 1998) and the specific customer focus with five identified options. The channels are the interface to the target market and can be distinguished into standardized network-based and traditional used for individual assistance. Since Web 2.0, customers are often part of the value creation (O'Reilly, 2007); therefore the customer relationship should be empowered (Clark, 2010). To maintain the customer relationship, various features for cloud customers are provided to increase the trust in the cloud provider. By delivering the value proposition, revenue streams can be generated based on the core product and service or with by-products and supplementary services. Revenue possibilities in the cloud are diverse; we distinguish between a direct customer-based and an indirect partner-based payment model. This distinction enables e.g. free services for the customer and profit for the provider.

Cloud Service Provider Selection

The huge variety of CSPs implicates the need for a selection of providers. For this purpose, we prioritize which CSPs we want to analyze first. This selection is based on a structured process, with worldwide CSP rankings. The first step is the evaluation of existing CSP rankings, based on internet search. In the second step, the 17 determined rankings (see Table 8) with 123 named CSPs are collected in one worksheet to give an overview of the ranking points for each named CSP.

In the third step, an average ranking point (ARP) is calculated for each CSP. For equalization and reduction reasons, only CSPs with two or more references were considered. This leads to 29 resulting CSPs with ARPs from 1.38 to 13.50, portrayed in the ranked table (see

Table 9). To give an overview, the offered cloud services of the CSPs are described briefly in the same table.

Table 8: Cloud Service Provider Rankings

No.	Ranking	Year	Posi-tions	Source
1	SearchCloudComputing	2012	10	http://searchcloudcomputing.techtarget.com/photostory/2240149039/Top-10-cloud-providers-of-2012
2	BTC Logic Infrastructure	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
3	BTC Logic Foundation	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
4	BTC Logic Platform	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
5	BTC Logic Network	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
6	BTC Logic Applications	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
7	BTC Logic Security	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
8	BTC Logic Management	2010	10	http://www.btclogic.com/documents/BTCLogic_TopTen_Q12010.pdf
9	Cloudreviews Cloud Storage	2012	10	http://www.cloudreviews.com/top-10-cloud-storage.html
10	Cloudreviews Cloud Apps	2012	10	http://www.cloudreviews.com/top-10-cloud-apps.html
11	Cloudreviews Cloud Hosting	2012	10	http://www.cloudreviews.com/top-10-cloud-hosting-services.html
12	HostMonk Hosting	2013-02	13	http://www.hostmonk.com/ranks/popularity/cloud
13	Cloud Directory Cloud Hosting	2013-02	20	http://www.clouddir.com/mostpopular/
14	Talkincloud Cloud Service Provider	2012	20	http://talkincloud.com/tc100
15	Convios Study - private user Germany	2012	10	http://web.de/presse/img/media/5d616dd38211ebb5d6ec52986674b6e4.pdf
16	Cloudhostingreviewer Cloud Hosting	2012	4	http://www.cloudhostingreviewer.com/
17	Forrester Private Cloud Vendors	2011	10	http://platformcomputing.blogspot.de/2011/05/

For each CSP a web-based analysis of the CSP's business model is conducted. This analysis includes the intensive browsing of the CSP's homepage as well as further web, press release, and news search with focus on the particular business model. Along the business model components, the characteristics of each CSP's business model are documented in one table. This table bases on the cloud business model framework and provides all design features (103 in number) as rows in the table. With "0" (= not applicable) and "1" (= applicable) it is documented in the columns which design features are implemented in each of the 29 business models. The characteristics are not exclusively in one design feature, various characteristics are possible in parallel. Some characteristics, i.e. the partner payment model, are not comprehensively observable in the search process, which are compensated with estimations. All "0"s and "1"s in this table (103 x 29 data size) are the basis for the statistical evaluation in the next section.

Table 9: Cloud Service Provider Selection

No.	CSP	Description	ARP	Ref.
1	Amazon	Huge product range of cloud infrastructure, administration, and application services (Amazon Web Services - AWS)	1.38	8
2	Dropbox	Web service for data synchronization and online data storage	3.00	2
3	Salesforce	Cloud software (CRM) and platform services, incl. a market place	3.00	4
4	RackSpace	Set of modular and open source based cloud infrastructure and administration services	3.44	9
5	IBM	Integrated solutions for Infrastructure, platform and administration services and consulting	3.71	7
6	Cisco	Tailor-made integrated infrastructure and collaboration cloud software services	4.00	2
7	CenturyLink / Savvis	Specific cloud hosting solutions	4.33	3
8	1&1	Dynamic cloud hosting packages	4.50	2
9	Oracle	Comprehensive set of cloud services, with communication/booking only via telephone	4.60	5
10	FireHost	Managed cloud hosting with focus on security	5.00	2
11	Joyent	Small portfolio of IaaS services with reference to complementary partner solutions	5.00	2
12	AT&T	Huge cloud service portfolio for business customers (IaaS, PaaS, SaaS, virtual desktops)	5.50	2
13	Citrix	Interoperable comprehensive SaaS solutions based on VMware	5.50	2
14	NetSuite	Cloud software (ERP), platform and infrastructure applications, incl. a market place	5.50	2
15	SingleHOP	IaaS, PaaS with scalable hosting and user-friendly mobile management applications	5.50	2
16	VMware	Market leader in virtualization, offering PaaS solutions and administration applications	5.50	4
17	EMC	Wide-ranging cloud product portfolio with distribution via partners	5.67	3
18	Google	Comprehensive but flat set of cloud infrastructure, platform and software services	5.80	5
19	Softlayer	Scalable cloud hosting	6.00	3
20	SugarSync	Web service for data synchronization and online data storage	6.00	2
21	GoGrid	Small product spectrum of IaaS services with a variety of partner programs	6.25	4
22	HP	Storage and platform service, virtual private cloud solution	6.50	4
23	Microsoft	Comprehensive cloud portfolio for private (SaaS) and business (PaaS, SaaS) customers	6.57	7
24	CA Technologies	Cloud integration solutions, administration applications and SaaS	7.00	2
25	Eucalyptus	AWS compatible IaaS with resource localization	7.50	2
26	Verizon/ Terremark	IaaS and individual business-specific integrated solutions	8.00	3
27	Enomaly	Private cloud hosting, virtual desktops and a spot cloud market for unused capacity	8.50	2
28	LayeredTech	Private cloud hosting	10.00	2
29	Hexagrid Computing	Intransparent cloud portfolio, promised IaaS cloud platform	13.50	2

3.2.4 Evaluation of the Cloud Business Models

Based on the results of the previous section, statistical procedures are conducted to evaluate the findings. In this statistical analysis, we present the frequency distribution of the design features in cloud business models and determine common patterns in the business models of CSPs.

Frequency Distribution of the Design Features

First, we consider the frequency distribution of the results and remark conspicuous frequency distances between alternative design features in the same sub-category.

» **Business Strategy** (see Figure 26): In the sub-categories of the business strategy, we notice that an inter-organizational market strategy is completely underrepresented. Market adaption and market design is nearly equal frequented. Among ranked and well-known CSPs, new cloud market entrants are as rare as a lateral business model diversification to cloud business. The most providers follow the cloud hype and expand their established business models on a horizontal level with already existing knowhow.

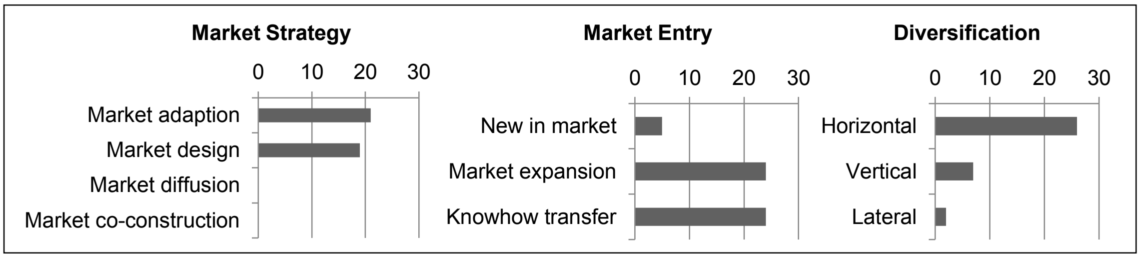


Figure 26: Frequency Distribution of Design Features in the Business Strategy

» **Value Proposition** (see Figure 27): The main core product of the ranked CSPs is balanced except "Business Process as a Service" (BPaaS). While storage, computing power, development environments, development tools, and software are frequently represented, BPaaS is a side issue. The product system supplements the core product primarily with administration, data processing, and marketing opportunities. The product system width and depth is slightly emphasized on a manifold range towards a limited range. As an additional service, the support is part of every cloud business model, while physical human supporters are rare. Public cloud services are ahead of the private and hybrid provisioning model, whereas community clouds are underrepresented. The promised customer experiences are primarily scalability as well as cost and time savings. Sustainability with regard to cloud services is rarely mentioned and therefore questionable.

» **Value Creation** (see Figure 28): In cloud businesses, the partner network is pronounced. Ecosystems, strategic alliances, and loose cooperation are almost equal in the amount. Partner relationships are maintained primarily to technology partners in similar or complementary business fields. In most cases of the ranked CSPs, the resources to create value are hardware, software, and knowhow. Besides, the value is created through in-house production of the service and partly complemented with consulting and integration services. Providing comparisons

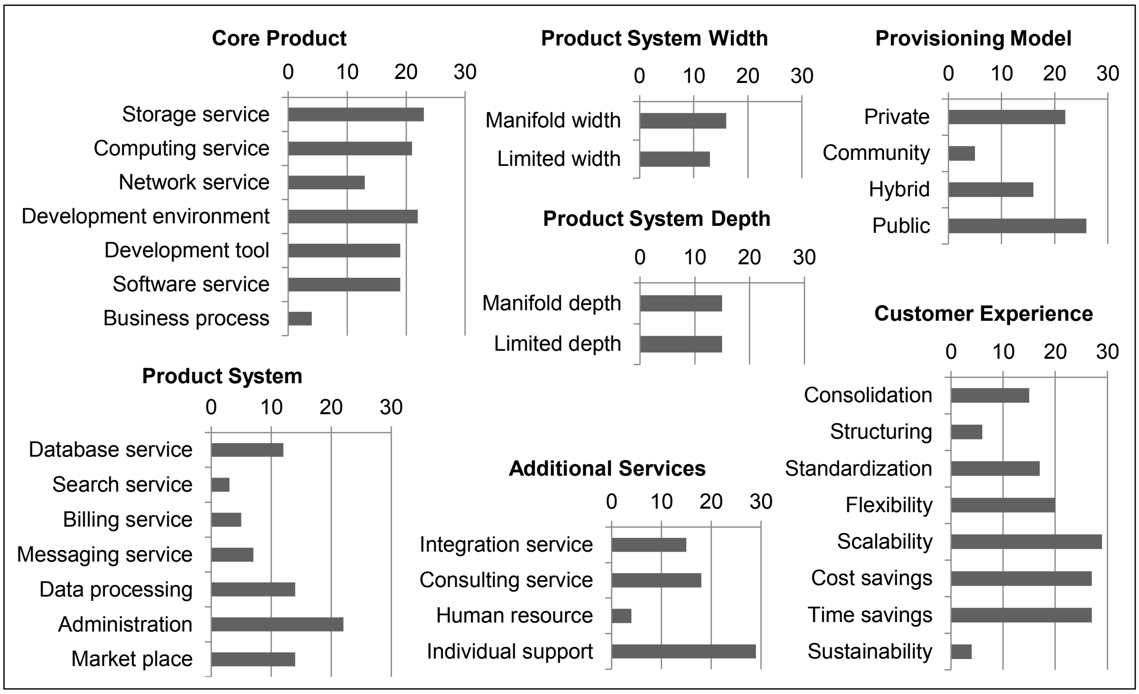


Figure 27: Frequency Distribution of Design Features in the Value Proposition

and categorizations of cloud services seems not to be a recognized provider type and is rarely represented within the ranked CSPs. Due to the existing knowhow and business expansions, primary costs are almost never initial costs and tend to be variable operational costs, partially mixed with fix variable costs.

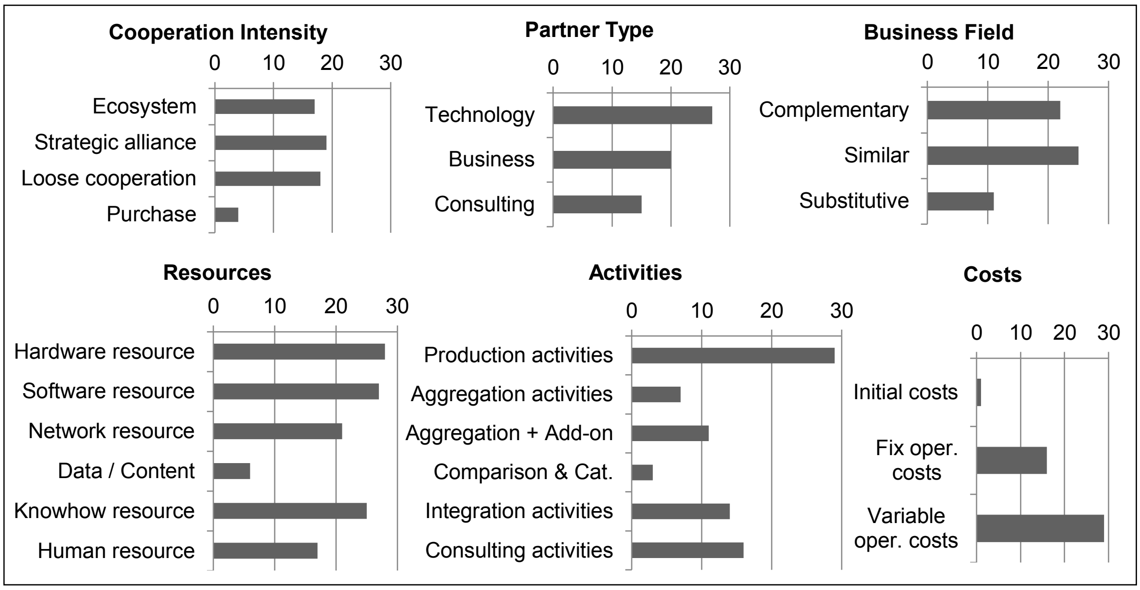


Figure 28: Frequency Distribution of Design Features in the Value Creation

» **Value Delivery** (see Figure 29): The target market focus is on mass and branch markets, whereby primarily small and medium-sized enterprises (SME) are addressed. The considered cloud services are of less relevance for niche markets and the public sector or consumers. To get in touch with the customer, the communication and distribution channel is mainly the internet and via telephone communication or mobile distribution. Traditional channels are underrepresented in communication and distribution. The customer relationship is strongly pronounced. In general, the revenue of the ranked CSPs is generated by the main service. Revenue streams are skimmed primarily in a subscriptions and pay-per-use manner, a partner payment model is used rarely.

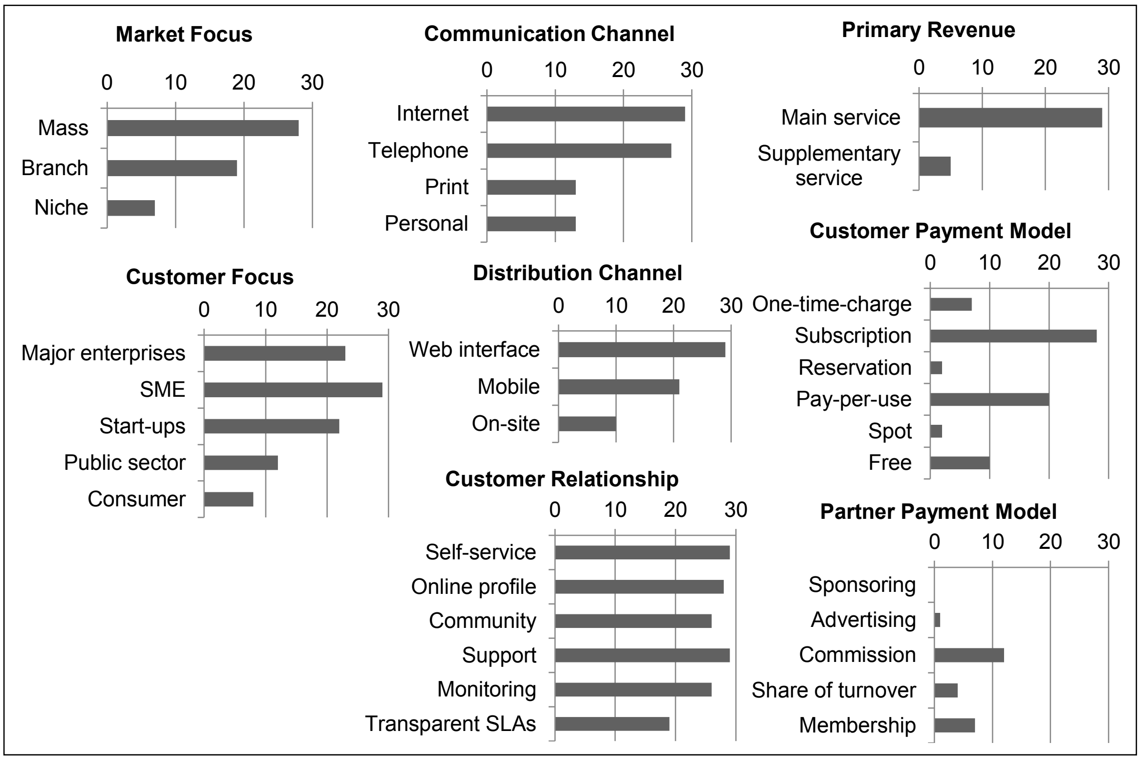


Figure 29: Frequency Distribution of Design Features in the Value Delivery

Common Patterns of the Design Features

In the second step, we perform a cluster analysis to discover patterns in the business model components. A cluster analysis is a method to determine unknown correlations in a data pool and helps to group similar data into clusters. In the ideal case, the clusters are internal homogeneous and external heterogeneous (Anderberg, 1973). The grouping can base on similarity or distance measure; for an ordinal scale level ("0" = not applicable, "1" = applicable) a similarity measure is more suitable (Bacher *et al.*, 2010). To find an optimum of clusters, an agglomerative hierarchical clustering method is chosen. This method starts with one data in one cluster and is grouping the clusters systematically according to their similarity until they belong to one route cluster. The agglomerative hierarchical clustering analysis (with linkage between the groups and squared Euclidean distance scale) is applied to the 103 design features with their characteristics in the 29 analyzed business models. A dendogram (see Annex, Figure 67) shows the clustering process (abscissa) for the design features (ordinate) and serves as a basis for defining the number of clusters. Hence, we identify the number of clusters by visual examination and decide to group the design features into four clusters (cluster distance of 17.5). The biggest one is the cluster 4 with 43% of the design features, followed by cluster 3 and 1 with 31% and 22%. The cluster 2 is underrepresented with 4%. By analyzing the clusters, it seems well planned that they differ regarding the absolute frequency of the applicable design features. Cluster 1 includes design features with an average of about five absolute listings, cluster 2 has about eleven, cluster 3 has about 16, and cluster 4 has an average of 25 listings (see Figure 30). This fact leads to the derivation that typical cloud business model design features exist, primarily collected in cluster 4, and some untypical design features, grouped in cluster 1 and 2.

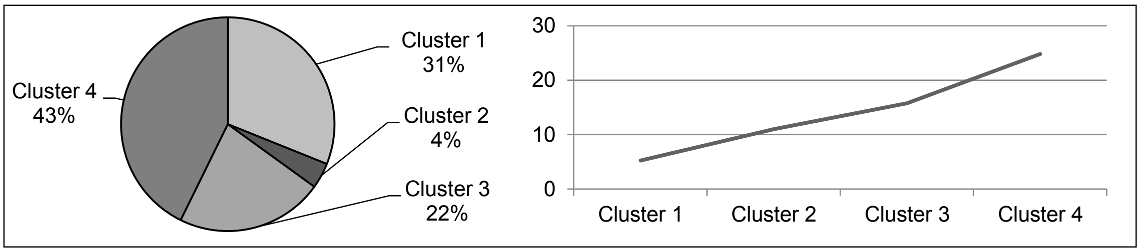


Figure 30: Frequency and Clusters of Design Features in the Business Models

To finish the analysis, the following bullet points explain the four identified clusters. Abstracting the descriptions of the clusters, common patterns of business models can be derived (see Figure 31).

» **Cluster 1**: This cluster includes primarily less frequently listed design features. These design features describe providers in the inter-organizational field with a vertical lateral diversification strategy. The value proposition consists of network services or BPaaS with search, billing or messaging services and additional human resource services. Structuring or sustainability is the promised customer experience and no partner relationships are maintained. Moreover, content is the resource, processed with aggregating or comparing activities, producing initial costs. Niche markets for the public sector or customers are addressed via a traditional on-site distribution channel. The revenue is generated with supplementary services and results from customer payment (without subscription and pay-per-use) or a partner payment model. Within the analyzed CSPs no provider exclusively fits into this cluster.

» **Cluster 2**: The second cluster is the smallest one. It describes newcomers in the cloud market with a limited range in the product system width and depth, generating the value proposition by aggregating other cloud services and complementing them with an add-on.

» **Cluster 3**: This cluster comprises primarily average applied design features. Providers offer development environments and tools or cloud applications in a product system with databases and data processing as well as a market place to publish services and applications for sale or rent. The product system's width and depth is manifold, additionally extended with integration and consulting services. Provisioned with a hybrid deployment model, the customer consolidation and standardization values were addressed. An ecosystem partnership with primarily consulting partners in substitutive business fields is maintained. Creating the value, especially human resources act with integrating and consulting activities and cause fix operational costs. The services are finally distributed to branch markets via traditional communication channels.

» **Cluster 4**: The biggest cluster includes primarily high frequently listed design features. CSPs adopt the cloud trend and tend to design the cloud market. They expand their business with a horizontal diversification and benefit from the knowhow transfer. The core product or service is mainly IaaS with administration and support service, provided in public or private clouds to ensure flexibility, scalability, as well as cost and time savings for the customer. A strategic coupled or loose linked partner network is maintained with technology and business partners in complementary or similar business fields. With hardware, software, network, and knowhow resources, the cloud service is produced and primarily results in variable operational costs. Focusing on the mass market, major enterprises, SMEs and start-ups are addressed. The communication and distribution is conducted via modern and internet-based channels, supported by comprehensive customer relationship maintenance (self-service, online profile, community, support, monitoring possibilities, and transparent SLAs). The revenue of the cloud service is earned with the main service via a direct customer-based subscription or pay-per-use pricing model.

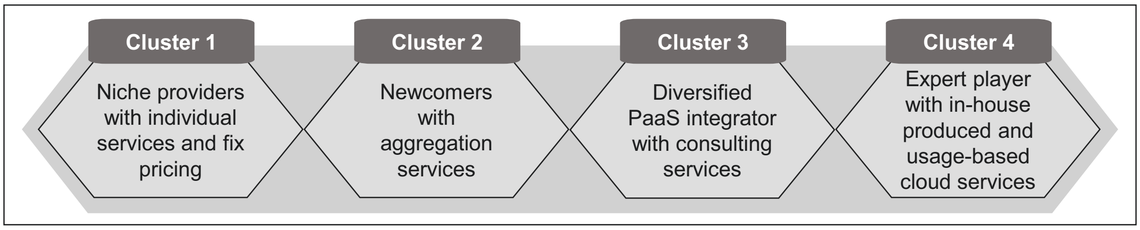


Figure 31: Common Patterns in Cloud Business Models

3.2.5 Discussion and Conclusion

The purpose of our article was the analysis of cloud business models and the identification of common business model patterns in the cloud business. Therefore, we introduced a business model framework as a basis for the analysis and evaluated the business models of 29 deliberately selected CSPs to answer the research questions. The analysis revealed four common patterns in the cloud business models. The first cluster is underrepresented within the analyzed CSPs and do not seem to describe cloud characteristics in particular. Amazon is applicable to the most characteristics of this cluster, but only as an extension to a higher fit with cluster 3 and 4. Dropbox, Salesforce, and Eucalyptus have the best fit to the second cluster. The most providers, such as HP or Cisco, occupy the third cluster in combination with many characteristics in cluster 4 only. The CSP with a large number of characteristics in the third cluster and the highest distance from other clusters is EMC. Cluster 4 is the most frequently represented arrangement of characteristics, often in combination with the third cluster. Providers, such as Softlayer and 1&1, fit into this cluster and have the highest distance from other clusters.

The analyzed CSPs for the cluster creation are well known and ranked in various cloud provider rankings; therefore, the clusters seem to be a favorable recipe for success. Following this, we considered how traditional service providers match with these cloud business model clusters and can succeed in the cloud market. The following recommendations for action for IT service providers, that want to exploit the cloud market, were derived:

- **Cluster 1** – Niche providers with individual services and fix pricing: IT service providers which does not hold own hardware, software or knowhow resources to transform them into standardized cloud services, are rather not yet able to keep up with the competition in the cloud market. They should concentrate on individual services in niche markets that will see no advantages in a cloud operation.
- **Cluster 2** – Newcomers with aggregation services: Newcomers in the cloud market can benefit from the standardized and interoperable cloud services and should concentrate on aggregating existing cloud services, extended by an additional feature.
- **Cluster 3** – Diversified PaaS integrator with consulting services: Experienced players should use their knowhow to enable other emerging IT service provider in the cloud business, by focusing on integrating and consulting services.
- **Cluster 4** – Experienced player with in-house produced and usage-based cloud services: Expert IT service providers, hosting own standardized hard- and software resources, can profit from economies of scale when providing on-demand cloud infrastructure services to the mass market.

Within the research evaluation, we uncover several gaps for future research options. Community clouds, in terms of inter-organizational cooperation of cloud providers, are clearly underrepresented. Likewise, partner payment models are not represented in practice and could be investigated in further research. Sustainability, as a benefit of cloud computing, cannot be confirmed as a key promise of CSPs and is questionable.

In further research, we will conduct a second cluster analysis grouping the CSPs. In this context, more characteristics of the CSPs can be mentioned, such as the size, the legal form, or the average ranking point, to compare the providers with the identified clusters.

However, some limitations and drawbacks of our paper have to be reflected. Considering multiple rankings by the same organization, we take the risk of an unintentional ranking weight. In addition, the design features are not independent of one another, which influences the cluster analysis. Finally, a comprehensive success factor analysis has to be conducted more complex and should contrast between ranked and not ranked CSPs.

3.3 Success Factors in Cloud Business Models

Table 10: Details of Publication No. 3.3

Title	**Success Factors of Cloud Business Models**
Authors	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	Proceedings of the European Conference on Information Systems (ECIS 2015)
Abstract	The acceleration of the technical change in the fast moving electronic market increases the uncertainty and risk of IT providers. This development seeks for stable guidelines and success factors for new and existing business models. Within our research, we conducted an intensive analysis of 45 providers on the cloud market regarding recipes for success. We systemized their business models with the help of a cloud business model framework and analyzed them statistically. We revealed 39 success-driving business model characteristics that emphasize product related success factors, a high vertical integration as well as the charging and costs dimension. Finally, we discussed the prediction for success of cloud business models. Until now, experienced market players have the most successful business models, while small newcomers have difficulties to compete.
Keywords	Cloud computing, business model, success factors, success indicators, qualitative content analysis
Link	http://aisel.aisnet.org/ecis2015_cr/114/
Version	Postprint in dissertation publication

3.3.1 Introduction

Since the beginning of the new digital economy (Cohen *et al.*, 2000; Gordon, 2000) in the late 90s, the business model concept became more significant, not only in practice but also in academic research (see e.g. the temporal distribution of publications for the search item “business model” in the AIS electronic library). The drivers of this development are firstly the increased performance of the information and communication technology (ICT) (Cohen *et al.*, 2000; Gordon, 2000), especially regarding the data processing and the data transmission (Staehler, 2002). Second, the internet as enabler for interactivity, ubiquity, multimediality, and distribution penetrates the economy and society faster than other mass media (Cohen *et al.*, 2000; Zerdick *et al.*, 2001).

The business model concept arises as an analysis unit that takes the new conditions into account (Staehler, 2002). The objective of a business model is to set a foundation for the following issues: understanding the appreciation of an existing business; recognizing own weaknesses to achieve the improvement of the business; and systematically evaluating new business ideas with their competitive advantages and success probabilities (Staehler, 2002). The most definitions use a component-based approach that abstracts the description of a business – of “what a company is doing in order to create and commercialize value” (Burkhart *et al.*, 2011) (see also (Osterwalder *et al.*, 2010; Wirtz, 2010)). Although a high number of academics analyze this concept, a common definition of the business model term is missing until now (Zott *et al.*, 2011; Lambert and Davidson, 2013).

With the acceleration of the technical change in the ICT and the diffusion of ICT products, there grow uncertainty and risks with new business models. Forecasts or long-term technology plans are limited, thus investments are fraught with higher risks (Bettis and Hitt, 1995). An very actual hype wave and representative example of these fast developing business models, is the cloud computing focus (Gartner, 2013c). With this business concept, providers offer freely scalable IT resources (e.g. servers, storage, applications, or network resources) in an on-demand manner via networks (intranet or internet) and receive usage-based revenue streams (Mell and Grance, 2011; Weinhardt *et al.*, 2009). With its high standardization and hierarchical structure, cloud services are able to build on one another. This induces the diversity and complexity of the cloud market and seeks for a reliable prediction for success.

Within our actual research, we used the business model concept as analysis unit for the analysis of success-driving factors and referred to a structured and detailed cloud business model framework from our previous research (Labes *et al.*, 2013a). We addressed the given need with the following research questions:

(1) What business model characteristics drive the success of cloud firms?

(2) How do the success-related characteristics operationalize given success factors from the literature?

Answering the questions, we analyzed the related work of success factors for business models. Then, we conducted a comprehensive study of 45 cloud firms to analyze their business models regarding success-driving characteristics. We discussed the literature-based success factors regarding the revealed successful characteristics and concluded with advices for the development of a cloud business and the prediction of success.

3.3.2 Related Work

Success factors are defined as “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization” (Rockart, 1979). The research on success factors is traceable to the 60s but the distinct research on successful business models is rare. An important research that focuses on success factors is the PIMS (Profit Impact of Marketing Strategies) study. Within this study, Schoeffler (1974) analyzed business data from 3000 business units (450 member companies of the strategic planning institute (SPI), all branches, average values over many years) and derived seven strategic factors that drive success. In 1979, Rockart mentioned critical success factors for businesses the first time (Rockart, 1979) and conducted interviews with CEOs to detect reliable factors for their corporate success (Rockart, 1982). Further, Peters and Waterman (1982) analyzed 43 of Fortune 500's top performing companies and derived eight themes that are essential for successful firms. Leidecker and Bruno (1984) proposed three levels of a critical success factor analysis with eight identification techniques. They applied those techniques and revealed success factors for specific industries as well as for different companies. Brentani (1991) analyzed generic success factors for new business services, as we can consider cloud services today.

Besides the general success factor research, some authors specifically focus on the cloud business. A survey among CIOs revealed general success factors of cloud services (CIO, 2008). Horsti et al. (2004) conducted a case study research and differentiated critical success factors and customer need factors for different maturity stages of an electronic business. A few authors developed success factors of the SaaS business, e.g. Ernst and Rothlauf (2012) revealed seven critical success factors from a literature-based argumentative study. Also Walther et al. (2012) conducted a literature-based research and derived 12 success factors for SaaS. The derived factors of both publications describe very fundamental aspects that should be basic for other service models such as PaaS and IaaS as well (CIO, 2008).

We find many overlaps between the mentioned success factors in the general and the cloud specific literature (see Table 11). This induces the assumption that some generic success factors are valid even for cloud businesses but need specific supplements. To clarify and operationalize these demands, we will compare the success factors with our analysis results.

Table 11: Critical Success Factors for General and Cloud Businesses

No.	Critical success factors	Generic focus					Specific electronic or cloud business focus			
		(Schoeffler *et al.*, 1974)	(Rockart, 1982)	(Peters and Waterman, 1982)	(Leidecker and Bruno, 1984)	(Brentani, 1991)	(CIO, 2008)	(Horsti *et al.*, 2004)	(Ernst and Rothlauf, 2012)	(Walther *et al.*, 2012)
1	Product portfolio / quality	x	x		x	x	x	x	x	x
2	Employees / productivity	x	x	x	x			x	x	
3	Innovation / differentiation	x		x	x	x		x	x	x
4	Availability / reliable infrastructure						x	x		x
5	Communication / SLAs / image		x		x			x	x	
6	Customer interaction / care / customness			x	x	x	x	x		
7	Knowhow / technology skills			x	x	x		x	x	
8	Vertical integration (universal or lean)	x		x				x		
9	Partner network				x			x	x	
10	Flexibility / reversion						x			x
11	Interoperability / implementation						x			x
12	Security / privacy / data control						x			x
13	Charging / cost savings / synergies				x	x	x			x
14	Flexible governance		x	x						
15	Investment intensity / capital	x			x				x	
16	Active decision making / management commitment		x	x		x				
17	Market position / growth / competitiveness	x				x				
18	Market attractiveness / segment adjustment					x				

3.3.3 Research Approach

Within our research, we used a positivistic approach (Myers, 1997) to exploratory increase the understanding and predicting of the business success. Osterwalder (2004) created a business model ontology that helps structuring a business model but it "is not a guarantee for success as it has to be implemented and managed". Veit et al. (2014) confirmed this with their research agenda for business models that emphasized the IT support for the successful development of a business models. We followed this idea and conducted an intensive study of 45 cloud providers and their business models.

We followed a mixed method approach and developed a strategy regarding a research design and data analysis for a comprehensive developmental purpose (Venkatesh *et al.*, 2013). The mixed method is a qualitative content analysis with an inductive formation of categories and data followed by a statistical evaluation of the data (Mayring, 2004).

Within the data generation part, we based our investigations on the existing cloud business model framework (see Figure 32) from previous research (Labes *et al.*, 2013a). A detailed description for each of the 105 business model characteristic is given in the Annex (see Table 29).

Category	Sub-Category		Design Feature									
Business Strategy		Market strategy	Market adaption	Market design	Market diffusion	Market co-construction						
		Market entry	New in market	Market expansion	Knowhow transfer							
		Diversification	Horizontal diversification	Vertical diversification	Lateral diversification							
Value Proposition		Core product („as a Service“)	Storage service	Computing service	Network service	Development environment	Development tool	Software service	Business process			
		Product system (PS)	Database service	Search service	Billing service	Messaging service	Data processing	Administration	Market place			
		PS width	Manifold width	Limited width								
		PS depth	Manifold depth	Limited depth								
		Add. services	Integration service	Consulting service	Human resource	Individual Support						
		Provisioning model	Private cloud	Community cloud	Hybrid cloud	Public cloud						
		Emotional cust. experience	Consolidation	Structuring	Standardization	Flexibility	Scalability	Cost savings	Time savings	Sustainability	Customization	Security
Value Creation	Partner Network	Cooperation intensity	Ecosystem	Strategic alliance	Loose cooperation	Purchase						
		Partner type	Technology partners	Business partners	Consulting partners							
		Business field	Complementary field	Similar field	Substitutive field							
	Resources & Activities	Resources	Hardware resource	Software resource	Network resource	Data / content	Knowhow resource	Human resource				
		Activities	Production activities	Aggregation activities	Aggregation with Add-on	Comparison & Categorization	Integration activities	Consulting activities				
	Costs	Primary costs	Initial costs	Fix operational costs	Variable operat. costs							
Value Delivery	Target Market	Market focus	Mass market	Branch market	Niche market							
		Customer focus	Major enterprises	SME	Start-ups	Public sector	Consumer					
	Distribution & Customer Relationship	Communic. channel	Internet connection	Telephone line	Print media	Personal interaction						
		Distr. channel	Web interface	Mobile interface	On-site interaction							
		Customer relationship	Self service	Online profile	Community	Support	Monitoring	Transparent SLA				
	Revenue	Primary rev.	Main service	Supplementary service								
		Customer payment	One-time charge	Subscription	Reservation	Pay-per-Use	Spot	Free				
		Partner payment	Sponsoring	Advertising	Commission	Share of turnover	Membership					

Figure 32: Cloud Business Model Framework

It is classified as a morphological box where the categories represent the basic components of a business model, as they are introduced earlier. The sub-categories and design features are the result of various discussions and workshops with academic cloud experts and related IT service providers. The design features in the morphological box show the possible options to "assemble" a business model.

We used this framework to analyze the business models of 45 cloud providers or its separated cloud division in case of a wider product portfolio. In doing so, we comprehensively reviewed the company's websites, encyclopedia items, blogs, and news feeds to obtain the empirical data. Two researchers reviewed the information in three cycles from January to July 2014 and filled the information in a table aligned with the characteristics to produce a detailed profile for each cloud business model. Some characteristics, i.e. the partner payment model, are not comprehensively observable in the search process, which are compensated with estimations.

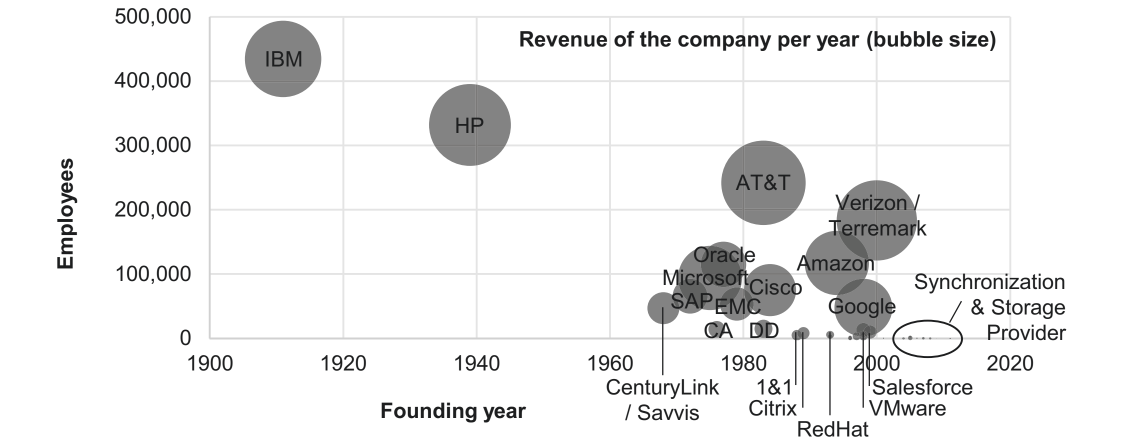
To enable comparable results, we converted the collected material into measurable data by rating the business model characteristics regarding their implementation in the business model (0 = "not represented", 1 = "represented", 2 = "strongly represented"). We continuously discussed and reviewed the assessments with each other to verify the coding consistency (Thomas, 2006). The final summarizing table containing "0"s, "1"s, and "2"s (105 x 45 data size) is the basis for the statistical analysis.

Within the data analysis part, we derived concrete characteristics of a business model that drive the success of a firm. To identify these critical business model characteristics we analyzed correlations between the business model characteristics and indicators for success. Then, we discussed the revealed success-correlated business model features regarding the given success factors from the literature. The results can give evidence for the existing success factors and reveal new insights for successful cloud business models. Finally, we can give recommendations for action regarding successful business models in the cloud market.

3.3.4 Analysis of Business Model Characteristics

Companies

Due to the huge variety of providers in the cloud computing market, we decided to use a structured process to select valuable cloud service providers. First, we determined worldwide cloud provider rankings, based on an internet search. We found 27 rankings from independent research companies, practitioner journals or cloud marketplaces, e.g. Cloud Reviews, Gartner, Forrester, or BTC Logic (see Annex, Table 30). To increase the objectivity and credibility, we considered all businesses that are mentioned by at least two rankings and selected 45 well-known cloud business providers for the analysis (see Figure 33). The variety within the selected providers is large. There are experienced companies such as IBM and HP, newer big players such as AT&T, Microsoft, Amazon and Google and smaller providers with a smaller turnover such as Citrix or RedHat. Since very recently, many very small storage and synchronization providers such as JustCloud or SugarSync have appeared in the cloud market.



01 1&1	10 Concur	19 GoGrid	28 Mozy	37 SingleHOP
02 Akamai	11 CenturyLink / Savvis	20 Google	29 MyPCBackup	38 Softlayer
03 AT&T	12 Dropbox	21 HP	30 Media Temple	39 SOS
04 Amazon AWS	13 Dimension Data	22 IBM	31 NetSuite	40 SugarSync
05 Box	14 EMC	23 Internap	32 Oracle	41 VMware
06 CA	15 Enomaly	24 JustCloud	33 Red Hat	42 Verizon/ Terremark
07 Carbonite	16 Eucalyptus	25 Joyent	34 RackSpace	43 Workday
08 Cisco	17 FireHost	26 Livedrive	35 Salesforce.com	44 ZipCloud
09 Citrix	18 GoDaddy	27 Microsoft	36 SAP	45 Zoho

Figure 33: Selected Cloud Service Providers

Indicators for Success

Determining the success factors, we used the key indicator system, proposed by Rockart (1979) as the "best" approach. State of the art research provides the return on investment (ROI) as common indicator for successful business models (e.g. (Schoeffler *et al.*, 1974)). Due to the limited accessibility of financial data for cloud businesses, we calculated the EBIT margin for cloud firms or in case of larger companies for the segment, the cloud business is dedicated to. Additionally, we complement the findings with another metric because financial data are not the only and best indicator for business performance (Eccles, 1991). Furthermore, the EBIT margin is treating young and fast growing firms unequal because their investments in growth commonly exceed their revenues thus returning a negative EBIT margin. Hence, we used a second indicator as researchers state that there is a relation between the firm's web visibility and its business performance (Wang and Vaughan, 2014; Vaughan, 2004). As Wang and Vaughan (2014) revealed, there can be a significant correlation between the number of inlinks (web visibility) to a company website and the business performance. We argue that this is a suitable indicator for internet driven businesses such as in cloud computing. To measure the inlink count, we used alexa.com as the web data base, following the approach of Vaughan and Yang (2012).

Analysis Result

Our correlation analysis is based on the spearman's rank correlation coefficient. First, we proved our assumption above and analyzed the correlation between the indicators and the age of the cloud company (see Table 12). We can see that the EBIT margin has a significant negative correlation to companies with a higher year of foundation, which confirm that younger companies have a smaller EBIT margin than older companies do. In contrast, the web visibility has no correlation and seems to be a stable and independent indicator that treats all companies equally.

Table 12: Correlation between the Company Age and Success Indicators

	ρ EBIT margin	ρ Web visibility
Year of company foundation	-0,446 **	-0,046

* = p < 0.05 (two-tailed test), ** = p < 0.025 (two-tailed test), *** = p < 0.01 (two-tailed test)

Further, we identified the most influencing business model characteristics (BMCs). The correlation between the EBIT margin and the BMCs shows 34 characteristics that are positively correlated and have a p-value less than 5% and can be seen as significant. Regarding the other indicator, the web visibility, 18 characteristics show a significant positive correlation. From these BMCs, seven characteristics correlate significantly with both indicators. For the following argumentation, we used those BMCs that have a significant positive correlation to at least one indicator and correlate positively with the other one. In case of a significant correlation with the web visibility, we also accepted a small negative correlation with the EBIT margin, to strengthen the disadvantaged young and small cloud providers. Finally, 39 characteristics remained as critical for the success of the business model (see Table 13) (for a full list of BMCs with correlation, see Annex Table 31).

Table 13: Critical Success Related Business Model Characteristics

No.	BMCs	ρ EBIT margin	ρ Web visibility	No.	BMCs	ρ EBIT margin	ρ Web visibility
1	Manifold width	0,68 ***	0,45 ***	21	Hardware resource	0,38 **	0,10
2	One-time charge	0,53 ***	0,11	22	Private cloud	0,37 **	0,15
3	Database service	0,51 ***	0,25	23	Market expansion	0,37 **	0,33 *
4	Monitoring	0,51 ***	0,19	24	Integration activities	0,36 **	0,08
5	Consolidation	0,51 ***	0,15	25	Supplement. service	0,35 **	0,30 *
6	Print media	0,50 ***	0,20	26	Fix operational costs	0,34 **	0,20
7	Knowhow transfer	0,49 ***	0,32 *	27	Integration service	0,33 *	0,14
8	Administration	0,49 ***	0,21	28	Branch market	0,33 *	0,04
9	Knowhow resource	0,49 ***	0,27	29	Production activities	0,32 *	0,12
10	Consulting activities	0,46 ***	0,05	30	Computing service	0,30 *	0,10
11	Hybrid cloud	0,46 ***	0,01	31	Community	0,29	0,56 ***
12	Manifold depth	0,45 ***	0,13	32	Individual support	0,27	0,39 ***
13	Consulting service	0,45 ***	0,13	33	Messaging service	0,25	0,48 ***
14	Similar field	0,43 ***	0,29	34	Development tool	0,23	0,33 *
15	Human resource	0,43 ***	0,34 **	35	Billing service	0,21	0,33 **
16	Pay-per-use	0,41 ***	0,04	36	Membership	0,18	0,30 *
17	Network resource	0,40 ***	0,08	37	Cost savings	0,17	0,37 **
18	On-site interaction	0,39 ***	0,11	38	SME	0,03	0,37 **
19	Vertical diversification	0,38 ***	0,32 *	39	Market design	-0,05	0,36 **
20	Development environment	0,38 **	0,31 *				

* = p < 0.05 (two-tailed test), ** = p < 0.025 (two-tailed test), *** = p < 0.01 (two-tailed test)

If we look at the results, the identified critical BMCs describe experienced market players who expand their existing business with a cloud division and act as a universal provider. Our indicators for success seem to prefer large firms to small newcomers in the cloud market. Therefore, the mentioned successful characteristics of a cloud business model are only indicators for success and do not allow a reverse conclusion that not success-related BMCs are not relevant for a successful business model.

Some expected features show no significant correlation because they are basic features that must be established by each cloud firm. That means characteristics that have a high adoption rate but show no correlation. For example, 'Web interface' and 'Internet connection' are represented very strongly (average rating >1.9, "strongly represented") within 100% of the business models. Furthermore, the BMCs 'Security', 'Scalability', and 'Support' are implemented by each firm (100%) and have an above-average rating (>1.0) but do not correlate significantly or even negatively. These mentioned BMCs are obviously relevant for a cloud business model but cannot serve as unique differentiating characteristic for success.

Some other characteristics that strongly correlate with the indicators describe rather traditional aspects (e.g. 'Print media', 'On-site interaction' and 'one-time charge'). This can induce that especially traditional methods strengthen the trust in new and unstable environments such as the cloud market and therefore lead to success.

To provide a cross-check, we conducted a second analysis. Based on our results we quantified the number of implemented critical BMCs in our sample and called this metric 'mean adoption of critical BMCs'. We analyzed the correlative context to the indicators and compared the results with the noncritical BMCs (see Table 14). The results show the proof that the mean adoption of the critical BMCs strongly and significantly correlates to the indicators for success.

Table 14: Correlation between the Adoption of BMC and the Success Indicators

	ρ EBIT margin	ρ Web visibility
Mean adoption of critical BMCs	0,634 ***	0,440 ***
Mean adoption of non-critical BMCs	-0,035	0,084

* = p < 0.05 (two-tailed test), ** = p < 0.025 (two-tailed test), *** = p < 0.01 (two-tailed test)

Further, we see evidence that the diversity between business models regarding the critical BMCs is more significant than between the noncritical BMCs (see Figure 34). As the figure shows, the mean adoption of both, critical and non-critical BMCs is about the same. Yet the adoption of the critical BMCs is distributed with a high dispersion whereas the non-critical BMCs do not differ much in our sample. That indicates that the implementation of all critical BMCs have a higher influence on the firm's success while the non-critical BMCs have only marginal effects.

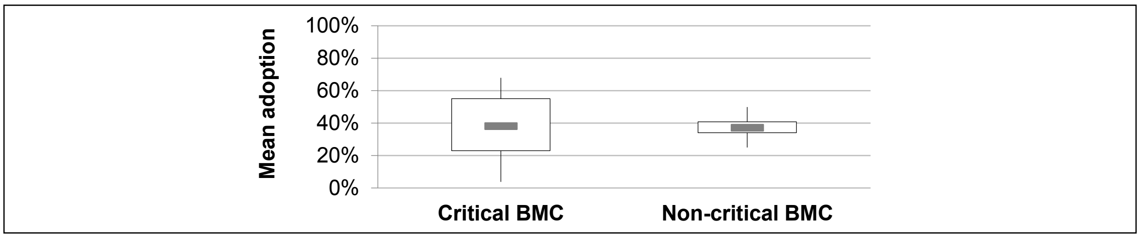


Figure 34: Diversity of the Adoption of Critical and Non-Critical BMCs

3.3.5 Success Factors and Business Model Characteristics

At the beginning of our research, we summarized success factors of business models for general and cloud purpose. Our research can now give concrete implementation guidelines for the success factors. We compared the literature-based cloud success factors with the BMCs and intensively discussed the implementation possibilities.

1. Product portfolio / quality: An attractive product portfolio and product performance have a significant influence to the business success (Ernst and Rothlauf, 2012). Providers with a better quality obtain higher prices and strengthen the customer loyalty to increase the business success. The analysis results address only the product portfolio and cover this success factor with BMCs of the core product ('Computing service', 'Development environment' and '- tool') and the product system ('Database -', 'Messaging -' and 'Billing service', as well as an 'Administration' possibility). Additional 'services' of 'Integration' and 'Consulting' are critical to success as well. Characteristics regarding the quality, such as 'Scalability', 'Flexibility' or 'Time savings' do not significantly correlate to the indicators.

2. Employees / productivity: Most studies propose the employees and the productivity as a positive correlated factor for corporate success. Productivity is the added value per employee and can be optimized especially in the cloud business: On the one hand, the high standardization and automation allows a better relation of employees to infrastructure (Greenberg *et al.*, 2009). On the other hand, the improved resource utilization increases the output value (Loos *et al.*, 2011). The BMCs cannot measure the productivity explicitly, only the characteristic 'Human resource' addresses this success factor.

3. Innovation / differentiation: The rate of new products and the differentiation to competitors is another factor that has a positive influence on the return on investment (ROI) (Schoeffler *et al.*, 1974). The high degree of standardization in cloud computing challenges the differentiation towards competitors and requires innovative ideas. The innovative role of a business model can be linked to success-related strategic BMCs. Providers that aim at 'Market design' and enter the cloud market with 'Market expansion' from an established position have the best possibilities for success.

4. Availability / reliable infrastructure: The availability of an online service is the basic requirement for the customer's acceptance. Only with the satisfying fulfillment, the market share of a cloud service can be increased. The successful BMCs 'Hardware -' and 'Network resource' can realize its basis. Furthermore, the customer relationship characteristic 'Monitoring' promotes the transparency and reliability of a cloud service.

5. Communication / SLAs / image: Another emphasized success factor is the communication to the customer and the customer satisfaction (Susarla and Barua, 2009). The outsourcing of a service and its data to a third party provider induces a high uncertainty and risk. The transported image as well as a customer-orientated communication and transparent service levels promote the trust of the customers and stimulate the distribution of the service. Within the BMCs, only the communication characteristic 'Print media' correlates significantly with the indicators. Other expected BMCs regarding the communication do not correlate strongly.

6. Customer interaction / care / customness: The deepened maintenance of the customer relationship is another success factor. Especially for new concepts such as cloud services, many questions will arise that need to be discussed. To address this success factor, the analyzed business models offer characteristics such as a 'Community' forum, 'On-site interaction' as distribution channel, and 'Individual support' services to maintain the customer relationship intensively.

7. Knowhow / technology skills: The company's knowhow has a significant influence on the success (Ernst and Rothlauf, 2012) for each provider, but especially for consultants and integrators. Cloud consultants serve with overall knowhow about the cloud market to facilitate the market entry for other companies, whereas integrators have explicit knowhow in implementing a dedicated cloud service. 'Knowhow' is represented as a key resource in the framework and correlates with the indicators for success. Further, the 'Knowhow transfer' from former business or related business units has a beneficial influence for success within the cloud market.

8. Vertical integration: The vertical integration has a positive influence on the ROI, if the integration is very high (Schoeffler *et al.*, 1974; Buzzell, 2004) or very lean (Peters and Waterman, 1982). Because of the interoperability between cloud services, the levels of integration can easily be separated. Small cloud providers can have advantages with lean and simple cloud services (low integration) while big cloud providers probably benefit as a universal provider by offering the whole cloud portfolio. Success-related BMCs of our analysis only focus on the universal cloud provider. Providers are successful with a 'Vertical diversification' by entering the cloud market and offering a product system with a 'Manifold width' and '- depth'. This aims at the customer value 'Consolidation' and emphasizes the in-house 'Production -' and 'Consulting activities'.

9. Partner network: In contrast to the traditional business, the cloud business has a higher focus on partner networks. Because of the standardization of cloud services, the market pressure and lock-in effects are decreasing. However, the contract negotiations are a critical condition especially in the IT business (Susarla and Barua, 2009). Besides the various integration possibilities, cooperation between SaaS providers and third party vendors can promote cost reductions (Ernst and Rothlauf, 2012), e.g. for the complex license management. Related BMCs that drive the success are a 'Similar field' of the partners, 'Consulting services' via partners and the partner payment model 'Membership'.

10. Flexibility / reversion: This success factor refers to the organizational flexibility of a cloud service in the form of flexible booking options for the customers, e.g. the 'Pay-per-use' model. Besides the flexible integration, accounting and scaling, a cloud service should provide a flexible exit possibility, as it is allowed by a 'Hybrid cloud' model in combination with own infrastructure. The expected customer value 'Flexibility' shows no significant correlation.

11. Interoperability / implementation: Another success factor especially for cloud services is the technical flexibility of a cloud service. This means the technical interoperability to a legacy system, communicating IT systems or connected partner systems via standardized interfaces. There is only one BMC that can be related to this success factor, which is 'Integration activities'. Potential characteristics such as the customer's experience of 'Standardization' do not strongly correlate with the success of the firm.

12. Security / privacy / data control: An important factor for the success of a cloud service is the security and data protection. The permanent exchange of personal data (also regarding the user behavior while using an online service) to a third party provider causes the compliance with high security requirements. The BMCs for privacy-focused provisioning models, 'Private -' and 'Hybrid cloud', are correlated with the indicators for success. However, the user experience characteristic 'Security' directly addresses this factor but has a negative correlation with success.

13. Charging / cost savings: The revenue model of a cloud service is a success factor as well. 'Cost savings' are desired by the customer and should be provided as BMC by the cloud service. The primary costs of the cloud service production can serve as regulation screw, i.e. the success-related BMC 'Fix operational costs'. The customer payment BMCs 'Pay-per-use' and 'One-time charge' correlate positively with the indicators. Besides the revenue focus of customers, also the partner payment model 'Membership' has a significant correlation. The main revenue from 'Supplementary services' can offer savings for the primary cloud service.

14. Flexible governance: This success factor describes a governance of a business model that is able to adjust and restructure the IS functions (Rockart, 1982) and deals with "loose-tight properties" (Peters and Waterman, 1982). The business model framework has no characteristics that cover and support this success factor; therefore, we have no correlations.

15. Investment intensity / capital: The availability of capital resources is relevant for high fixed and operating costs (Ernst and Rothlauf, 2012; Leidecker and Bruno, 1984). The PIMS-study confirmed that businesses with large market shares have above-average rates of investment turnover and working capital (Schoeffler *et al.*, 1974). The framework addresses this aspect with success-related business assets such as 'Knowhow resource', 'Network resource', and 'Hardware resource'.

16. Active decision making / management commitment: Another factor regarding the management of a business model describes a philosophy that acts hands-on, shows its commitment, and drives quick decisions (Peters and Waterman, 1982). There is no doubt that this is an important aspect, but no characteristics of the framework describe this success factor. Management factors need to be addressed in parallel to the business model.

17. Market position / growth / competitiveness: The market share and growth is a major influence on the success of a firm and is influenced by the competitiveness of a company. Correlating characteristics such as existing knowhow for a 'Knowhow transfer' and an active role in 'Market design' can strengthen this position.

18. Market attractiveness / segment adjustment: The determination of the target market is another success factor of a business model. Within the market focus, the 'Mass market' is assessed with the third highest rating of all characteristics and is implemented within 98% of the analyzed cloud business models. Therefore, this factor cannot serve as differentiating characteristic. The BMC 'Branch market' is correlated positively with the two indicators as well as the 'SME' customer focus. Further, the target market addresses other providers with 'Membership' services.

To give an overview at the mapping results, we show all relations between the BMCs and the success factors (see Table 15 on the next page). We can see an emphasis at the product related success factor, followed by a vertical integration as well as the charging and costs dimension. The success factors regarding an active and flexible management can find no equivalent within the business model characteristics and need to be arranged in parallel to the business model. The frequency distribution of the indication of success factors cannot be taken as an absolute assessment but gives advices for the significance, operationalization, and implementation of success factors within a cloud business model.

3.3.6 Discussion of Successful Business Models

By creating a business model, the revealed critical BMCs should be considered carefully in particular but the other factors should not be neglected in principle. Within an analysis of our firms regarding their mean adoption of critical BMCs, we can see that firms with a higher EBIT margin and a higher web visibility have a higher adoption of critical BMCs within their business models (see Figure 35). If we look at the firms in detail, it is significant, that the big firms have the highest implementation rate of the critical BMCs for success. Microsoft meets 68% of the critical BMCs, followed by Amazon's AWS (65%), IBM (65%), CenturyLink / Savvis (64%), Cisco (64%), and VMware (64%). The small cloud synchronization firms have the lowest adoption of the critical BMCs: SOS (4%), ZipCloud (5%), MyPCBackup (4%), JustCloud (4%), and Mozy (9%).

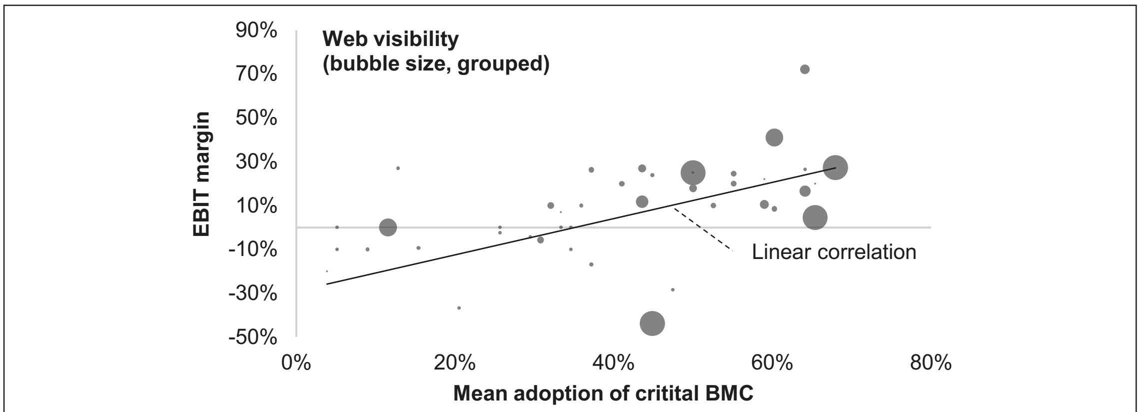


Figure 35: Correlation of the Mean Adoption of Critical BMCs to the Success Indicators

Table 15: Relations between the Critical BMCs and the Success Factors

No.	**Success Factors** **Critical success-related BMCs**	Product portfolio / quality	Employees / productivity	Innovation / differentiation	Availability / reliable infrastructure	Communication / SLAs / image	Customer interaction / care / customness	Knowhow / technology skills	Vertical integration (universal or lean)	Partner network	Flexibility / reversion	Interoperability / implementation	Security / privacy / data control	Charging / cost savings / synergies	Flexible governance	Investment intensity / capital	Active decision making / management commitment	Market position / growth / competitiveness	Market attractiveness / segment adjustment
1	Manifold width								x										
2	One-time charge													x					
3	Database service	x																	
4	Monitoring				x														
5	Consolidation								x										
6	Print media					x													
7	Knowhow transfer							x										x	
8	Administration	x																	
9	Knowhow resource							x								x			
10	Consulting activities								x										
11	Hybrid cloud										x		x						
12	Manifold depth								x										
13	Consulting service	x								x									
14	Similar field									x									
15	Human resource		x																
16	Pay-per-use										x			x					
17	Network resource				x											x			
18	On-site interaction						x												
19	Vertical diversification								x										
20	Development environment	x																	
21	Hardware resource				x											x			
22	Private cloud												x						
23	Market expansion			x														x	
24	Integration activities											x							
25	Supplementary service													x					
26	Fix operational costs													x					
27	Integration service	x								x									
28	Branch market																		x
29	Production activities								x										
30	Computing service	x																	
31	Community						x												
32	Individual support						x												
33	Messaging service	x																	
34	Development tool	x																	
35	Billing service	x																	
36	Membership									x				x					x
37	Cost savings													x					
38	SME																		x
39	Market design			x														x	
	Sum(x)	9	1	2	3	1	3	2	6	4	2	1	2	6	0	3	0	3	3

To assess a cloud business model, we further can establish a useful connection to cloud business model clusters from our previous research (Labes *et al.*, 2013a). Within this research, we revealed four clusters of characteristics for types of cloud providers (see Figure 36, left) based on an examination with the same cloud business model framework. Now, we can analyze which clusters includes the most successful BMCs and draw conclusions to the success of a business model type. We can see that the third cluster has the highest relative share of critical BMCs, followed by the fourth. The newcomers are the smallest cluster and provide no characteristics that correlate with the indicators for success. The fourth cluster is the largest and provides the highest absolute number of critical BMCs.

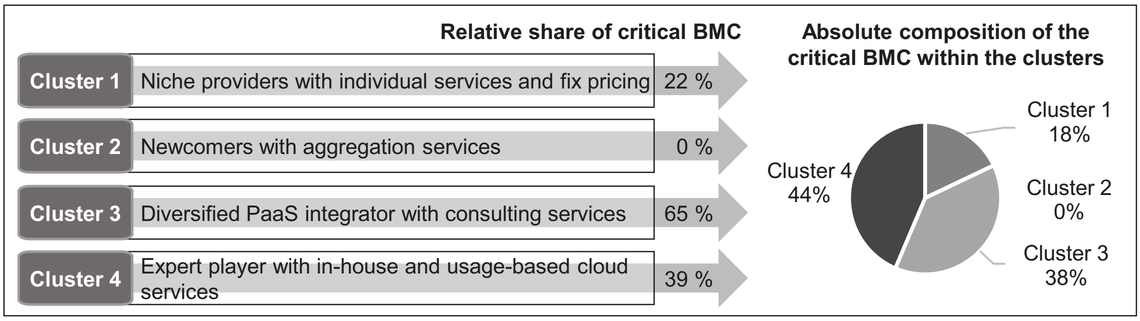


Figure 36: Composition of the Critical BMCs Regarding the Cloud Provider Types

We can conclude that the clusters 3 and 4 describe the most successful cloud provider types, whereas the third cluster has the most efficient ratio of success-related business model characteristics.

Until now, the most successful cloud business models are apparently the big players that benefit from a lot of knowhow, infrastructure and contacts from their traditional business. Business models of small niche providers are not related to the critical BMCs. At this moment, we cannot evaluate if these business models will be successful, but maybe in a few years the cloud market has changed.

3.3.7 Conclusion

The purpose of our research was to determine success factors of a cloud business model. Our analysis of 45 firms and their cloud business models revealed a set of 39 success-related critical BMCs. We proved the validity of the critical BMCs with a cross-check and further analyses. Though our indicators for a successful business model can be seen as critical assumptions we can prove that not only single critical BMCs randomly correlate with our indicators, but also a more holistic approach shows that these specific BMCs can be found grouped disproportionately frequent in business models of firms with better business performance.

For the current market situation, the success-related characteristics describe experienced market players who expand their traditional business with existing knowhow, infrastructure and contacts and act as a universal cloud provider. The success of newcomers in the cloud market is limited and cannot be fully measured so far.

Our evaluation of the results with the success factors given from the literature show a valid linkage to the critical BMCs. We gave advices for the significance, operationalization, and implementation of success factors within a cloud business model. The graphical summary of the results show an emphasis at the product related success factor followed by a high vertical integration as well as the charging and costs dimension.

For future research, we propose to break down our meta-approach and conduct selective analyses of firms with the same size, age or cloud level focus to produce results that are more comparable. Moreover, we suggest deepening the research on reliable indicators for the success of a business model.

Regarding our research, we accept some limitations. For the analysis of the cloud business models, we considered the promoted information at the websites and news feeds. We evaluated the subjective information by the double control principle but we cannot proof the reliability of the stated information by the firms (especially regarding the product performance). Further, the transfer of the BMCs to success factors indicates that the business model framework cannot cover the success factors completely.

Besides, the key indicators for the business model success seem to be not a well-investigated research field. Especially in young markets, where companies do not declassify financial information, there should be more measures related to the potential success of a business model. Within our analysis, the indicators seem to favor big and established firms towards the newcomers in the cloud market. Therefore, the comparison between big and small firms is difficult.

3.4 Successful Types of Cloud Business Models

Table 16: Details of Publication No. 3.4

Title	Successful Types of Cloud Business Models
Authors	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	International Journal of Business & Information Systems Engineering (BISE 2016)
Abstract	The acceleration of the technical change in the fast moving electronic market increases the uncertainty and risk of IT providers. Influenced by new IT provisioning concepts such as cloud computing, providers seek for stable guidelines and success factors for new and existing business models. Within our research, we conducted an intensive analysis of success-driving factors in the business models of 45 providers in the cloud market. We used a cloud business model framework with 105 characteristics to systemize the business models and analyzed them statistically regarding two indicators for success. The results showed 39 success-driving business model characteristics and a cluster analysis led to three common combinations of characteristics that describe meta types of cloud business models. The most successful meta type is a specialized cloud provider with customer-oriented branch solutions, while small newcomers with aggregation services experience difficulties to be competitive. To evaluate the results, 12 interviews with cloud experts were conducted to verify the research results and the success of each business model type. The interview statements were aggregated and summarized to give recommendations for action and a prediction for success of cloud business models.
Keywords	Cloud computing, Business model, Success factors, Qualitative content analysis, Expert interviews, Cloud provider, Value proposition, Cloud strategy,
Link	http://link.springer.com/article/10.1007/s12599-016-0455-z / DOI: 10.1007/s12599-016-0455-z
Version	Preprint in dissertation publication

3.4.1 Introduction

Since the beginning of the new digital economy (Cohen *et al.*, 2000; Gordon, 2000) in the late 90s, the business model concept became more significant, not only in practice but also in academic research (Veit *et al.*, 2014). This trend is also evidenced by the increasing number of publications in the AIS Electronic Library. The drivers of this development are firstly the increased performance of the information and communication technology (ICT) (Cohen *et al.*, 2000; Gordon, 2000), especially regarding data processing and data transmission (Staehler, 2002). Second, the internet as enabler for interactivity, ubiquity, multimediality, and distribution penetrates the economy and society faster than other mass media (Cohen *et al.*, 2000; Zerdick *et al.*, 2001). With the acceleration of technical change in the ICT and the diffusion of ICT products, uncertainty and risks grew with new business models. Forecasts or long-term technology plans are limited, thus investments are fraught with higher risks (Bettis and Hitt, 1995).

An actual hype wave and representative example of these fast developing business models is the cloud computing focus (Gartner, 2013c). With this business concept, cloud providers offer freely scalable IT resources (e.g. servers, storage, applications, or network resources) in an on-demand manner via networks and receive usage-based revenue streams (Mell and Grance, 2011; Hayes, 2008; Weinhardt *et al.*, 2009). The diversity on the cloud market is very high, because the standardized and hierarchical structured services are able to build on one another. Different provisioning models (public, private, hybrid, and community) increase the complexity and seek a reliable prediction for success.

The business model concept arises as an analysis unit that takes the new conditions into account (Staehler, 2002) and is still an actual research topic (Veit *et al.*, 2014). The objective of a business model is to set a foundation for the following issues: to understand the appreciation of an existing business; to recognize own weaknesses to achieve the improvement of the business; and to systematically evaluate new business ideas with their competitive advantages and success probabilities (Staehler, 2002).

Most definitions use a component-based approach that abstracts the description of a business – of "what a company is doing in order to create and commercialize value" (Burkhart *et al.*, 2011) (see also (Osterwalder *et al.*, 2010; Wirtz, 2010)). Although a high number of researchers analyzed this concept, a common definition of the business model term is missing until now (Zott *et al.*, 2011; Lambert and Davidson, 2013). There are already miscellaneous classifications of different definitions given by several researchers (Shafer *et al.*, 2005; Al-Debei and Avison, 2010; Burkhart *et al.*, 2011; Zolnowski and Boehmann, 2011; Zott *et al.*, 2011). Within previous research (Labes *et al.*, 2013b), we analyzed these classifications with up to 30 definitions and aggregated them to eight components as a basis for our analyses. At the value creation side are the partner network, resources and activities, and costs; in the center the cloud strategy and the value proposition; and at the side of value delivery, target markets, distribution and customer relationship, and revenue streams describe a business model.

Within our research, we used the business model concept as analysis unit for the examination of success-driving factors and common business model types. For a detailed analysis of the business models, we referred to a structured and detailed business model framework from our previous research (Labes *et al.*, 2013a). We addressed the given need with the following research questions:

(1) Which business model characteristics drive the success of cloud business models and which business model type is most successful?

(2) What can cloud providers do to increase the success of their business models?

To answer these questions, we analyzed success factors for business models in theory and conducted a comprehensive study of 45 cloud firms to find success-driving characteristics in practice and successful patterns. We discussed the results with cloud service providers and conclude with recommendations for the development of a cloud business and the prediction of success.

3.4.2 Related Work

Success factors are defined as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" (Rockart, 1979). The research on success factors is traceable to the 1960s but the distinct research on successful business models is rare. An important research that focuses on success factors is the PIMS (Profit Impact of Marketing Strategies) study. Within this study, Schoeffler (1974) analyzed business data from 3000 business units (450 member companies of the strategic planning institute (SPI), all branches, average values over many years) and derived seven strategic factors that drive success. In 1979, Rockart mentioned critical success factors for businesses the first time (Rockart, 1979) and conducted interviews with CEOs to detect reliable factors for their corporate success (Rockart, 1982). Further, Peters and Waterman (1982) analyzed 43 of Fortune 500's top performing companies and derived eight themes that are essential for successful firms. Leidecker and Bruno (1984) proposed three levels of a critical success factor analysis with eight identification techniques. They applied those techniques and revealed success factors for specific industries as well as for different companies. Brentani (1991) analyzed generic success factors for new business services, as we can consider cloud services today.

Besides the general success factor research, some authors specifically focus on the cloud business. Horsti et al. (2004) conducted case study research and differentiated critical success factors and customer need factors for different maturity stages of an electronic business. With a focus on success factors of the SaaS business, Ernst and Rothlauf (2012) revealed seven critical success factors from a literature-based argumentative study. Also Walther et al. (2012) conducted literature-based research and derived 12 success factors for SaaS. The derived factors of both studies describe very fundamental aspects that should be the basis of other service models like PaaS and IaaS as well.

We arranged the extracted success factors along the mentioned business model components and found many overlaps between the mentioned success factors in the general and the cloud specific literature (see Table 17). This induces the assumption that some generic success factors are valid for cloud businesses but need specific supplements. The results from the literature highlight the business strategy, the value proposition itself, and resources and activities to create the value proposition. The theoretical advice is the first step for the awareness of the location of success factors in a business model. With our research, we aim to clarify and operationalize these demands from a practical business perspective.

Table 17: Critical Success Factors in the Business Model Components

No.	Critical success factors in the business model components	Generic focus					Specific focus		
		(Schoeffler *et al.*, 1974)	(Rockart, 1982)	(Peters and Waterman, 1982)	(Leidecker and Bruno, 1984)	(Brentani, 1991)	(Horsti *et al.*, 2004)	(Ernst and Rothlauf, 2012)	(Walther *et al.*, 2012)
1	**Business Strategy**, e.g. innovation, differentiation, vertical integration (universal or lean), flexible governance	x	x	x	x	x	x	x	x
2	**Partner Network**, e.g. pronounced partner relationships				x		x	x	
3	**Resources & Activities**, e.g. productivity, knowhow, reliable infrastructure, active decision making, management commitment	x	x	x	x	x	x	x	x
4	**Costs**, e.g. cost savings, synergies, investment intensity, capital availability	x			x	x		x	x
5	**Value Proposition**, e.g. product portfolio, -quality, security, flexibility, reversion, interoperability, privacy, data control	x	x		x	x	x	x	x
6	**Distribution & Customer Relationship**, e.g. customer interaction, -care, communication, image, SLAs, customness		x	x	x	x	x	x	
7	**Revenue**, e.g. charging, price				x				x
8	**Target Market**, e.g. market position, -attractiveness, -growth, -competitiveness, segment adjustment	x				x			

3.4.3 Research Approach

Within our explorative research, we used a positivist approach (Myers, 1997) to increase the understanding and predicting of business success. Osterwalder (2004) created a business model ontology that helps to structure a business model but it "is not a guarantee for success as it has to be implemented and managed". The successful development of business models was confirmed as a valuable research direction (Veit *et al.*, 2014). We followed this idea and conducted an intensive study of 45 cloud providers and their business models to derive success driving business model aspects.

To develop a deep understanding of the addressed field, we mixed quantitative and qualitative methods (Venkatesh *et al.*, 2013). Within the mixed method approach, we followed an explanatory method design (Creswell and Clark, 2007) and combined a quantitative cross-sectional analysis of secondary data with qualitative semi-structured interviews to evaluate the results.

For the cross-sectional study, we systematically selected 45 cloud business models of relevant cloud providers or its separate cloud division in the case of a wider product portfolio (for details see Labes *et al.* (2015)). The data collection for the analysis based on secondary data. For gathering the data, we comprehensively reviewed the company's websites, encyclopedia items, blogs, and news feeds to obtain empirical data. Two researchers reviewed the information in three cycles from January to July 2014. For the evaluation of the results, we used qualitative content analysis (Mayring, 2004; Miles and Huberman, 1994). Content analysis proposes three steps of data reduction, data display, and drawing conclusions (Faust, 1982; Hsieh and Shannon, 2005; Miles and Huberman, 1994). For data reduction we coded the data in systemization categories from previous research findings (Hsieh and Shannon, 2005). This systemization is a detailed cloud business model framework (Labes *et al.*, 2013a) with 105 business model characteristics (BMCs) classified in a morphological box where the categories represent the basic components of a business model. The BMCs in the morphological box show the possible design features to "assemble" a business model and are potentially success-related (Osterwalder, 2004). The coding process describes a rating of the BMCs in each business model (0 = "not represented", 1 = "represented", 2 = "strongly represented"). We discussed and reviewed the assessments with each other to verify the coding consistency (Thomas, 2006). For the data display, we summarized the gathered data of the 45 business models in a table aligned with the 105 BMCs to produce one database (105 x 45 data size) as the basis for statistical analyses. We conducted a correlation analysis and a cluster analysis to derive concrete BMCs of a business model that drive the success of a firm. The correlation analysis identified the critical BMCs regarding the indicators for success and the cluster analysis revealed frequent combinations of BMCs that describe common business model types. In the third step, we drew conclusions (Miles and Huberman, 1994) and combined both analyses to derive and discuss the most successful business model type.

To enrich the quantitative analysis results with a qualitative perspective based on primary data, we evaluated the results within interviews of cloud experts. This is proposed in the literature to interpret and assess a specific issue (Gläser and Laudel, 2010; Myers, 1997).

A structured procedure was used to provide guidance to (1) identify the research issue, (2) select the interview partners, and (3) determine how to conduct the interviews (Kirsch, 2004). We selected 12 international experts on cloud computing from different perspectives (provider, customer, consultant, and broker) to represent key stakeholder groups on the success of the cloud provider's business model. All experts have between 10 and 35 years experience in IT and cloud computing and have leading positions within their companies. A structured interview guide with 13 questions was developed within the research team. It includes a general part of evaluating general success factors for business models and a specific part to evaluate the concrete results of the analyses. For the evaluation of the interviews, we used the qualitative content analysis again (Mayring, 2004; Miles and Huberman, 1994) with the three steps of data reduction, data display, and drawing conclusions (Faust, 1982; Hsieh and Shannon, 2005; Miles and Huberman, 1994). For data reduction, the interview protocols were aggregated to give a summary (Patton, 2005; Schilling, 2006) and structured along the cloud provider types from the research findings (Hsieh and Shannon, 2005) of the statistical analyses to display the data. In the third step, we drew conclusions (Miles and Huberman, 1994) and compared the results of the qualitative interviews with the results of the statistical analyses and the literature analysis on success factors for cloud business models. Finally, we summarized the discussion, assessed our analysis and derived recommendations for action regarding successful business models in the cloud market.

3.4.4 Analysis of Cloud Business Models

Critical Business Model Characteristics

Determining the success factors, we used the key indicator system, proposed by Rockart (1979) as the "best" approach (Rockart, 1979). State of the art research provides the return on investment (ROI) as common indicator for successful business models (e.g. (Schoeffler *et al.*, 1974)). Due to the limited accessibility of financial data for cloud businesses, we calculated the EBIT margin (ration of earnings before interest and taxes) for cloud firms or in the case of larger companies for the segment of the cloud business. Additionally, we complement the findings with another metric because financial data are not the only and best indicator for business performance (Eccles, 1991). Furthermore, the EBIT margin treats young and fast growing firms unequally because their investments in growth commonly exceed their revenues thus returning a negative EBIT margin. In a former analyses we confirmed that the EBIT margin has a significant negative correlation to companies with a higher year of foundation, which confirms that younger companies have a smaller EBIT margin than older companies (Labes *et al.*, 2015). Hence, we used a second indicator as researchers state that there is a relation between the firm's web visibility and its business performance (Wang and Vaughan, 2014; Vaughan, 2004). As Wang and Vaughan (2014) revealed, there can be a significant correlation between the number of inlinks (web visibility) to a company's website and the business performance. We argue that this is a suitable indicator for internet driven businesses such as cloud computing. To measure the inlink count, we used alexa.com as the web data base, following the approach of Vaughan and Yang (2012). The web visibility shows no correlation to the year of foundation (-0.046) and seems to be a stable and independent indicator that treats all companies equally.

We identified characteristics that have a significant positive correlation to at least one indicator and correlate positively with the other one. In case of a significant correlation with the web visibility, we also accepted a small negative correlation with the EBIT margin, to strengthen the disadvantaged young and small cloud providers. Finally, 39 characteristics remained as critical for the success of the business model (see Table 18, for details see Labes *et al.* (2015)).

Table 18: Critical Success-related Business Model Characteristics

No.	Critical success factors and their correlation significance in practice
1	**Business Strategy**: knowhow transfer (***/*), vertical diversification (***/*), market expansion (**/*), market design (/**)
2	**Partner Network**: partners in similar field (***/)
3	**Resources & Activities:** knowhow - (***/), human - (***/**), hardware - (**/), network resource (***/), production - (*/), consulting - (***/), integration activities (**/)
4	**Costs**: fix operational costs (**/)
5	**Value Proposition**: manifold width (***/***), -depth (***/), computing service (*/), development environment (**/*), -tool (/*), consolidation (***/), cost savings (/**), administration (***/), private - (**/), hybrid cloud (***/), database - (***/), consulting - (***/), integration - (*/), billing - (/**), messaging service (/***), individual support (/***)
6	**Distribution & Customer Relationship**: print media communication (***/), on-site interaction (***/), monitoring transparency (***/), customer community (/***)
7	**Revenue**: one-time charge (***/), pay-per-use revenue (***/), revenue with supplementary service (**/*), membership fees for partners (/*)
8	**Target Market**: branch market (*/), SME customers (/**)

Legend: (EBIT margin / Web visibility); * = $p < 0.05$, ** = $p < 0.025$, *** = $p < 0.01$, two-tailed test

The BMCs describe experienced market players who expand their existing business with a cloud division and act as a universal provider. The used indicators seem to lead to large firms instead of small newcomers in the cloud market. Therefore, the mentioned successful BMCs of a cloud business model are only indicators and do not allow a reverse conclusion that not success-related BMCs are not relevant for a successful business model.

Some expected features show no significant correlation because they are basic features that each cloud firm must establish. This means characteristics that have a high adoption rate in the business models but show no correlation. For example, ‘Web interface’ and ‘Internet connection’ are not revealed as success-related but are represented very strongly (average rating > 1.9, “strongly represented”) within 100% of the business models. In addition, the BMCs ‘Security’, ‘Scalability’, and ‘Support’ are implemented by each firm (100%) and have an above-average rating (>1.0) but do not correlate significantly or even negatively. These mentioned BMCs are obviously relevant for a cloud business model but cannot serve as unique differentiating characteristic for success.

Some other characteristics that strongly correlate with the indicators describe rather traditional aspects (e.g. ‘Print media’, ‘On-site interaction’ and ‘one-time charge’). It can be induced that especially traditional methods strengthen the trust in new and unstable environments like the cloud market and therefore lead to success.

To provide a cross-check, we conducted a second analysis. Based on our results we quantified the number of implemented critical BMCs in our sample and called this metric 'mean adoption of critical BMCs'. We analyzed the correlative context to the indicators and compared the results with the noncritical BMCs. The results proved that the mean adoption of the critical BMCs strongly and significantly correlates with the indicators for success (EBIT margin 0.634***, web visibility 0.440***) while the non-critical BMCs do not correlate (EBIT margin -0.035, web visibility 0.084).

Further, we see evidence that the diversity between business models regarding the critical BMCs is more significant than between the noncritical BMCs (see Figure 37, left). As the figure shows, the mean adoption of both critical and non-critical BMCs is about the same. Yet the adoption of the critical BMCs is distributed with a high dispersion whereas the non-critical BMCs do not differ much in our sample. This indicates that the implementation of all critical BMCs have a higher influence on the firm's success while the non-critical BMCs have only marginal effects.

Within an analysis of the firms regarding their mean adoption of critical BMCs, we can see that firms with a higher EBIT margin and a higher web visibility have a higher adoption of critical BMCs within their business models (see Figure 37, right). If we look at the firms in detail, it is significant that the large firms have the highest implementation rate of the critical BMCs for success while the small cloud synchronization firms have the lowest adoption of the critical BMCs.

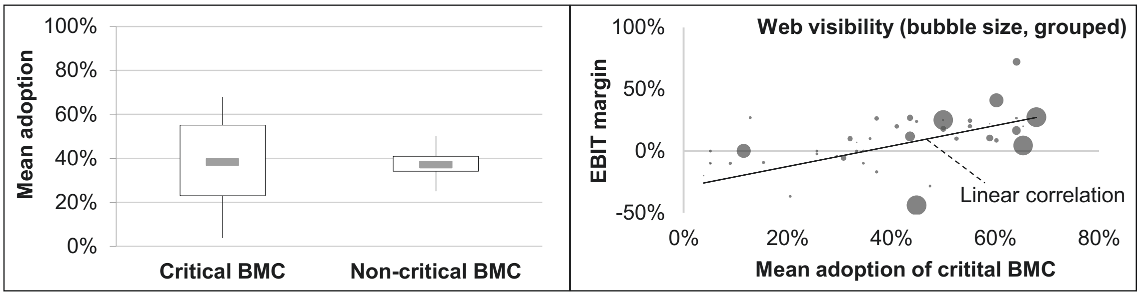


Figure 37: Mean Adoption of the Critical Business Model Characteristics

Common Patterns of Business Model Characteristics

Next, we performed a cluster analysis on the database to discover patterns in the BMCs. A cluster analysis is a method to determine unknown correlations in a data pool and helps to group similar data into clusters. In the ideal case, the clusters are internal homogeneous and external heterogeneous (Anderberg, 1973). The grouping can be based on similarity or distance measures; for the ordinal scale level used (0 = "not represented", 1 = "represented", 2 = "strongly represented"), a similarity measure is more suitable (Bacher et al., 2010). To find an optimum of clusters, we chose an agglomerative hierarchical clustering method. This method starts with one data in one cluster and groups the clusters systematically according to their similarity until they belong to one route cluster (see dendogram in Annex, Figure 68). Due to high accuracy values, we chose the agglomerative hierarchical clustering analysis with the squared Euclidean distance scale and the minimum variance method (Ward's method) (Punj and Stewart; Blashfield, 1976).

We identified three clusters (see Figure 38, left) that can describe common business model meta types. The types are primarily characterized by a well-balanced number of BMCs: cluster 1 with 38 BMCs (36%), cluster 2 with 39 BMCs (37%), and cluster 3 with 28 BMCs (27%) (see Figure 38, middle). The implementations of the meta types in the analyzed business model vary in their average expression and their dispersion (see Figure 38, right). While the first type includes BMCs that have a low applicability in the business models (average implementation 14%), BMCs of type 2 were applied relatively often (average implementation 65%). Type 3 shows the highest variance in the implementation, which implicates that the comprised BMCs have a higher influence on success.

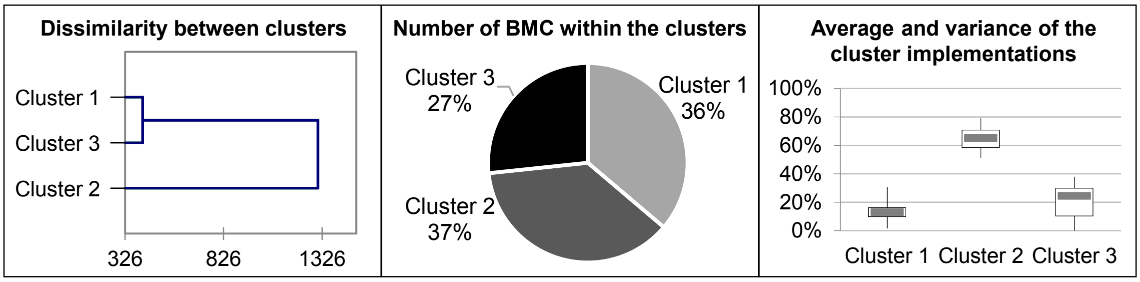


Figure 38: Clusters of Business Model Characteristics

The **first type** describes providers that adapt existing cloud strategies or plan to cooperate in inter-organizational fields. They are newcomers in the cloud business or diversify their existing business on a horizontal or lateral level. The value proposition describes a limited service portfolio in depth and width with additional database -, search -, or billing services. The services can comprise structured data or content and allow an individual customization. The community cloud model is applicable especially for cooperation in inter-organizational fields and partners in substitutive areas. The service creation is based on activities of comparison and categorization as well as aggregation and creating add-on services. This induces mostly initial costs. The target customers are located in niche markets and the communication mainly takes place via traditional channels such as print media or personal contact. After a one-time charge, the revenue is skimmed with supplementary services. Besides special revenue models such as spot or reservation for services or resources, this type includes all BMCs for a partner revenue model.

The **second type** describes cloud providers that design and form the cloud market with a transfer of existing knowhow. They provide a variety of different software services and assist with individual support and consulting services. The services are highly standardized, and offered as multi-tenancy public cloud service. This allows a high flexibility and scalability as well as time and cost savings for the customer. The providers promise a high security level as well. The partner network is well pronounced in complementary fields with different types of collaborations with technology and business partner. The cloud services are produced with own hardware, software and knowhow resources. This results in fixed and variable operational costs. The services address the mass market and each firm size. Well-developed support as well as online profiles and communities establish sound customer relationships. Revenue streams are generated based on subscriptions with the main service.

The **third type** describes providers that diversify their business on a vertical level to provide services with a manifold depth. These services are primarily infrastructure and platform services with additional data processing, administration and marketplace services. Integration services help to migrate or connect legacy systems with the cloud environment. The provided services are private or hybrid and enable a consolidated and sustainable IT environment at the customers' side. Consulting partners in similar fields support the own activities of consulting, integration, and on-site interaction at the customers place. The target customers are specifically addressed in different branches and the public sector. A transparent monitoring of the services as well as transparent SLAs support a trustful customer relationship and enable a usage-based customer payment.

To assess the revealed cloud business model types, we established a connection between the clusters and the success-driving BMCs. We can see that the third type has by far the highest relative share of critical BMCs (71% of all BMCs in cluster 3 are success-related), while the first type provides the least success-related BMCs (16% of all BMCs in cluster 1 are success-related) (see Figure 39). As shown before, the second type includes the BMCs with the highest implementation. This led us to the assumption that the second cluster includes the basic BMCs that are mandatory to run a cloud service but do not serve as a unique selling proposition compared to the BMCs in the third cluster.

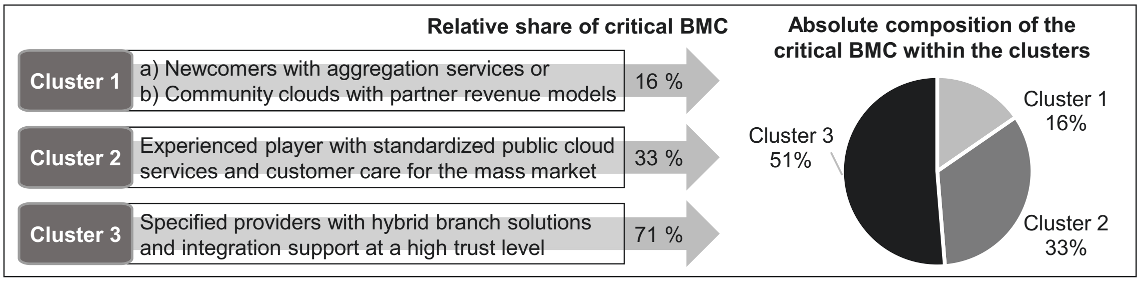


Figure 39: Successful Cloud Business Model Types

3.4.5 Expert Evaluation of the Analysis Results

Evaluation of the Success Factors in the Cloud Business Models

To evaluate our research results, we conducted expert interviews, as introduced in the research approach section. In performing the interviews, we addressed specific interview criteria such as credibility, transferability, dependability, and conformability to derive rigor and trustworthy results (Baxter and Eyles, 1997). In the first step, we sent the interview guide (see Annex, Figure 69) by mail, to allow the experts to prepare themselves for well-reflected answers. In the second step we conducted a personal depth interview face-to-face or via telephone (Gaskell, 2000) and discussed the important aspects the experts outlined. The interviews were conducted by the main authors who have expert knowledge in the research area (Hopf, 2004) and lasted between 30 and 60 minutes. To establish a natural conversational situation, we renounced the audio recording of the interview. The interviewees might keep unofficial but valuable information or answer the questions influenced by official or public expectations (Gläser and Laudel, 2010). Furthermore, it is argued that the recording can become irrelevant if the content is of importance and not how it is presented (Gläser and Laudel, 2010). Hence, the renouncement of recording and transcription can be tolerated in research (Liebhold and Trinczek, 2009) especially if it does not contribute to the quality of the results (Franz and Kopp, 2004). We documented each relevant piece of the expert's information on the developed interview protocol, partially with exact quotations.

Within the first part of the interview, the experts were asked to rank the identified components of a business model according to what they believe drives the success of a cloud business model. We built a ranking from all 12 experts and compared it to the results of the cloud literature and the correlation analysis (see Figure 40). The components in the cloud literature results were ranked by the number of authors who addressed this business model component and the number of specific success factors. The components that were addressed with the analysis of critical BMCs were ranked according to the relative share of critical BMCs for each component.

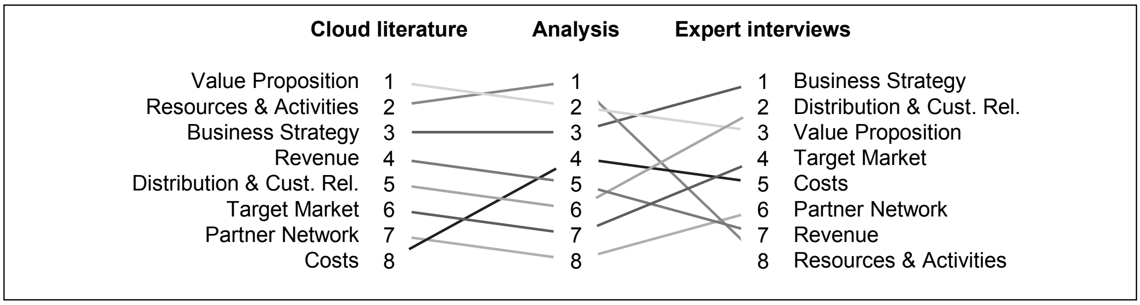


Figure 40: Comparison of the Research Results with the Expert Opinions

Whilst some components' ranks stayed relatively stable between the literature and the analysis results, the interviews revealed relevant differences. The value proposition is mentioned as the most important component in literature and lost one rank position in the business model analysis and one in the expert interviews in favor of other components. Nevertheless, cloud computing is mentioned as a highly disruptive concept that enables a huge variety of new services to address the cloud market. Resources and activities were ranked highly in the literature and analysis results but moved to the last place in the experts' views. They argued that resources are not important in the cloud market, because they are already existent at the customers' place or can easily be purchased on a cloud basis. The business strategy was already highly ranked in literature and practice, and the experts considered it as the most important component. The experts stated that innovation and a clear strategy are most important to differentiate a business model on the cloud market and build up a customer base. The revenue perspective was ranked in the literature within the upper ranking half and lost importance within the analysis and expert opinion. The experts argued that a valuable cloud service would have no problems finding a customer base that pays for it. The importance of the distribution and customer relationship was not valued very high in the literature and the analysis results but moved to the second position within the interviews. A good customer relationship was named as very important especially with highly standardized cloud services. The target market was also assessed as a more important component. The experts argued that new and specified cloud business models have to find a concrete market. The importance of partner networks is not highly valued in the literature and the analysis results but it increased in the expert interviews. Partner networks were mentioned as valuable to create end-to-end solutions and increase the time-to-market. The cost view is seen as the least important component in literature but increased within the analysis and also in expert opinion. Nevertheless, the experts argued that a cost focus would impede new cloud providers from innovating and is more valuable for large providers and saturated markets.

Evaluation of the Cloud Business Types

The second part of the interview addressed the business model types revealed in the analysis. The experts were asked what recommendation for action they would give to providers that see themselves with a certain fit to these types and want to increase their success.

The **newcomer cloud providers** (first type) are faced with a crowded market and need to define and understand their market entry strategy and their target market very well (e.g. to find niche markets with wealthy customers). They should use their advantages towards the large providers and develop agile, lean, and specialized cloud services and not focus on commodity IT. A view on the US market could be a beneficial thought as well. A partner network between providers is valuable for scalability, risk reduction, capital reduction, economies of scale, knowhow increase, and a faster time to market. This serves as a booster until the company has established itself and has gained enough experience and credentials. In a long-term view, partner dependencies should be reduced to minimize risks and weaknesses, because "it is still a battle". The financial components of costs and revenue streams play a secondary role compared to the right core concept for the right market.

The **standardized mass ware providers** (second type) have high economies of scale and a good understanding of their technology. Due to standardized services, a low trust level, and less direct contact to the customers, it is very critical to success to focus on a sound customer relationship, an effective branding, and a marketing strategy. Customer analyses help to specify the customer’s demands and to “imagine what the customer wants before they know they need it”. Furthermore, as the provided services are probably too complex for the average customer, providers need to increase the transparency and find an appropriate pricing model to generate revenue streams out of their offerings. Low service entry barriers such as free trials and premium customer services can additionally increase the profit. Channels, partnerships, and target markets are already established or easier to create to sell the value proposition; therefore, these components are not highly critical to success.

The **specialized cloud providers** (third type) “understand what, why and where they are doing what they are doing". An innovative and high qualitative core value, the right security strategy and high customer orientation result in high trust levels and customer loyalty. A partner network can be established to create end-to-end solutions and the providers must ensure that the business model cannot be imitated easily. The offer of options in the combination of off-premise and on-premise in the scope of hybrid cloud solutions and a smooth-running transformation process is still a unique selling proposition but in the future, legacy systems will become obsolete and each service will be standardized and flexible. To compensate for the lack of scalability in personal customer care, the providers need to use the disruptive cloud concept as a driver for continuous innovations that creates needs in the customers.

3.4.6 Conclusion

The purpose of our research was to determine success-driving characteristics of a cloud business model (see research question 1) and to identify the most successful business model types (see research question 2). For this reason, we examined the literature regarding success factors of business models in the cloud market and revealed a focus on value proposition, resources and activities and the cloud strategy. We complemented this theoretical view with a business model analysis of 45 cloud firms with a framework that comprises 105 business model characteristics (BMCs). A correlation analysis revealed a set of 39 success-related critical BMCs that confirmed the focus of the same business model components as highlighted in the literature. Through cluster analysis, we revealed three common patterns of BMCs combinations that describe business model meta types: (1) newcomers with partner-focused aggregation services, traditional channels and partner revenue models, (2) experienced providers with standardized public cloud services for the mass market based on own resources and a well-developed customer relationship, and (3) providers of specific branch solutions in hybrid provisioning models and integration support on a high trust level. The third type was assessed as the most successful, while the first type was described as the least successful player that has difficulties competing in the cloud market.

Within an evaluation with the 12 expert interviews, we reviewed the success factors given by the literature and analysis, and intensively discussed advice to increase the success of the revealed business model types. The aggregated expert advice led to recommendations for the business models of cloud providers that see themselves with a certain fit to these meta types. Cloud providers can use these recommendations as guidelines to optimize their business models and increase their success.

Regarding our research, we accept some limitations. For the analysis of the cloud business models, we considered the promoted information on the websites and news feeds. We evaluated the subjective information by the double control principle but we cannot prove the reliability of the stated information by the firms (especially regarding the product performance). As the cloud market is changing rapidly (e.g. SAP bought Concur in December 2014), our results may not be current. Besides, the research on key indicators for business model success seem to be neglected. Especially in young markets, where companies do not declassify financial information, there should be more measures related to the potential success of a business model. Within our analysis, the indicators seem to favor large and established firms rather than newcomers in the cloud market. Therefore, the comparison between large and small firms is difficult. Furthermore, the ranking of the interview results has no empirical value due to the small sample of 12 interviews.

For future research, we propose to break down our meta-approach and **conduct** selective analyses of firms with the same size, age or cloud level focus to produce results that are more comparable. Moreover, we suggest deepening the research on reliable indicators for the success of a business model.

4 Cooperation-Based Design Concepts for Cloud Business Models

The in-depth part of the present research focuses on artefacts that support a cooperative value creation of cloud service providers. This chapter comprises three scientific publications that address the research question B1 to B3.

The first section introduces the cooperation topic with a comparison of network theories and the development of a cooperation framework. The framework will be evaluated with the application to 16 community clouds in reality.

To decrease reservations towards cooperation in cloud computing, the second section shows the iterative development and workshop-based evaluation of a business board game that serves as simulation environment for a community cloud.

The third sections focuses on further cooperation incentives and describes the development and game-based evaluation of a mathematical profit sharing mechanism that increases the overall profit within a community cloud.

Table 19: Publications in the Cooperation-Based Concepts Chapter

Section	Title	Published (*Submitted*)*	Reference
4.1	The Value of Community Clouds for Collaboration in the Public Sector	Proceedings of the Americas Conference on Information Systems (AMCIS 2015)	(Labes and Zarnekow, 2015)
4.2	A game-based evaluation model for a successful cooperation in cloud computing	Proceedings of the Informatik Konferenz – Jahrestagung der Gesellschaft für Informatik. Lecture Notes in Informatics (LNI 2014) P.232	(Labes, 2014)
4.3	A Profit Allocation Mechanism for Business Cooperation in Cloud Computing	*Journal of Electronic Markets (EM 2016)* rejected for resubmission*	

4.1 Cooperation Value within Cloud Computing

Table 20: Details of Publication No. 4.1

Title	**The Value of Community Clouds for Collaboration in the Public Sector**
Authors	Stine Labes, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	Proceedings of the Americas Conference on Information Systems (AMCIS 2015)
Abstract	The public sector has discovered cloud computing technologies and therefore demands an adequate cloud provisioning model. The community cloud seems to be a good balance between safety and trust as well as efficiency, cost reduction, and competitiveness for public facilities. Following this presumption, we analyzed the network potential for cooperation in the public sector. First, we reviewed the scientific literature around this concept and clarified the term 'community cloud'. Then, we conducted a study of network theories to derive common values that are addressed in cooperation. In combination with network characteristics, we developed a framework that characterizes a network and assesses its specific network value. For evaluation purposes, we applied the framework to community cloud implementations in the public sector and discussed the results regarding the network value. The research findings reveal basic network values for community clouds in the public sector and will serve as analysis and assessment guidelines.
Keywords	Cloud computing, community cloud, network value, government, public sector
Link	http://aisel.aisnet.org/amcis2015/eGov/GeneralPresentations/3/
Version	Postprint in dissertation publication

4.1.1 Introduction

Cloud computing has been established as a technology and business concept in the information technology (IT) industry. With this concept, customers can obtain freely scalable IT resources (infrastructure, platform, software) in an on-demand manner via networks and pay usage-based fees (Mell and Grance, 2011; Weinhardt *et al.*, 2009). These resources "as a service" avoid long-term capital expenditures and can load for cost reductions. In the public sector, due to limited budgets, structural rigidities, and extreme risk aversion (Fischer and Figliola, 2013), financial investments in innovative IT technology are rare to date. Recently, public institutions have begun to realized that modern IT technologies are more efficient, enable cost reductions, can even increase safety (Liang, 2012) and allow attractive e-government offers for the citizens (Tan *et al.*, 2013). Therefore, there is increasing demand for a provisioning model that fits most closely to the conditions in the public sector. A public cloud allows freely scalable services, while a private cloud ensures critical or personal data. A hybrid cloud combines these two dimensions and processes critical data in a private environment and non-critical data on public cloud resources.

Combining all cloud advantages, a community cloud makes use of great synergies. Companies with the same needs, legal requirements, goals or the same data can cooperate and operate on a common IT resource pool without dependencies on third party vendors (Briscoe and Marinos, 2009b). This concept will overcome the lack of scalability and resource efficiency of private clouds as well as the loss of trust with public cloud services (Briscoe and Marinos, 2009b; Repschläger *et al.*, 2011; Liang, 2012). While the hype wave on public and private cloud services is over, the community model rises as a relevant technology trigger in practice (Butler, 2012; Gartner, 2013b). It is expected that government, healthcare, and financial sectors will roll out the earliest community cloud implementations, but the adoption process is slow (Haff, 2010). Reasons for this can be high entry barriers, high risks and investments, uncertainty of success, and a late reward. Nevertheless, forecasts for community clouds predict a market increase by a factor of five from 2013 to 2018 (MarketsAndMarkets, 2013).

To support this valuable migration of the public sector institutions into community cloud environments, we analyze how the community cloud should be applied to reach the highest benefits from the perspective of cooperation. Within this scope, we refer to general network theories and analyze the reasons for companies to cooperate. We address the research with two research questions:

(1) How can network theories and network characteristics contribute to a framework that evaluates the cooperation value of a network?

(2) Which community cloud type that can be derived from the literature has the highest value of cooperation within a community?

To answer the research questions, we structure the remainder of this article as follows: first, we introduce the related work regarding community clouds in the public sector and derive different cloud community types. Then, we present the research approach that addresses the research questions. Following this approach, we investigate generic network and cooperation theories to derive the basics for cooperative behavior and combine this with the characteristics of cooperative networks. Based on the results, we develop a framework to characterize a network and to assess its value regarding the reasons for cooperation. Afterwards, we analytically evaluate the framework with an application to the different community cloud categories. We use implemented community cloud examples in the public sector to discuss the network value for the different community cloud types and to derive implications for practice and future research.

4.1.2 Related Work

Regarding the literature on cloud concepts in the public sector, in-depth research is rare so far (Yang and Tate, 2012) and reveals a gap for e-government specific implications (Haag *et al.*, 2014). The public sector is mentioned as predestinated for community cloud provisioning (Marston *et al.*, 2011a). The differences in the broadband internet connection inherently influence the adoption worldwide, where the USA still has the pioneering role in this process (Evans and Yen, 2006; West, 2010).

A community cloud describes a close cooperation between companies or organizations in the cloud computing business. Government bodies often collaborate to develop a common cloud strategy (Corbin, 2012) or build a common cloud platform for their facilities (Wyld and Maurin, 2009). Particularly, the security and compliance aspects are enhanced with a community cloud (Paugh, 2012), therefore, collaborative networks are recommended also for the healthcare sector (Bach *et al.*, 2001). Research confirms that the customer's choice of a deployment model is driven by security and costs aspects; and the community cloud provides a compromise of both factors (Liang, 2012). Detailed studies have analyzed specific cloud aspects such as benefits, risks, and adoption challenges of software as a service (SaaS) for the public sector (Janssen and Joha, 2011) but have not focused on special community aspects. Other studies reported roadmaps and migration strategies for governments of different countries to prepare for the cloud, for example, Arab countries (Al-Khouri, 2013) and USA (Wyld, 2010).

Within the cloud sector, there are two distinct points of view for a community cloud model. Some researchers emphasize the customer side and describe the community cloud as a deployment model "for exclusive use by a specific community of consumers from organizations that have shared concerns" (Mell and Grance, 2011). Others focus on a community at the provider side and describe it as a deployment model for cooperative value generation. They concentrate on merging resources to profit from a major resource pool without dependences on third party vendors or additional acquisition (Briscoe and Marinos, 2009b; Saovapakhiran and Devetsikiotis, 2011). Hence, in offering or using a distinct cloud service, providers and/or customers can cooperate. The cooperation intensity between the customers is relatively low and not emphasized within academic publications. Cooperation at the provider side is analyzed primarily at a technical level with B2B integration scenarios (Schubert and Legner, 2011), government cloud federations (Villegas *et al.*, 2012; Kurze *et al.*, 2011), and inter-clouds (Aoyama and Sakai, 2011; Grozev and Buyya, 2014). For both provider-based and customer-based community clouds, organizational systematizations are rare. Deepening these thoughts, we propose a taxonomy with two dimensions for the differentiation between the customer and the provider side (see Figure 41).

In the **provider dimension**, either a single vendor provides the cloud service or more than one provider participates in the service creation. If more providers are involved, they can cooperate with each other by providing the cloud service or they can act independently. Within the literature, the provider-based community is closely related to "inter-cloud-computing" (Grozev and Buyya, 2014; Aoyama and Sakai, 2011; Popp *et al.*, 2013) and "cloud federation" (Kurze *et al.*, 2011; Toosi *et al.*, 2014). We made the same distinction for the **customer dimension**, so that the cloud service can be used as a single-tenant service by one customer or as a multi-tenant service by more than one customer. The customers can also cooperate using the cloud service or procure the service independently.

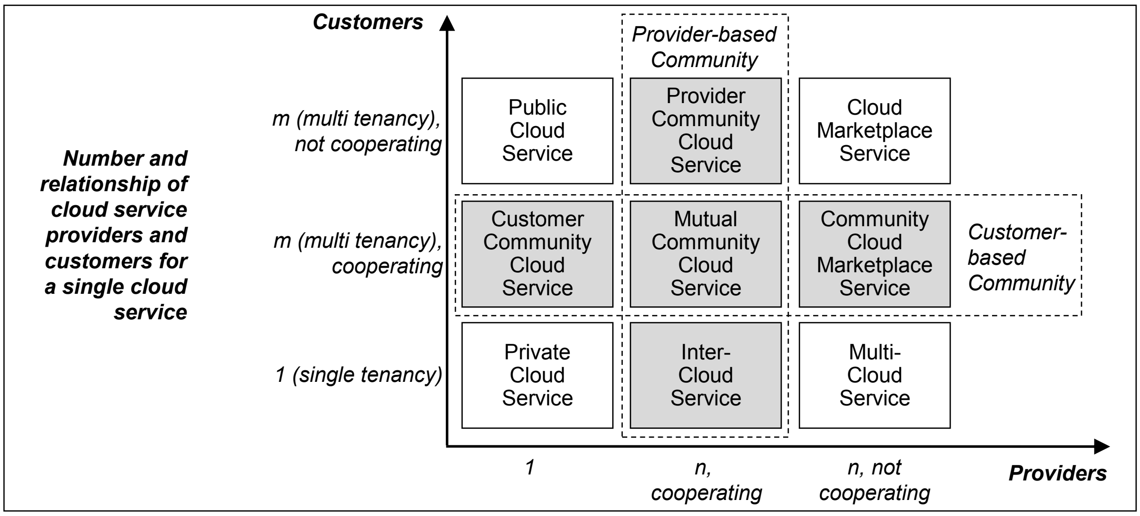


Figure 41: Taxonomy of Cloud Computing Services

A cloud service offered by a provider (first column of the figure) in a single-tenant manner to one customer is a *private cloud service*. If a group of customers (with shared concerns) use the cloud service, we can identify a *customer community cloud* (Mell and Grance, 2011). For example, this can be a "platform as a service" (PaaS) offered by a single provider for a gaming community where the customers commonly develop and modify applications with given cloud-based engines (Maximilien *et al.*, 2008). If the cloud service is multi-tenant and open to all customers, it describes a *public cloud service*.

A group of cooperating providers (second column of the figure) can provide an *inter-cloud service* (Grozev and Buyya, 2014) to one customer to enable a dynamic coordination of services and loads. With this joint service provisioning a customer avoids a vendor lock-in and profits from synchronized service levels, and reduced administration (Grozev and Buyya, 2014). If a community of providers serves also a group of cooperating customers (overlap of providers and customers is possible), we can identify a *mutual community cloud*. For example, NeCTAR is an association of Australian education institutions that commonly provide, maintain, and use cloud databases and tools (NeCTAR). If the provider-based community service is open to the market, we have a *provider community cloud*. An exemplary scenario here is an association of IT service providers for "infrastructure as a service" (IaaS) (Kurze *et al.*, 2011). The providers can collaborate and merge their IT resources regarding the distribution of risks and the assurance of high availability services (e.g. disaster management (Aoyama and Sakai, 2011; Grozev and Buyya, 2014)).

A cloud service that involves multiple independent providers (third column in the figure) for value creation and is used by one customer, describes for example the *multi-cloud scenario* (Grozev and Buyya, 2014). If more than one customer consumes the service, we can identify a *cloud marketplace* relationship. At a *community cloud marketplace*, the customers can cooperate, e.g. to exchange experiences with various services and service providers (Martens *et al.*, 2011).

4.1.3 Research Approach

In order to answer the research questions, we applied the design science research approach (Hevner *et al.*, 2004) to provide an artifact for subscription in practice (Gregor, 2006). We pursue the publication scheme for a design science research study (Gregor and Hevner, 2013) and followed the design science research guidelines. We aim to provide an evaluation framework for cooperation networks in cloud computing (Guideline 1: Design as an Artifact). This framework contributes to the promising, but rarely studied topic of community clouds. It supports the slow adoption process with a method to prove the network value of a community cloud design (Guideline 2: Problem Relevance). The evaluation part was conducted with an analytical assessment of the applicability and usability of the artifact. We analyzed community cloud implementations in the public sector, assigned them to the types of provider-based and customer-based communities and discussed their network value (Guideline 3: Design Evaluation). The combined foundations, the developed artifact as well as the derived implications for practice and future research shape the contribution of this research (Guideline 4: Research Contribution). We used and adopted the theoretical knowledge base to deductively develop a new artifact (Gregor and Hevner, 2013) (Guideline 5: Research Rigor). Within the development process, we first investigated economic and psychological network theories to examine their decision criteria for cooperation (Uzzi, 1996; Lado *et al.*, 1997). We used and iteratively extended a keyword search in different bibliographic databases for keywords such as "business network", "business cooperation", "network cooperation", "business network", "business community", "community cloud", "inter-cloud", "cloud federation", and "collaboration network". Researchers have applied network theories to explain specific cooperation issues (Clemons and Row, 1992; Lado *et al.*, 1997). We combined all the observed theories and their related concepts and revealed common values of network cooperation. The consideration of different theories in parallel is recommended by the literature (Grandori and Soda, 1995; Ketchen and Hult, G. Thomas M., 2007; Madhok, 2002; Poppo and Zenger, 1998). The derived values represent the frame of the artifact. In the second step, we extended the literature search with the keywords "characteristics", "attributes", and "properties" to derive deductively cooperation-based characteristics from the academic literature. We analyzed the literature and iteratively discussed the assignment of the network characteristics to the values of network cooperation. The developed framework shows how the characteristics of a network serve for an assessment of the network regarding its network value (Guideline 6: Design as a Search Process) (see Figure 42). We plan to present the research results to an academic audience as well as to practitioner forums in order to increase the visibility and give recommendations for action (Guideline 7: Communication of Research).

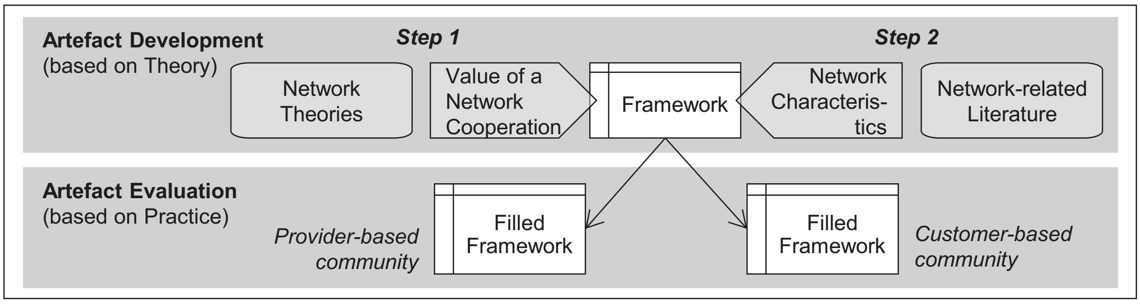


Figure 42: Research Structure

4.1.4 Cooperation Framework

Cooperation is the change from an individualistic behavior to a collectivistic behavior that enables advantages if all parties cooperate (i.e. "prisoner's dilemma"). With an agreement in advance, this strategy results in a stable state (Axelrod and Hamilton, 1981). Strategic networks have a positive effect on the performance of a company in general (Hinterhuber and Levin, 1994; Uzzi, 1996; Alvarez *et al.*, 2009; Rosenfeld, 1996). We studied various theories to build a rigorous framework from different perspectives. Within this process, we analyzed the New Institutional Economic Theories (Williamson, 2000; Uzzi, 1996) with Transaction Cost Theory (Coase, 1937; Williamson, 1979, 1985; Ebers and Gotsch, 1995), Principal Agent Theory (Laffont, 2003; Pratt *et al.*, 1991), and Property Rights Theory (Demsetz, 1967; Möller, 2006). Strategic Research was also considered with Knowledge-Based View (Grant, 1996), Capability-Based view (Wernerfelt, 1984), Resource-Based view (Wernerfelt, 1984), and Market-Based View (Srivastava *et al.*, 2001; Makhija, 2003). Furthermore, Organization Theories with Resource Dependency Theory (Pfeffer and Salancik, 1978) and Inter-Organizational Relations Theory (Evans and Yen, 2006) influence network creation. Additionally, we considered Co-opetition Theory (Bengtsson and Kock, 2000; Brandenburger and Nalebuff, 1997), Game Theory (Neumann and Morgenstern, 1944; Axelrod and Hamilton, 1981), Evolution Theory (Darwin, 2009; Margolis, 1984), and social influences (Granovetter, 1983; Hofstede and Hofstede, 2005; Uzzi, 1996) to complement the framework. With an overview of the network theories, we can derive five common values that are addressed within the theory description (see Figure 43): reduction of the transaction costs, interdependencies between the members, a strengthened market situation, access to rare resources and economies of scale. These common values constitute the categories for the evaluation framework of cooperation networks.

Network Theory	Cooperation Value in the Network	Common Value
Transaction Cost Theory	A network decreases transaction costs with middle specific and middle uncertain services as well as a high number of similar transactions.	Cost Savings
Property Rights Theory	A network is the optimal cooperation model to decrease transaction costs and external effects.	
Principal Agent Theory	A network establishes interdependencies through equal rights between client and supplier, which causes a high trust level and lower agency costs.	Interdependencies
Resource Dependency Theory	Network cooperation causes interdependencies that equate the strength of all members and enhances the trust and risk tolerance regarding resource dependencies.	
Interorganizational Theory	A network grows with the trading of more complex goods and services and leads to interdependencies and relationships of trust between the partners.	
Game Theory	Network cooperation can ensure higher economic benefits within an unstable Pareto equilibrium.	
Evolution Theory	Cooperative behavior can increase the moral obligation and commitment of the community regarding future group interests.	
Social influences	Network cooperation can induce social influenced behavior that avoid destructive decisions or strategies.	
Market-Based View	Network cooperation is used to establish barriers to market entry.	Market Strength
Co-opetition Theory	Network of cooperation and competition leads to a high rate of innovations supported by enhanced access and usage of resources, knowledge or capabilities.	
Resource-Based View	Network cooperation is used to optimize the access and usage of rare resources.	Resource Access
Knowledge-Based View	A network optimizes the access, intensity, structure, and process intelligence of special knowledge and enables the development of new process knowledge or common standards.	
Competence-Based View	A network reduces the operating expenses through joint planning, management and monitoring as well as an optimal use of the resources.	Economies of Scale

Figure 43: Common Cooperation Values of the Network Theories

Regarding the **transaction costs** category, we have found a few characteristics that have an influence on the transaction of services and property rights. The *number of parties* (Blecker and Liebhart, 2006; Borchert and Urspruch, 2003) can increase the volume of similar transactions in a network. The *relations* between the legally independent individuals or organizations can have economic, political, or social bindings (Borchert and Urspruch, 2003; Blecker and Liebhart, 2006; Harland, 1996) that are established e.g. to decrease external effects of property rights. The *type of* distributed *services* within a network are batch or interactive jobs (Grozev and Buyya, 2014) whereas only batch jobs decrease the transaction costs.

The network value of **interdependencies** is affected by a high number of network characteristics. The *degree of cooperation* for a network can vary between no cooperation (market, external procurement of services) to full cooperation (hierarchy, in-house production of services) (Oxley, 1997; Powell, 1990; Thorelli, 1986), while a middle degree of cooperation causes the highest mutual interdependencies. The *participation level* of the organization can include the entire company, individual areas, or just a few employees (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003), whereas the last variant does not establish high interdependencies. The *relation intensity* between the members varies from verbal agreement via a written contract to capital equity (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Laffont, 2003; Möller, 2006; Pratt *et al.*, 1991) and enhances the interdependencies. The *development* of a community can be on an ad hoc basis or grown over the course of time (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Möller, 2006). When growth is not well planned interdependencies can especially increase(Evans and Yen, 2006). The *temporal existence* of a network is defined as unlimited in duration or for a fixed period of time or task (Borchert and Urspruch, 2003). Interdependencies will grow with the intended duration. The *cooperating roles* of the members in a network can be customers (similar to principal), providers (similar to agent) or coordinators (Briscoe and Marinos, 2009a, 2009b; Pratt *et al.*, 1991). The highest interdependencies occur with mutual overlaps between the roles.

The category of **market strength** is addressed by the following characteristics. The *identity* of a cooperative network can be established by a uniform public appearance (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003) to reach a better market position as a larger player. Further, the geographic *distribution* of the members characterizes a cooperation network (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Grozev and Buyya, 2014; Hofstede and Hofstede, 2005) and is relevant to strengthen the market situation especially for local and regional player.

Characteristics that focus on the **resource access** are for example the *company size* of the members (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003). Primary medium- and small-sized members profit from networks (Rosenfeld, 1996) while large organizations often have enough resources on their own to compete in the market. Further, we distinguish the *involvement* that describes an active or passive participation of the members (Borchert and Urspruch, 2003; Evans and Yen, 2006). The value of knowledge sharing will increase with higher involvement. The *value added stage* considers cooperating organizations on a horizontal level e.g. to extend their resource capacities, or a vertical level e.g. to access related but not available resources (Möller *et al.*, 2005). Usually participants with the same interests collaborate; therefore, a lateral cooperation is rare.

Regarding increasing **economies of scale** through cooperation, the *scope* of responsibility distinguishes between supporting services core competences (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; MarketsAndMarkets, 2013; Bengtsson and Kock, 2000), where supporting services have a higher standardization to enable economies of scale. Second, the type of the shared *competences* is defined by its function, e.g. sourcing or production (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Bengtsson and Kock, 2000). Networks can be particularly valuable in specific *branches* such as government, healthcare, financial, logistics, education, and gaming (MarketsAndMarkets, 2013). The network value regarding economies of scale is high within the same branches with the same needs. Activities at the value creation side have lower risks in networks than on the value delivery side (Brandenburger and Nalebuff, 1997). Regarding governance, we distinguish an internal or an external *management* (Bellmann and Gerster, 2006; Borchert and Urspruch, 2003; Grozev and Buyya, 2014). An internal management has a higher potential to enable economies of scale, especially when its *coordination* mechanism (Briscoe and Marinos, 2009b) is centralized.

For a cooperating venture, categorized with the network characteristics, the framework shown in Figure 44 can offer an evaluation whether the community model provides a valuable contribution to the business. The expressions of characteristics with the highest network value are highlighted in *italics*.

Value	Characteristic	Expression of Characteristic						
Transaction Cost	Number of parties	*High*	Middle	Low				
	Relations	*Economic*	*Political*	Social				
	Type of service	*Batch*	Interactive					
Interdependencies	Degree of cooperation	High	*Middle*	Low				
	Participation level	*Entire company*	*Individual areas*	Few employees				
	Relation intensity	*Capital equity*	*Written contract*	Verbal agreement				
	Development	Ad hoc	*Grown*					
	Temporal existence	*Unlimited*	Temporary					
	Cooperating roles	Customers	Providers	Coordinators	*Mixed*			
Market Strength	Identity	*Uniform appearance*	No uniform appearance					
	Distribution	*Local*	*Regional*	National	International			
Resource Access	Company size	Large	*Medium*	*Small*	Single individuals			
	Involvement	*Active*	Passive					
	Value added stage	*Horizontal*	*Vertical*	Lateral				
Economies of Scale	Scope	*Supporting services*	Core competencies					
	Competencies	*Sourcing*	*Research*	*Infrastructure*	Technology	Development	Production	Supply
	Branches	*Same*	Different					
	Management	*Internal*	External					
	Coordination	*Centralized*	Decentralized					

Figure 44: Community Cloud Framework

4.1.5 Framework Evaluation

The developed framework supports new cooperation ventures to describe, analyze, and assess the network value of their community cloud implementation. We evaluated the framework regarding its usability and applicability in the practical context. For this reason, we compared the network value of the community cloud types that were derived from the related work earlier. We found 16 highly relevant cases in the public sector, classified them as customer-based or provider-based community (see Table 21), and compared the results of the framework application.

Table 21: Community Cloud Cases for the Framework Evaluation

Case	Government Cloud Service	Coun-try	Commu-nity Type
A	Since 2008, the distributed institutions of Carlsbad (California) use the online communication and collaboration services by Microsoft (http://info.apps.gov/content/city-carlsbad-california).	USA	Customer
B	Since 2008, Washington D.C. is using the “Google App Services” in 86 departments. Los Angeles (California) also provides Google’s cloud services to their departments since 2009. Since 2012, the State Orlando and the US Department of Interior uses Google’s email services as well (http://gov.googleapps.com/).	USA	Customer
C	Since 2009, the General Service Administration (GSA) offers a platform with IaaS, PaaS and SaaS for public institutions in the USA (www.apps.gov). The platform closed in 2012 and was replaced by an information site on cloud computing in government (http://info.apps.gov/).	USA	Customer
D	Since 2011, Amazon provides the AWS GovCloud for the public authorities of the US (http://aws.amazon.com/de/govcloud-us/) and the CIA (http://fcw.com/Articles/2013/03/18/amazon-cia-cloud.aspx).	USA	Customer
E	Since 2012 with the Nebula project, the NASA uses a unified platform for web space, development tools and centralized services for scientists and researchers on a cloud basis (http://www.nasa.gov/open).	USA	Customer
F	In 2011, Canada’s economic action plan is to reduce the data centers and consolidate the IT services with the “Shared Services Canada” (http://news.gc.ca/web/article-en.do?nid=614499)	Canada	Customer
G	Since 2012, Canada uses the “IBM SmartCloud Enterprises” to enhance delivery capabilities (https://apps.na.collabserv.com/).	Canada	Customer
H	In December 2013 started a program named “Meghraj” that means king-cloud and aims to move government data, services and application to a shared government cloud (http://www.livemint.com/Industry/RN7yyjLwbeV66tPCXfrJUM/Cloud-computing-Govt-to-roll-out-Meghraj-in-Dec.html).	India	Customer
I	In 2009, Japan’s Ministry of Internal Affairs and Communications (MIC) decided to build an inter-ministerial cloud platform named “Kasumigaseki Cloud”. The implementation consolidates all IT systems of the public sector and is targeted for 2015 (http://www.cloudbook.net/directories/gov-clouds/gov-program.php?id=100016).	Japan	Customer
J	Since 2011, Singapore starts to implement Google Apps, e-learning platforms, a cloud-based toll-system and expands its broadband network (http://www.ngp.org.sg/documents/Cloud_Computing _in_Singapore_1st_Edition.pdf).	Singa-pore	Customer
K	The eHealth action plan 2012-2020 aims to unite the European countries by providing smarter, safer and patient-centered health services (http://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=9156)	Europe	Customer
L	Since 2010, the British authorities plan the government cloud “G-Cloud” as a network for all British public institutions with IaaS, PaaS, and SaaS (http://www.cloudbook.net/directories/gov-clouds/uk-government-cio-council).	UK	Customer
M	Since 2011, the services of the Danish procurement authority are sourced to the largest telecommunications company in Denmark IDC (http://www.datacentres.com/news/tdc-gets-danish-cloud-computing-framework-deal).	Den-mark	Customer
N	In 2010, the Australian project National eResearch Collaboration Tools and Resources (NeCTAR) starts to deliver virtual laboratories, electronic research tools, and a federated research cloud on a shared environment (http://www.nectar.org.au/).	Aus-tralia	Mutual
O	Since 2010, a Cloud-Enabled Space Weather Modelling and Data Assimilation Platform (CESWP) is a science community and enables space weather simulations to scientists around the world (http://www.cybera.ca/projects/completed-projects/ceswp/).	Canada	Mutual
P	Since 2011, the Government Green Cloud Laboratory (GGC-Lab) analyses saving potentials with an energy efficient load balancing between public IT service providers (http://www.ggc-lab.de).	Ger-many	Provider

Customer-based Community Cloud

Customer-based communities in the public sector describe government institutions that cooperate to increase the bargaining power in negotiations for private cloud structures. Therefore, governments often make a deal with a large cloud service provider (e.g. Amazon, IBM, or Oracle) to combine data, cloud resources, and services to create a smart government platform for the distributed facilities of a government. For example, more than 100 government organizations in the USA are using the cloud services of Amazon's AWS (Chandra and Bhador, 2012) (Case D) and a other governments are using Google App Services (Cases B, J). The joint management of capabilities and knowledge can reduce the operating expenses and ensure optimal use of resources, unified knowledge, processes and federal structures.

In consideration of the **transaction cost** characteristics in the framework, many institutions cooperate to increase the value of shared information, e.g. regarding the citizens (Cases A-D, F-L). A customer-based community cloud in the public sector often cooperates on a political basis, while social aspects are rare. The type of collaboration cloud services used is primarily interactive (Cases A-C, E-H, J-L).

Regarding the **interdependencies**, the customers in a community cloud act at a medium cooperation network level, but they have a little minor cooperation effort with tendencies to the market mode (Cases A-D, F-J, M). If the community serves as a shared IT resource pool for the customers (e.g. Case D), only the IT departments are involved in the community. Contractual relations are the basis for the cooperation. Due to critical data in the public sector, a community cloud is a sensitive topic so that implementations in the government sector show a planned cooperation development. The existing customer-based communities are rather long-term government networks, but a temporal limit is conceivable as well in the public sector, e.g. for a legislative period. The cooperating roles are primarily the customers with integrated coordinators (Cases A-M).

To increase the **market strength**, the given implementations of customer-based communities in the public sector show a uniform identity (Cases A-D, F-M) that confirms the cross-linked market power and increases the trust and growth potential. The location of the customer-based communities affects developed countries in around the globe where the community can cross borders and reach from regional (Cases A, B) to international (Cases E, K).

To benefit from **resource access**, primary small to medium-sized government institutions collaborate and rather passively use a shared resource pool or cloud hardware and software service. They act at a horizontal value added stage and aim at the availability of complementary and substitutable resources as well as shared data (e.g. nationwide data of citizens) and IT services (Cases A-D, F-M). This implies a reduction of redundantly stored data, facilitates the exchange of information, and accelerates the processes in the public sector.

The precondition for **economies of scale** is reached with similar structures and processes in the same branch when they share basic IT services (e.g. security, backup, applications) or process data with similar business applications. In the case of basic IT services (Cases

A-D, F-M), the type of the shared competences in the network is rather far from the consumers at the value creation site but in sharing the same specialized services with data near the customer (Case E), the competencies move closer to the customer at the value delivery side. Primarily, an external provider with a centralized architecture manages the cloud services, databases, knowledge sharing, common rules, and standards.

Provider-based Community Cloud

Provider-based communities in the public sector describe governmental IT service providers that work together in the value creation of their services. They describe federated inter-clouds in academic and industry projects. The academic projects are usually realized as a mutual community cloud that provide and use research and data on a cloud basis (Cases N, O). Implementations are less frequent and not in the same stage of development as customer communities.

Regarding the **transaction costs**, the number of parties is rather low in provider-based communities, because of the exponentially increasing administration effort (Case P). These communities cooperate in political as well as economic relations to profit from the cooperative agreement that limits the adjustments of property rights. The shared jobs are rather interactive services in collaboration communities (Case N) and batch jobs (Cases O, P) in a cooperative IT provision.

The **interdependencies** will be established with a middle degree of cooperation that has tendencies towards hierarchy (Case P) to ensure a higher trust level between the provider-based community members. With a cooperation between providers in a shared value creation, often the entire company is part of the community and a higher cooperative involvement is required (Case P). The contractual relations strictly define requirements, penalties, and revenue streams (Case P). In addition, provider-based communities are developed ad hoc and are established without a fixed end. The cooperating roles are IT services providers (Case P) or individuals (Case N, O) that join in a community and share IT services and data in mixed roles from the provider- and the customer perspective.

The **market strength** will not be increased with a uniform identity (Case N-P), because a common market strength on the provider side is rather obstructive regarding competition regulations (Case P). Due to individual restrictions for providers in different countries (especially the data protection requirements), provider-based communities in the public sector are rather located in regional or national areas of developed countries (Case P) and borders are crossed only in uncritical cases (Case O).

To make use of the **resource access** the cooperating providers are middle-sized companies that rather actively operate a defined order in a community, share knowledge and create common standards (Case N-P). The providers act within a heterarchical network of equal rights at a horizontal level (Case N-P). A vertical cooperation along the value-added chain is conceivable if the relation is not a simple procurement process, but a close partner contract.

Regarding the use of **economies of scale**, the analyzed communities have good opportunities by cooperating in their supporting services in the value creation within the same high potential branch (e.g. infrastructure, service operation, and analytics) (Case P). Provider-based communities in the public sector prefer an internal management to share competencies and use economies of scale (Case P). Regarding the coordination, providers do not want to lose sovereignty and prefer a polycentric leadership (Case P). This architecture represents the interests of all members in the community, but requires a high coordination effort. The considered mutual science communities (Cases N, O) show similar expressions of the characteristics as the customer-based communities.

4.1.6 Comparison and Discussion

The community-related implementations reviewed show an imbalance in favor of the customer-based communities. Even the provider-based communities identified in practice tend to be mutual community clouds where the cooperating members are provider and customer at the same time.

Regarding the decrease in **transaction costs**, the customer-based communities benefit with a high number of transactions between many participants and bindings that decrease political external effects. The rather interactive transactions are not applicable for large distances between the members. Provider-based communities do not maximize the number of transactions because of administration effort between many members (Provan and Kenis, 2008). On the valuable side, their political and economic bindings limit the adjustments of property rights and the processed batch jobs cause lower transaction costs in a network (Coase, 1937; Williamson, 1979, 1985).

For both types, **interdependencies** are established with a middle cooperative network mode that is the optimal compromise for better reliability of the service than with internal provisioning or a higher trust level than with external procurement. The networks are established for rather long-term periods (Holland and Lockett, 1998) and contractual relations in the community provide safety and risk reduction (Pratt *et al.*, 1991; Laffont, 2003). The high trust level between the governmental IT service providers and their customers is a sound condition for cloud computing in the public sector, i.e. between public authorities, as well as between public authorities and the citizens. Trust is an essential precondition in a community cloud, because cooperating members sacrifice knowledge advantages in contribution to the success of the community. However, provider-based communities have higher interdependencies with a more intense relationship than in customer-based communities. The most profitable advantage of interdependencies appears in mutual communities of overlapping roles where each member acts as a principal and agent at the same time (Briscoe and Marinos, 2009a, 2009b; Pratt *et al.*, 1991). This reduces agency costs, because it is not profitable to increase the individual's utility level at the expense of other members.

In the **market strength** perspective, customer-based communities benefit from a uniform appearance to reach a greater market power for negotiations with providers while this uniform identity can be disadvantageous for provider-based communities. Both types have a high market benefit in combining local and regional institutions.

Regarding the **resource access**, it is conspicuous that customer-based as well as provider-based communities use the cooperation concept to increase the resource benefits of small and medium sized companies while large enterprises often have enough resources on their own to compete in the market. Both community cloud types have cooperating members in the same branch but members in provider-based communities are more actively involved in the cooperation than in customer-based communities. Therefore, the benefit from knowledge alliances, new process knowledge, and common standards is much higher in this community type.

Due to **economies of scale**, cooperating companies in both types profit from increased similar transactions in standardized infrastructure services (Ebers and Gotsch, 1995). Especially the public sector can benefit from standardized services to compensate for future personnel shortages. The shared services in provider-based communities have higher benefits for networks because the risk is lower of the services that are located at the value creation side (Bengtsson and Kock, 2000). Customer-based communities need to take care not to share too much of their core competencies. The external management in customer-based communities induces a loss of control for the community members and is therefore not advisable for communities with critical data or services. Provider-based communities have an internal management but struggle with a complex architecture. This implies the presumption that the establishment of a provider community cloud is a more difficult venture compared to a customer community.

Regarding the strategic network value, the provider-based community can provide more overall advantages. They profit from higher interdependencies, better availability and usage of resources or knowhow, and higher economies of scale with resource efficiency. The customer-based communities only reach a slightly better network value within the market perspective (see Figure 45).

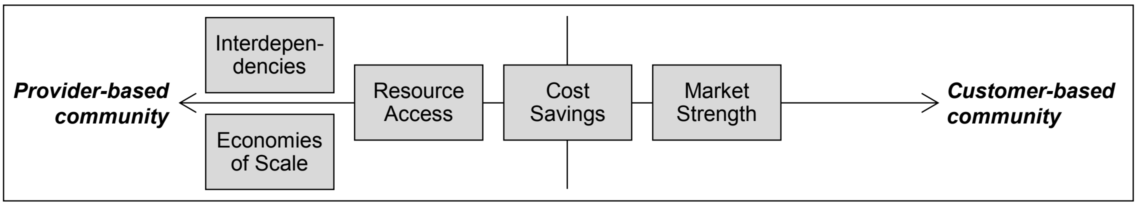


Figure 45: Network Value of Provider-based and Customer-based Communities

4.1.7 Conclusion

Summarizing our research, we can confirm the community cloud as an appropriate provisioning model for the public sector. The research revealed that the establishment of a community cloud is a complex and difficult venture and needs to be supported.

To address this need, our contribution is manifold. First, we enlighten the reader regarding the community cloud concept and propose the distinction between provider-based and customer-based community clouds. Then, we gave an overview of network theories that are used by scientific authors to explain cooperation. Based on these theories, we created a framework to characterize a community cloud and evaluate its network value. This framework serves as an analysis guideline to assess the community cloud model for new or existing cloud ventures and answers the first research question. Finally, we evaluated this framework for provider- and customer-based community clouds to answer the second research question. We exposed the community cloud type that has better chances to establish particular network value. The provider-based community showed the most benefits from a network cooperation.

Practitioners can use the framework as a guideline for the assessment of a planned community cloud implementation. The framework is not only valid for the public sector and can be used in a related context. The evaluation results of both community types serve as an orientation guide for relevant network values that should be addressed in the implementation process in detail.

The academic research can support this gap by further investigations of community clouds. An increasing acceptance of cloud computing, especially in the public sector, will overcome the mentioned challenges to reap the benefits. A deeper case study research of community clouds and other evaluations in practice can complement the results and eliminate limitations.

The framework does not give an artifact with a comprehensive and final set of network characteristics but it is extendable. Another drawback of the research is the sample-based evaluation, where the community clouds are distributed unevenly in practice and the information was gathered by web search only. These limitations can be remedied with the further research suggestions.

4.2 Simulation Environment for Cloud Cooperation

Table 22: Details of Publication No. 4.2

Title	**A game-based evaluation model for a successful cooperation in cloud computing**
Author	Stine Labes Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Published	Proceedings of the Informatik Konferenz – Jahrestagung der Gesellschaft für Informatik. Lecture Notes in Informatics (LNI 2014) P.232
Abstract	While the cloud concept has passed the hype of emerging technologies, community clouds became more popular, but are rarely addressed in publications so far. Within our research, we iteratively developed a business board game that contributes to give a more elaborate and realistic user experience for a complex cooperative situation and the strategy development in a community cloud. With action research, the game closely fits to a relevant defined problem and we validated its efficacy within a workshop with expert IT practitioners. Finally, we conclude with benefits for academic research and practical implementations.
Keywords	Cloud Computing, community cloud, cooperation, business game, serious game
Link	http://subs.emis.de/LNI/Proceedings/Proceedings232/371.pdf
Version	Postprint in dissertation publication

4.2.1 Introduction

Over the last few years, cloud computing got established as a technology concept in the information technology (IT) industry. With this concept, customers can obtain freely scalable IT resources (e.g. servers, storage, applications, and network resources) in an on-demand manner via networks (intranet or internet) and pay usage-based fees (Mell and Grance, 2009; Weinhardt *et al.*, 2009). These resources "as a Service" avoid long-term capital expenditures, can load for cost reductions and promote the flexibility of IT provisioning, particularly in the budget-limited public sector.

There exist four cloud provisioning models with an increasing legal separation of clients combined with a decreasing opening to publically accessible network resources: public (multi-tenancy, internet), private (single-tenancy, intranet), hybrid (combination of private and public), and the community cloud (restricted multi-tenancy, merger of intranets from several organizations). While the hype on public and private cloud services seems to be over, the community model rises as a relevant provisioning model in practice (Gartner, 2013b; Haff, 2010; Butler, 2012). Organizations with the same needs, legal requirements, goals or the same data can cooperate, merge their intranets, and use a common IT resource pool without dependences on third party vendors (Briscoe and Marinos, 2009b). This will overcome the lack of scalability and resource efficiency of private clouds and the loss of trust with public cloud services (Briscoe and Marinos, 2009b; Liang, 2012; Repschläger *et al.*, 2011).

As Henry Ford already mentioned, "*Coming together is a beginning; keeping together is progress; working together is success*" (Henry Ford, 1863-1947). For participating in a long-term cooperation, a high involvement is required for the community that takes into account the cooperative and competitive behavior for each member. To cope with the sensitivity for this situation in advance, members will benefit from a simulation situation where they can test different strategies before they come to the decision to take part in the contract-related productive mode of the community cloud.

In this study, we are interested in examining if a business board game can contribute to a more elaborate and realistic user experience for the cooperative situation, the decision-making and the strategies to be pursued. For this approach, we will first give some theoretical background on cooperation in cloud computing and related work on the promoted game context. Afterwards we introduce our research approach and formulate the research questions. Then the background for the business board game is described as well as the game design and the evaluating experiments with IT service providers. The outcomes of our research will be relevant to comparable complex situations. We end with a discussion of the results and draw conclusions for academic research and practice.

4.2.2 Theoretical Foundation

Embodying cooperation in cloud computing, a community cloud describes a cloud provisioning model that "aspires to combine distributed resource provision from Grid Computing, distributed control from Digital Ecosystems and sustainability from Green Computing […], while making greater use of self-management advances from Autonomic Computing" (Briscoe and Marinos, 2009a). Following this conceptualization, we further propose the differentiation of two types of communities in the cloud: provider-based and customer-based community clouds (see Figure 46). In offering or using a distinct cloud service, either the providers or the customers can collaborate and cooperate.

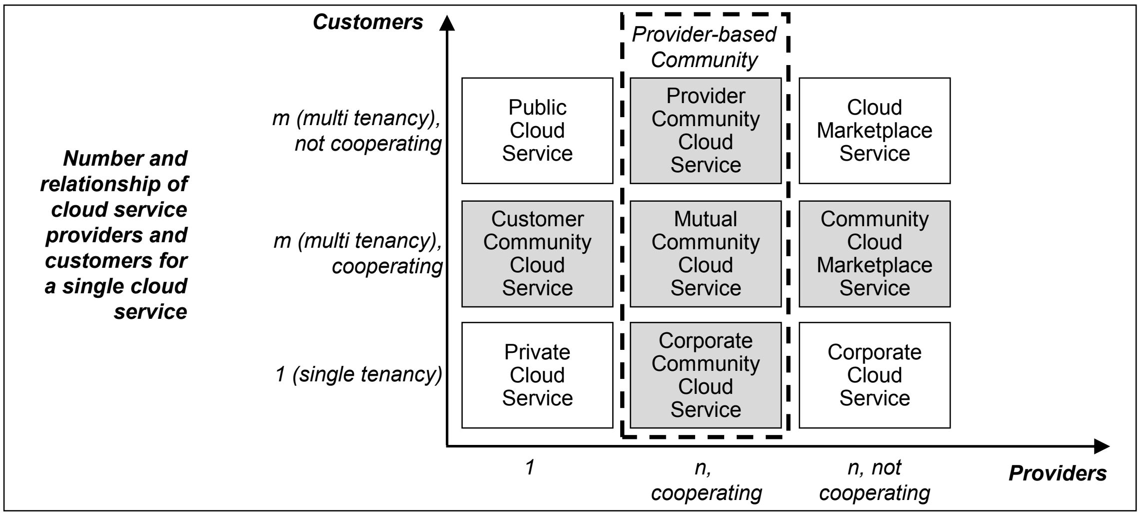


Figure 46: Types of a Community Cloud

A customer-based community cloud can be established if the same cloud service is used and shared by an association of customers. For example, a customer community cloud can be a governmental cloud service (e.g. software application) offered by one big cloud service provider for the cooperating institutions of a dedicated country or state with similar needs and interests. A provider-based community cloud is a service offered by a merger of cloud service providers with similar services and objectives. For instance, they collaborate to collectively provide a cloud service, to extend their range of services or to share their IT resource pools to gain resource efficiency. An exemplary scenario for a provider community is the assurance of high availability for services (e.g. disaster management). A mutual community cloud, i.e. a provider- and a customer-based community cloud at the same time, is for example a community of research and education facilities, where all community members have access to actual research data and can support each other by processing this research data. With the use of private clouds, high requirements for data protection are met as well. Therefore, also medical units or other fields with critical data can profit from this provisioning model. With our game-based research, we address the provider-based community cloud types.

4.2.3 Related Work

In academic research, community clouds are eminently underrepresented. Only a few authors have focused on this cloud provisioning model so far. Practical implementations of customer-based communities are seen in the public, medical or gaming sector, while provider-based communities are rare and still laboratory projects only.

Reasons for this gap can be high community entry barriers, high risks and investments, but uncertainty of success and a late reward. To address these issues, a possibility is required, where potential members can test their real behavior in a simulated environment (Lang *et al.*, 2009) to decrease the uncertainty. Traditional methods for this goal do not provide the optimal opportunity to link abstract concepts with the background in practice (Ben-Zvi and Carton, 2008) or have a higher financial effort (Streefkerk *et al.*, 2008). Therefore, serious games are proposed as evaluation tool (Lang *et al.*, 2009). These games are systems with a specific intent to assist, persuade or deceive the player's behavior (Benbasat *et al.*, 1987; Chatterjee and Price, 2009; Fogg, 2003; Oinas-Kukkonen and Harjumaa, 2009). Other authors focus on the user activity of play and call it "meaningful play" (Salen and Zimmermann, 2004). A similar approach is the use of games with a human computer interface, supported by different authors. To support the practical context of such games, the design of the game must closely describe the context situation and decision processes (Bevan, 1995; Jokela, 2003). Moreover, the game should differentiate which elements needs to be controlled or eliminated to finally get a relevant model (Dunn and Guadagno, 2012) for community (cloud) cooperation in practice. A game manager plays an important role and provides immediate feedback to the players (Kiili, 2005). Complementing the considerations, some authors provide summaries of related work for serious gaming in the business context (Hasan and Verenikina, 2009; Liu *et al.*, 2013; Faria *et al.*, 2009).

Similar approaches are implemented in other research projects. One publication deals with a game-based approach for a similar complex situation, where astronauts can test personalized support situations in advance of a long duration mission (Smets, N. J. J. M. *et al.*, 2008). Other authors validate the game simulation method as a vehicle for testing an environment of decision-making for decision support systems (Ben-Zvi, 2009) or the use of an enterprise resource planning system (Foster and Hopkins, 2011). Complementing this, some authors propose a business game taxonomy to develop an international and open database for business games (Greco *et al.*, 2013) or to classify game-playing research (Liu *et al.*, 2013). Considering this classification, game research rather focuses individualistic but less cooperative or competitive game design so far (Liu *et al.*, 2013).

4.2.4 Research Approach

The goal of our research is to develop a game that emulates the situation of a provider-based community cloud to promote the imagination of the players. This game should help to analyze the players' behavior to finally derive implications for the success of a community cloud. Following this intention, we distinguish two research questions:

(1) How should a business board game look like to emulate a provider-based community cloud and create a realistic experience for participating players?

(2) Does the business board game produce a more elaborate user experience for the cooperative situation, the decision-making and the strategies to be pursued?

Within the scope of design science research (Hevner *et al.*, 2004), we use a multi-method approach to follow a proposed four-step game development approach (Lang *et al.*, 2009). First, the (1) problem definition is answered with action research, where we accompanied a community cloud project, conducted several interviews and a workshop with the community cloud members. From the results, we derive preconditions, basics and design principles for the (2) game conception. The game design aims to fulfil the development principles of persuasive system design (Oinas-Kukkonen and Harjumaa, 2009; Pisan and Tan, 2012) for serious games or "games with a purpose" (Ahn and Dabbish, 2008; Deterding *et al.*, 2011; Herzig *et al.*, 2012). These guidelines propose e.g. enjoyment factors, an accurate game result insurance, and evaluation measures (Ahn and Dabbish, 2008; Deterding *et al.*, 2011; Herzig *et al.*, 2012). After the rough conceptualization, we (3) play the game and iteratively revise the specifications. Finally, we (4) analyze the game and validate the efficacy of the game approach with a workshop experiment with four practitioners having expertise in IT service providing but not as a community cloud member.

4.2.5 Community Cloud Game

Problem Definition

The game bases on the practical intention to implement a community cloud as part of the project "Government Green Cloud Laboratory (GGC-Lab)". The GGC-Lab project is funded by the German Federal Ministry of Economics and Energy to analyze the possibilities of environmental sustainability and resource efficiency of the IT in the public sector. The project covers the use case of providing intelligent and cloud-based software application services based on a community of cooperating IT service providers. The project consortium consists of currently four public IT service providers, where each provider serves his own customers in the public sector. While those customers use software applications, the IT service provider needs to handle the resulting computing load. In the GGC-Lab, this load can be processed decentrally on the distributed IT infrastructures of the community members. In case of capacity shortage or cost saving targets, each member has the choice to transfer the load to the community. Based on efficiency criteria, a resource controller balances the load to save costs and generate the best community profit. The efficiency is described by the energy costs for processing the load order. Other balancing strategies are considered as well, such as the amount of energy, the emission of carbon dioxide or a sustainable energy mix. Summing up, the project intends to optimize the IT utilization, get a flexible resource approach, consolidate and standardize the service provisioning, increase the service quality and finally reduce the service costs.

This situation is emulated with the game, where the players benefit from a simulation framework for developing and testing strategies of potential community cloud members. Within the community game, the players have to process different load orders, can optimize their resource efficiency, and will be influenced by environmental events.

Game Conception

Along with the project GGC-Lab, the board game provides a fixed framework for long-term community cooperation. Static features display the community cloud construction and describe the game design. Procedural features model the community cloud processes and describe the playing process.

Static features of the game conception

The design of the board game considers a game board that represents the community cloud. Further, every player has a smaller personal board that depicts the own infrastructure resources (building and IT capacity) and is connected with the community game board. A deck of shuffled load order cards is positioned in the middle of the game board with the backside facing up. Controlled by a thrown dice, the players move on a game path in predefined rounds (see Figure 23), influenced by random events:

» **Sit out**: "Your community contract is in revision, you have to miss a round."

» **Heat**: "The temperature is rising and causes extra cooling effort for your IT. Your costs per processed unit increase about +5€."

» **Cold**: "The temperature is decreasing and causes less cooling effort of your IT. Your costs per processed unit decrease about -5€."

» **Increasing energy costs**: "The energy price at the energy stock market increases. Your costs per processed unit increase about +5€."

» **Decreasing energy costs**: "The energy price at the energy stock market drops. Your costs per processed unit decrease about -5€."

» **Server infrastructure failure**: "Problems with your IT infrastructure force you to deliver your received load order to the community."

» **Network failure**: "Problems with your network connection force you to process your received load order on your own."

Moving on the game path, the players can optimize their own infrastructure resources (building and IT capacity) and need to process load orders. Load units are represented by cubed gaming pieces that differ in color (shades of grey) to show the payment value of the load unit. Other cubed gaming pieces (white) signify capacity units in optimization mode. The concrete design of these features is justified with the practical background of the projects' problem definition (see Table 24).

Table 23: Static Features of the Game Path

Feature	Characteristic	Background of the problem definition
Path event	The players move on a path of random event- and non-event-fields.	By operating a data center, changing conditions and not anticipated events occur.
	The event fields influence the efficiency and the ability of the player to process or deliver load orders.	The data processing can be influenced by random environmental, technical, or contractual impacts.
Playthroughs	Fixed number of playthroughs per game, 2 to 4 are recommended.	This means the medium-term view of the cooperation.
Rounds	Fixed number of 4 rounds per playthrough.	It is the short-term equivalent with accounting periods.
	Changing starting player per round in clockwise direction.	This covers the varying order situation and balance the positions of the members.

Table 24: Static Features of the Game Content

Feature	Characteristic	Background of the problem definition
Capacity	Every player has 9 capacity units for load processing; a capacity unit can process a load unit.	Every IT service provider of the community has its own server infrastructure dedicated for community orders.
	The capacity units will be occupied for a round when they are optimized or process a load order.	While the server infrastructure is under construction for efficiency or busy, the capacity units will not be available.
Efficiency	The player starts with an efficiency of level “A” with 100€ costs per processed load unit.	At the beginning, the costs are relatively high and aligned with the revenue possibilities and an efficiency incentive.
	The optimization of capacity units costs 20€ per unit and upgrade (“A+++” is maximum) and causes -1€ costs for the efficiency in the next rounds.	The optimization costs for the capacity units are aligned with the amortization through energy savings of the IT investment after assumed 2 accounting periods.
	The optimization of the building and air-conditioning technology with 50€ per upgrade (“A+++” is maximum) has an effect of -4€ costs for the efficiency in the next rounds.	The optimization costs for the building and air-conditioning technology is aligned with the amortization through energy savings of the investment after assumed 12.5 accounting periods.
Orders	The load volume varies between 2 and 10 load units; the frequency distribution is equal for each load.	Variety of orders, from small to not grantable with own capacity. The frequency distribution is experimented and iteratively balanced with the capacities.
	The payment varies between 90€, 100€ and 110€ per processed load unit; the frequency distribution is equal for each payment.	Without optimization, the revenue covers the average costs of a members load processing. Underpaid orders are usual, e.g. to maintain an important customer.
	If a job cannot be processed completely, a penalty (10% of the order value) occurs to the player who brings in the order.	This case corresponds with a violation of service level agreements. The handling in practice inspires the height of the penalty.
Finance	Players have a seed capital of 500€.	Members have limited financial background.
	Each round has fixed costs of 20€.	The height is iteratively balanced with the average costs and the revenue.

Procedural features of the game conception

Starting the game process, the first player has to be drawn by a random method. He starts the first round in the first playthrough and can continue the game process (see Figure 47). Each move of the active player contains sub-processes for improving the capacities and processing the load orders. After each player has moved, a balance of accounts follows and the next round starts. After pre-defined number of playthroughs, the game ends and a score needs to be calculated to determine the winner.

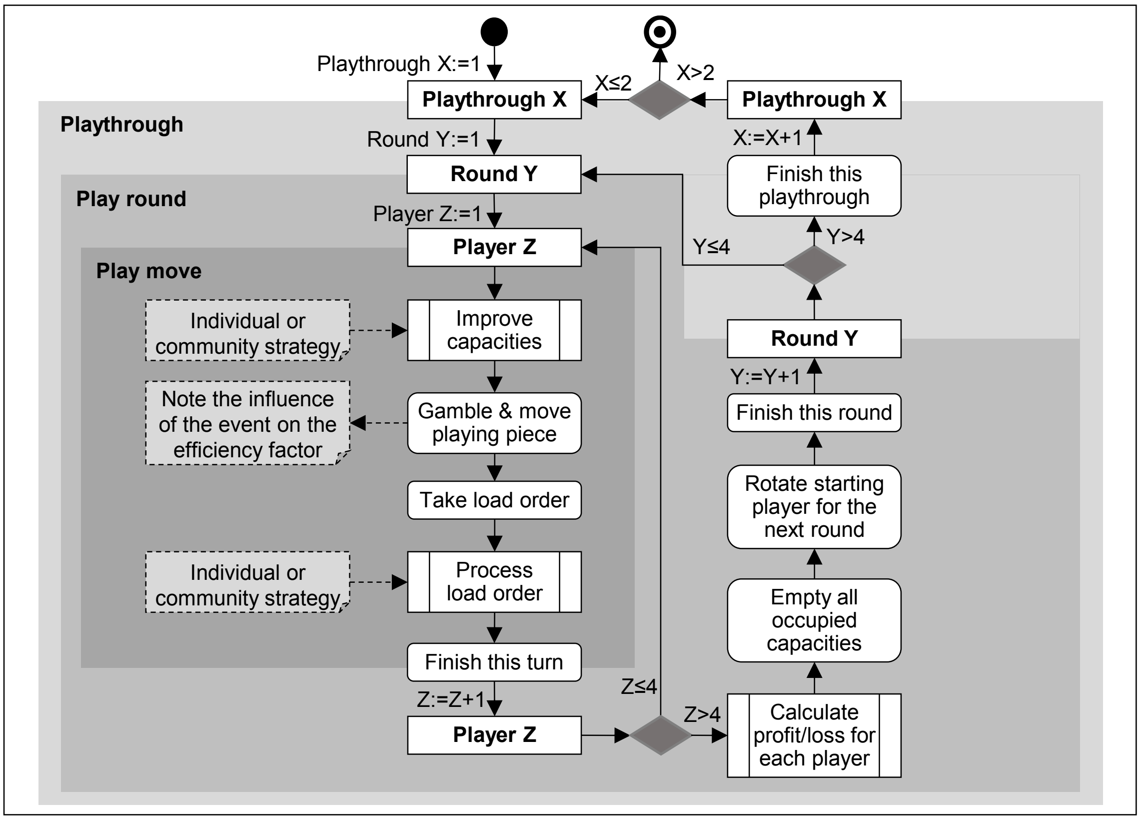


Figure 47: Rule Design in the Game Process

The first sub-process describes the optimization decision (see Figure 48). A player can optionally optimize his resources for the next rounds but with the optimization mode, he occupies his resources for the actual round and has limited capacities to process load units and earn revenue. The more efficient a player is the higher is its profit from the load order processing.

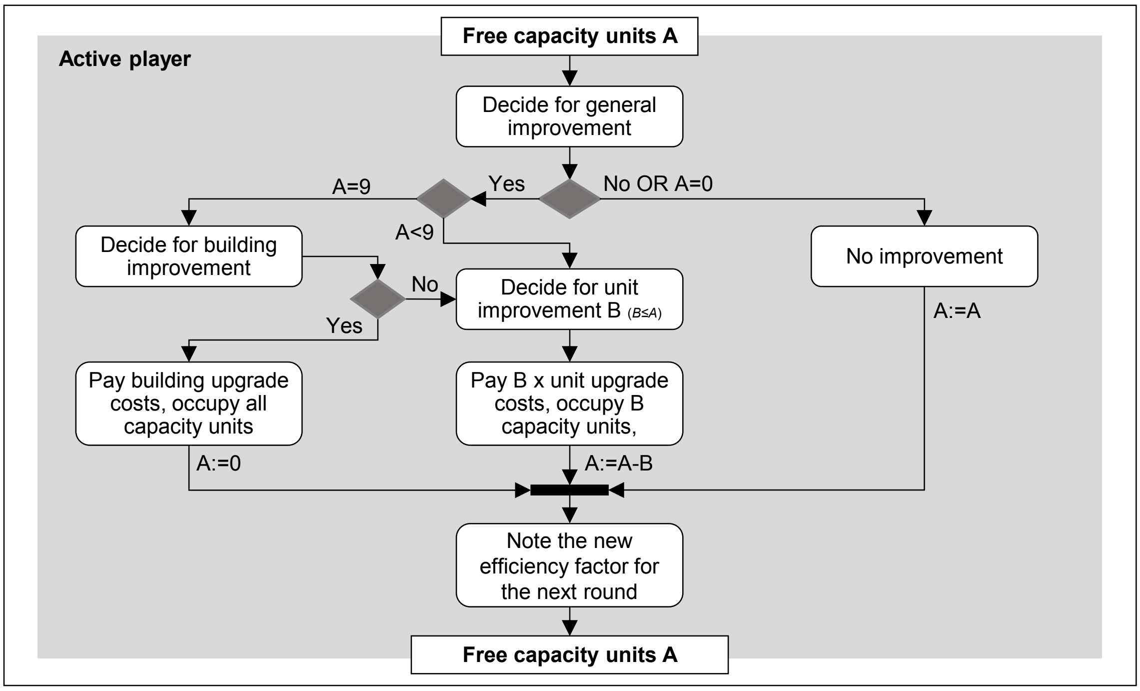


Figure 48: Rule Design in the Sub-Process "Improve Capacities"

The second sub-process (see Figure 49) describes the load processing decision: a player receives a load order and has to process the load within the limits of capacity or deliver load units to the community. By providing load units to the community, the next best efficient player has the first choice to process the load. This continues until the load order is fully processed or the delivering player needs to pay a penalty.

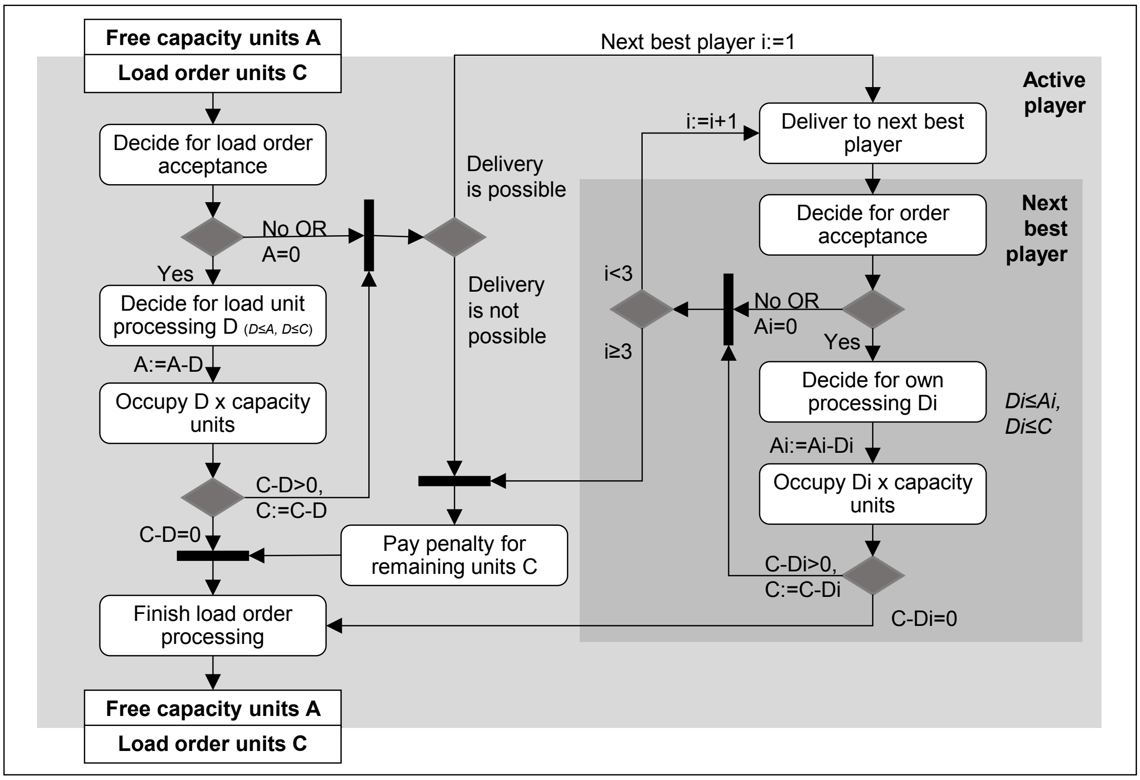


Figure 49: Rule Design in the Sub-Process "Process Load Order"

Game Play and Game Strategy

Before playing the community cloud game, the players need to agree on a community strategy. There exist two opposite strategy positions: complete individual optimum (egoistic) and perfect community optimum (altruistic). While an egoistic strategy aims at maximizing the own infrastructure utilization and account balance, the altruistic strategy tends to optimize the overall savings. The final strategy can be positioned between both extremes and some policies for acting should be formulated, e.g. when is a player allowed to optimize his resources or when should a player deliver his load order to the community. A game manager can enforce the agreed strategy and plays an active role by reflecting the game decisions to the players.

The goal of the game is to be successful with the developed strategy. To measure this fact and to increase the players' enjoyment, we calculate a score for active and efficient behavior. Each player wants to gain the highest score. Within an egoistic strategy, each player's goal is to optimize his account and have a higher balance than the other players do; therefore, the score includes the profit of the own load processing and the proportionally account balance. The other extreme is to renounce the freedom of choice for the load delivery to the community, so that only the efficient players will process the load orders.

Following this strategy, the score includes the profit of the transferred overall profit and the proportionally efficiency factor.

To combine the advantages of both strategies, a hybrid strategy considers the resource and cost optimization of the community, but also optimizes and balances the individual optimum. Along with the approach of persuasive systems (Lehto *et al.*, 2012; Oinas-Kukkonen and Harjumaa, 2009; Pisan and Tan, 2012), such a strategy should be incentivized within the game, e.g. with a special revenue sharing model. This model can (a) provide a commission for delivered load orders to incentivize the transfer of load units to the community. Moreover, the formula uses a profit share to (b) facilitate a compensation of the effort of joining and participation in the community and another share (c) according the efficiency performance of the members to incentivize the active involvement. The score for the members includes the profit of the own and the delivered load processing as well as the proportional account balance and efficiency factor.

We tested the game elements several times, e.g. with different load order volumes and compensations or costs for optimizations, to finally get a playable and interesting game. To give the reader a visual impression of the game, the prototype of the designed game is shown in the following picture (see Figure 50).

Figure 50: Game Prototype for the Community Cloud Simulation Game

Game Analysis

We validated the game-based approach with an experimental workshop to demonstrate the effectiveness and reliability of the game. Four expert IT providers played the game to give qualitative feedback and develop the scope of pursued strategies and policies. Within this workshop, we tested two scenarios and compared the results of the incentivizing revenue sharing formula with the normal revenue sharing:

1. Egoistic strategy with the goal of maximization the own account balancing
2. Cooperative strategy with the goal of optimization the overall account balancing
    a. Regular revenue sharing option
    b. Revenue sharing formula option

We played both game variants with two playthroughs. The feedback of the players was eminently positive. Initially, the game was perceived as 'complex' but with the increasing understanding, the players perceived the simulation situation as very realistic and felt the fun factor when they can process a well-paid load order. Within the egoistic game variant, the players have the major challenge to decide for optimizing the IT or keep open the possibility of load processing for profit making. Playing the cooperative variant, the players got deep into the situation and became aware of the important things to decide and the common policies to be agreed upon. Once, the players had identified the cooperative goal and their individual roles, they improved their teamwork with strong coordination skills. They developed and pursued strategies and give ideas for changing or extending the ruleset to make the game more realistic.

Comparing the results from the egoistic and the cooperative game variants, we can detect tendencies for a more profitable processing in the cooperative variant (see Figure 51). The total number and average revenue of the processed units was approximately identical in both played variants, which promotes a comparability of the results. Comprehensible, the proportion of delivered units to the community is higher in the cooperative than the egoistic strategy. The delivery causes a higher profit in the cooperative game, even though the optimization effort was slightly smaller. The overall balancing of the accounts is a little higher with the cooperative strategy. This difference should increase with the number of playthroughs.

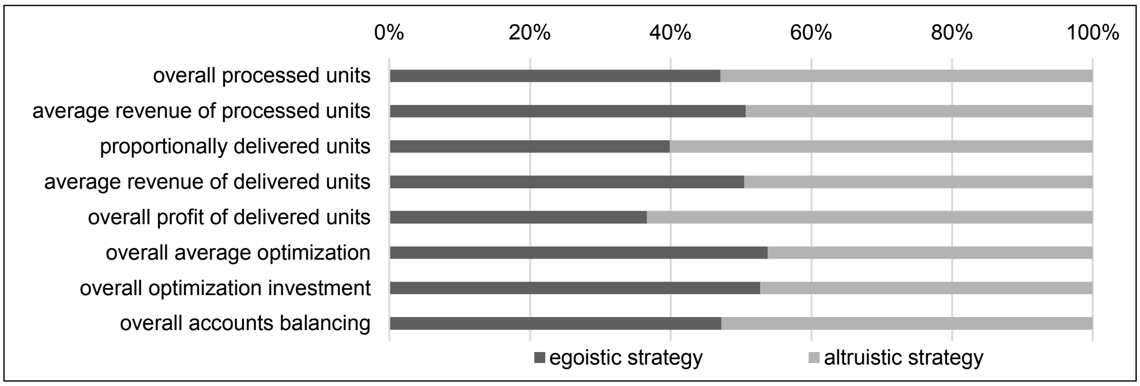


Figure 51: Comparison of the Egoistic and Altruistic Game Strategy

The generated profit surplus with the cooperative strategy can be allocated to the players to incentivize their altruistic behavior. This can be implemented with the proposed revenue sharing formula and aspire a more levelled balance of accounts (see Figure 6).

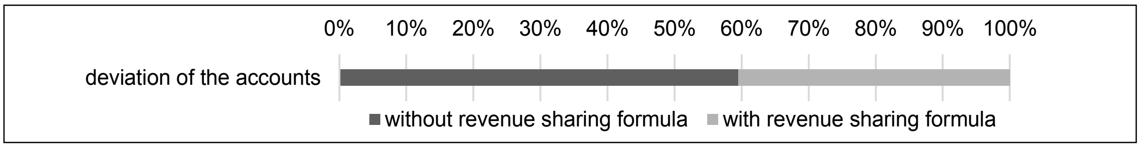


Figure 52: Deviation of the Accounts within the Altruistic Game Strategy

4.2.6 Conclusion and Outlook

With our research, we contribute with a novel evaluation method for testing realistic behavior in a simulated situation. This situation is the participating and strategy developing in a community cloud, a relatively immature field in research and practice. Hence, our project is rather positioned as an invention, regarding the knowledge contribution framework of the design science research (Gregor and Hevner, 2013).

Answering the first research question, we developed a board game, closely derived from action research in a real project, and validated it with playing experiments in an expert workshop. Regarding the second research question, the workshop confirmed the expected intensification of the sensitivity for the cooperation scenario and the players appreciated the game for the simulation possibility.

Our benefits for academic research are manifold. For our research, we can determine the scope of strategies and goals for cooperating IT service providers in a community cloud. The game gives the possibility to analyze which strategies or rules are successful. Furthermore, we have a tool to simulate an implemented revenue sharing mechanism that helps to set incentives for a cooperative behavior of the community members. Our theoretical implication is a transferable method to use a serious game for the analysis and understanding of the participants' behavior.

In practical terms, the game can be used for workshops to inspire the participants with the possibilities of cooperative behavior in cloud computing and help to shift traditional opinions. We have demonstrated that the concept is an enjoyable and inexpensive method to enable complex decision-making in a simulated environment.

Looking to future research options, the game should be analyzed with more playthroughs to verify the results of the strategy comparison. Moreover, different experiment settings can be compared with control groups, the number of players could be raised, and a higher number of game processing gives more evaluated answers. Further, a structured survey can analyze how the game-based approach affects the players' opinion. Finally, to implement and automate the game process, an online version of the game could be valuable for more quantitative analyses.

4.3 Incentivizing Profit Sharing Mechanism for Cloud Cooperation

Table 25: Details of Publication No. 4.3

Title	**A Profit Allocation Mechanism for Business Cooperation in Cloud Computing**
Authors	Stine Labes, Rüdiger Zarnekow Technical University of Berlin Chair of Information and Communication Management Straße des 17. Juni 135, 10623 Berlin, Germany
Submitted	Journal of Electronic Markets (EM 2016) - rejected for resubmission
Abstract	The community cloud is a provisioning model that combines the high trust level of private clouds with the scalability and resource efficiency of the public cloud concept. A common value creation in a community cloud of cooperating but individual IT service providers requires a fair profit allocation. Due to a lack in the related literature regarding a suitable basis for a profit sharing mechanism, we discussed design goals in workshops with IT providers. Following a design science approach, we iteratively developed an incentivizing profit sharing mechanism with mathematical equations. The evaluation includes numerical examples and describes a validation of the incentive system conducting a game-based simulation workshop with additional IT providers. The results show that the developed incentive system of the profit sharing mechanism enhances the cooperativeness of the IT providers and increases the overall profit compared to an egoistic or a cooperative strategy without profit sharing.
Keywords	Community cloud, profit allocation, cooperative business model
Link	-
Version	Preprint in dissertation publication

4.3.1 Introduction

In the globalized world, business companies are faced with increasing competitive pressure, saturated markets, and various technical and regulatory market barriers. While the strategic form of economic organizations is primarily dominated by competition (Lado *et al.*, 1997; Porter, 1980), cooperation between businesses help meeting the mentioned challenges and increase the success of the individual firms (Alvarez *et al.*, 2009; Hinterhuber and Levin, 1994; Rosenfeld, 1996; Uzzi, 1996). A cooperation network is a collaborative form of economic organization that aims at mutual advantages in external competition through internal cooperation (Borchert and Urspruch, 2003; Uzzi, 1996; Thorelli, 1986). This cooperation can take place hierarchically on a vertical level along the supply chain or heterarchically on a horizontal level between companies at the same stage in the supply chain (Sacchetti and Tortia, 2015).

In our digital age, the cooperative approach emphasizes another benefit that addresses the very recent security discussion (as evidenced by the increasing number of publications in the AIS Electronic Library). A digitally isolated company probably has the lowest risk regarding computer viruses, data theft or other system attacks. However, this isolation impedes inter-firm coordination with suppliers or partners and limits economic benefits and resource efficiency. To secure their economic digital survival, companies need to become inventive in operating their future business.

Prime example of a security-sensitive topic is cloud computing. Based on existing technology concepts such as virtualization, cloud computing enriches the IT industry with innovative business models. With this concept, customers can obtain freely scalable IT resources (e.g. servers, storage, applications, and network resources) in an on-demand manner via networks (intranet or internet) and pay usage-based fees (Mell and Grance, 2011; Weinhardt *et al.*, 2009). These resources "as a Service" avoid long-term capital expenditures, can lead to cost reductions, and promote the flexibility of IT provisioning.

Data storage and processing by third parties via public internet structures influences the customers' perception of trust and data security in a negative way (Briscoe and Marinos, 2009b). This discussion is driven by business segments such as the public (Liang, 2012) or healthcare sector (Bach *et al.*, 2001) and is still a considerable impediment to the adoption of cloud computing (Han *et al.*, 2014). Four provisioning models affect these security aspects and already consider a cooperative approach. We distinguish between public, private, hybrid, and community cloud models (Mell and Grance, 2011). While public cloud services reach the highest economies of scale and scope with its multi-tenancy provisioning (Armbrust *et al.*, 2010), private clouds are hosted or managed for single tenants and maintain all data under the legal control of the organization to reduce the mentioned risks (Jamil and Zaki, 2011). Most customers prefer private cloud structures to handle their data (Maher *et al.*, 2013; KPMG, 2013), but due to the necessity of dedicated resources, scalability and cost reductions through resource efficiency are limited.

The community cloud provisioning model can offer a solution to remedy this dilemma. Companies with the same needs, legal requirements, goals or the same data have the opportunity to cooperate and operate on a shared IT resource pool without depending on third party vendors (Briscoe and Marinos, 2009b). Especially the standardized and module-based cloud services simplify a cooperative service creation or service usage. This will also improve the lack of scalability and resource efficiency of private clouds and address the loss of trust and security with public cloud services (Briscoe and Marinos, 2009b; Liang, 2012; Repschläger *et al.*, 2011).

However, academic authors as well as practitioners concentrate on the models of public and private cloud computing, while the community cloud has played a minor role so far. Reasons for a slow adoption process in practice can be high organizational entry barriers (Schoedwell *et al.*, 2014), high risks and investments as well as uncertainty of success and late rewards. These obstacles can be overcome with a transparent mechanism that gives incentives for cooperative behavior and allocates all profits and liabilities between the community members fairly.

The aim of this study is to address this research gap and examine such a profit sharing mechanism. First, we will analyze the literature regarding profit allocation in cooperative networks. Then, we evaluate the theory basics for cooperation and develop our research approach. In order to align the mechanism with existing needs, we discuss design principles with IT experts. Further, we iteratively develop a mechanism and test it with numerical input parameters to reach a well-balanced formula. Finally, we evaluate this mechanism within a numerical example and a simulation game for IT experts, where they can test their real behavior and cooperation strategies in a simulated community cloud environment.

4.3.2 Related Work

The academic literature considers cooperation in cloud computing from two sides. On the one hand, the National Institute of Standards and Technology (NIST) positions cloud cooperation on the customers' side with the community cloud concept, which is a service that "is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns" (Mell and Grance, 2011). Other authors follow this definition and broaden it with the cooperation on the provider side also defining the community cloud as cooperation network "with nodes potentially fulfilling all roles, consumer, producer, and most importantly coordinator" (Briscoe and Marinos, 2009a). Related terms in the literature describe the provider-based cooperation with "inter-cloud-computing" (Grozev and Buyya, 2014; Aoyama and Sakai, 2011; Popp *et al.*, 2013) and "cloud federation" (Kurze *et al.*, 2011; Toosi *et al.*, 2014).

Deepening these thoughts, we propose to distinguish between customer-based communities where customers cooperate in using the cloud service and provider-based communities with providers cooperating in creating the cloud service (blinded reference). In academic research, only a few authors focused this provisioning model until now. Practical implementations of customer-based communities exist in the public, medical, and gaming sectors, while provider-based communities primarily address infrastructure resource sharing (Aoyama and Sakai, 2011).

In customer-based communities, the members use the revenue model given by one provider, so there is no complex profit distribution between the consuming community members. This is different on the providers' side, where the internal cost and revenue allocation is a complex and open issue. A group of cooperating providers can offer an inter-cloud service to customers enabling a dynamic coordination of services and processing workloads. The costs and the incoming revenue streams of conjointly generated value need to be allocated fairly. With this joint service provisioning a customer avoids vendor lock-in and profits from synchronized service levels as well as reduced administration effort (Grozev and Buyya, 2014).

In order to determine existing approaches for profit sharing mechanisms in a cooperation network, we draw together the relevant papers around community clouds, inter-organizational cooperation and the internal distribution of profits. The following databases were accessed: AISeL, EBSCO (Business Source Complete), Google Scholar, and IEEE Xplore (Source: Communication, Networking & Broadcasting; Computing & Processing). To query these databases, we combined keywords of the cooperation focus, the profit focus, and the distribution focus as search items in the abstracts of the articles:

> *"abstract: (community cloud OR inter-cloud OR inter-organizational OR network OR cooperation OR business web OR cloud federation) AND abstract: (revenue OR cost OR profit OR proceeds OR billing OR incentive OR payoff OR income) AND abstract: (model OR system OR allocation OR sharing OR distribution OR scheme OR accounting OR split OR settlement)"*

We selected publications based on their title, screened over 200 abstracts, extracted relevant publications, and complemented our literature basis through forward (author-based) and backward (reference-based) search.

On a strategic level, business webs or networks "bring together mutually networked, permanently changing legally *independent actors* in customer centric, mostly *heterarchical organizational forms* in order to create (joint) value for customers" (Blau *et al.*, 2009). The authors followed the works of Tapscott *et al.* (2000) and Steiner (2005) who analyzed the success of network-based business models of value creation. Some authors mentioned critical preconditions and functional requirements of the cooperating systems, but an internal profit distribution was not specified any further (Aoyama and Sakai, 2011; Grozev and Buyya, 2014). However, academic authors confirmed an "*equitable and efficient formula* […] for the distribution of profits generated by the network" as a central issue (Lakhal, 2006). Kräkel (2006) analyzed the individual profit seeking in exogenous and endogenous profits and justified that a high internal struggle on profit sharing discourages profitable firms ("adverse selection"). He concluded that cooperating organizations are more likely to survive that are "most successful in solving problems of *internal rent seeking*".

Most authors and initiatives focused on technical aspects of cloud computing (Khajeh-Hosseini *et al.*, 2010; Aoyama and Sakai, 2011). Actual literature on the community cloud is rare, especially from the provider's point of view (Li *et al.*, 2009). The community cloud is well defined in only two publications by Briscoe and Marinos (2009a; 2009b). They combined cloud computing with digital ecosystems and defined a community cloud as a self-managed and democratic association of cooperating cloud providers and users with the same interests (Briscoe and Marinos, 2009b, 2009a). According to both authors, the community can develop a cloud for their special interests and usually address a *limited customer base*. Furthermore, the authors mentioned that a *community currency* should be considered as membership increases in numbers. Regarding the required community currency, Brandl *et al.* (2007) addressed the problem of allocating costs for shared IT services and infrastructures. They stated that a fully apportioned resource consumption (e.g. CPU time) is not useful in distributed value creation. Therefore, they proposed a measurement methodology and a software toolkit for the determination of the resource profiles using only logged service invocations as a *general billing unit* instead of metering every component during the operation. Regarding the technical integration of a community, Schubert and Legner (2011) revealed five different cooperation scenarios with a centralized or decentralized approach. The "parallel use of different information systems with data interchange and direct connection" is the most commonly adapted scenario for vertical and horizontal integrations. This *decentralized integration* mode avoids the partners' loss of control and allows additional profits to be allocated to the partners without dependencies on third-party providers. Due to *savings* within an integrated community cloud regarding coordination costs (Legner, 2009) and resource efficiency (Repschläger *et al.*, 2011), the additional profit needs to be *allocated fairly*. Moreover, this profit distribution model must provide *incentives* for the members to form a competitive situation where everyone has more benefits from active cooperation than with selfish behavior (Li and Lee, 2008).

Earlier research offers profit distribution approaches in related fields, but not for the case of community clouds. Chauhan and Proth (2005) provided a profit sharing model for a provider-retailer partnership that maximizes the combined profit. Also Lakhal (2006) used a mathematical approach to propose a model for determining transfer prices in network-manufacturing ventures that maximizes operating profits. Furthermore, Chen *et al.* (2008) proposed a cost- and efficiency-based profit-sharing mechanism for production-distribution alliances. Li and Lee (2008) investigated the business model of resource providers in a peer production system. They have analyzed the centralized and decentralized structure and provided an incentive mechanism to prevent over provisioning. Aram *et al.* (2009) analyzed stable coalitions between providers of wireless networks that maximize the providers' aggregated payoff, using a game theory approach. Blau *et al.* (2010) developed an auction mechanism to coordinate value creation in service value networks and a transfer function to implement incentives and increase a network's degree of interoperability. Moreover, Zong and Peng (2011) used game theory to investigate the distribution game of cooperative innovation income of modular production networks. They built an apportion model to ensure the successful operation of cooperation innovation. For coalition in wireless networks, Lu *et al.* (2011) confirmed the question for a stable allocation of the additional profit and calculated the payoff optimization for the service providers in a coalitional game. Aram *et al.* (2009) further developed their approach with a payoff coalition game and calculated the providers' payoffs within the cooperation (Singh *et al.*, 2012). Cho and Yi (2013) also used a coalition game theory approach to develop an incentive structure for a stable cooperation in peer-assisted services with multiple content providers.

Many authors focus on profit sharing along the value chain coordination, e.g. simulative negotiation of the profit sharing contract in value chains (Giannoccaro and Pontrandolfo, 2009). Unfortunately, these approaches consider different hierarchical levels, not equal members at the same stage in the value chain.

4.3.3 Research Approach

The manuscript aims at promoting the cooperation between cloud computing companies and encourages shared generated value. Therefore, we developed a profit sharing mechanism for the community cloud purpose and addressed this issue with the following research questions:

(1) Which profit sharing mechanism can incentivize a cooperative value creation in the community cloud?

(2) Does the mechanism lead to preferred community value creation by providers in contrast to an individual value creation?

To explain specific cooperation issues, scientific researchers have applied network theories for their research approaches (Clemons and Row, 1992; Lado *et al.*, 1997). Within our research, we want to study and influence the behavior and strategy making of IT service providers to reach higher profits within cooperation compared to an egoistic behavior. This situation is described within game theory as the prisoner's dilemma (Axelrod and Hamilton, 1981; Neumann and Morgenstern, 1944). Players can choose their strategy between cooperation, competition or defection to maximize their own profit. The Nash equilibrium describes a situation, where a member cannot change its strategy without getting worse in profit. Whereas, the Pareto equilibrium reaches the highest overall profit, but it is not stable, because other members can spoil this situation to reach a higher individual profit. Mutual cooperation with incentives or penalties can ensure higher economic benefits for all players compared to competition or unilateral defection (Brandenburger and Nalebuff, 1997; Lado *et al.*, 1997). Such an incentivizing system will be given by the profit sharing mechanism. The partners in the cooperation network do not need to show altruistic behavior because the incentives will compensate their individual loss. This system leads to a syncretic rent-seeking behavior (Lado *et al.*, 1997) with a mix of high cooperation and high competition similar to that described within co-opetition theory (Brandenburger and Nalebuff, 1997) (see Annex, Figure 70).

In order to answer the research questions, we applied the design science research approach (Hevner *et al.*, 2004). We pursued the publication scheme for a design science research study (Gregor and Hevner, 2013) to provide an artifact for subscription in practice (Gregor, 2006). To increase the relevance of the research for Information Systems (IS) practice (Baskerville and Myers, 2004), we applied action research (Avison *et al.*, 1999; Baskerville and Myers, 2004) to iteratively create and evaluate a mathematical profit sharing model for efficient cooperation in a community cloud. To ensure a rigorous methodology in creating the artifact, we followed the five steps for design science developments by Kuechler and Vaishnavi (2008):

After considering the problem awareness (step 1) advocated in the introduction and related work of this paper, we derived the research questions. To evaluate an applicable approach for the community cloud, we conducted a semi-structured workshop with the Heads of IT of five different service providers in Germany. We selected these providers because they are members of an actual project that plans to implement a community cloud (Government Green Cloud Laboratory, www.ggc-lab.de) and can provide actual experiences and expert knowledge. The workshop was semi-structured and took about four hours. The experts developed design principles for profit sharing in a community cloud and compared the design principles with the existing approaches in the literature. The suggestion of the workshop was to construct a new profit sharing mechanism that meets the requirements of the providers (step 2). Therefore, we decided to develop an incentive system with mathematical formulation (step 3). We iteratively evaluated different design alternatives to get an optimal solution for any combination of input parameters. The proposed mechanism is designed to form a stable balance, serve different scenarios and align the incentives of the members to induce them to act in a way that is optimal for the community profit.

Any model that aims to be implemented in a practical context needs to be validated (LeBaron and Tesfatsion, 2008). We first demonstrated the utility of the profit sharing mechanism with a numerical simulation to show the potential of the cooperative community value creation compared to an egoistic value creation. To evaluate the whole incentive system (step 4), we followed the proposed guidelines of Hevner *et al.* (2004) and conducted a second workshop with other four Heads of IT of four different German data centers to simulate the profit sharing mechanism with a game-based approach. We selected the workshop members based on their interest in the potential participation of such a community cloud. The simulation game describes the situation of a provider-based community cloud as a board game (blinded reference) and is the basis to test the profit sharing mechanism. In parallel to the game process, we noted every decision of the participants and asked for their reasons. Afterwards, we analyzed their behavior and compared the results of the different strategies within the simulation game to draw a conclusion (step 5). The summarized structure is shown in Figure 53.

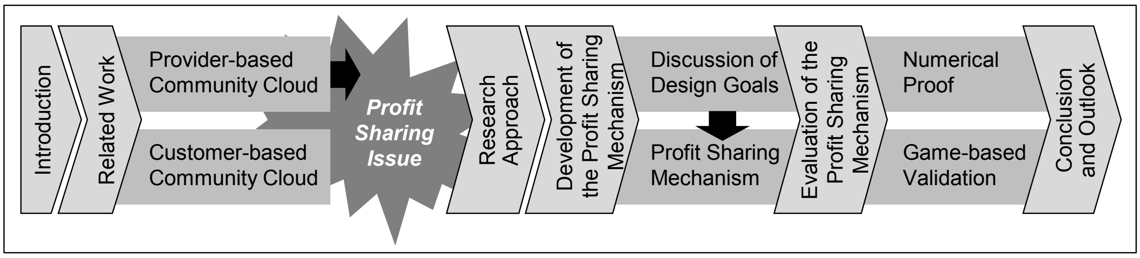


Figure 53: Structure of the Research Approach

4.3.4 Development of the Profit Sharing Mechanism

The profit sharing mechanism aims to cover the case of generating common value in a cooperative community of IT service providers. These providers serve their customers with IT services in software, networks or hardware. In processing the services, the providers can cooperate to share their IT resources for load balancing purpose.

Discussion of Design Goals

To evaluate design principles, we discussed the community situation within a first workshop with the providers. The individual goals of the providers are their resource utilization and profit maximization, while the overall goal of such a community is general savings through resource efficiency. In the case of a capacity shortage, there is no hesitation in a community member requesting a load balancing between the other members. However, with a disparity in cost efficiencies between the members in mind, the load transfer to a more efficient member can gain a higher overall profit without the pressure of a capacity bottleneck. In such a scenario, the member that would be deciding on whether to transfer a data processing job to the community might not benefit directly from the load transfer.

An efficiency-driven load balancing within the community promotes maximized overall profits but possibly affects the individual's profit maximization strategy. The providers mentioned that individual goals should be partially subordinated to the superior community goal, but they were afraid of losing or sharing control within a community. Therefore, this case needs incentives, on the one hand for the transferring member and on the other hand for the receiving member(s) within the community. An effective profit mechanism should aim at an equilibrium within the community, where each member participates in the common value creation, wants to be efficient, and feels comfortable with the decision of entering the community cloud.

Bringing the previous discussion points together, we can formulate two superior design goals for the required profit sharing mechanism that enable syncretic rent-seeking behavior (Lado *et al.*, 1997):

» **Design goal 1 – cooperative efficiency:** The formula should enable cooperative efficiency if the community processing of the load job yields a higher overall profit than without cooperation.

» **Design goal 2 – individual rationality:** The formula should allow for individual rationality whilst transferring data processing load to the community by compensating any losses suffered in the process.

For the operationalization of these design goals, we needed to transfer the collaboration effort into cost and profit streams. Then, we developed a profit sharing mechanism that gives financial incentives for joining the community, the active participation in the community, and finally the individual improvement of the providers' efficiency. The profit distribution has three kinds of means as followed:

» **Incentive to transfer a load to the community → "compensation":** To incentivize the load transfer in the case of an alternative efficiency optimum, the member who transfers the load of the data processing job to the community receives a profit compensation.

» **Incentive to accept a load in the community → "efficiency share":** To promote the individual efficiency and allow an additional profit with load balancing in the community, the accepting members that process the transferred load receive an efficiency-based profit share.

» **Incentive to join the community → "basic financing":** To compensate for the fixed costs (initial costs, opportunity costs or other limits) for participating in the community cloud, all members receive an equal share of the profit. This also avoids a misrepresentation of fixed costs and promotes economic management.

When we compared these design conditions with the existing approaches in the literature and discussed them within the first workshop, we did not find an appropriate mechanism for democratic load balancing and common value creation in a community cloud (see Table 26). Therefore, we decided to develop a new mechanism as described within the following section.

Table 26: Attributes for the Profit Sharing Mechanism

Design Aspects \ Authors	Chauhan and Proth (2005)	Lakhal (2006)	Chen et al. (2008)	Li and Lee (2008)	Aram et al. (2009)	Blau et al. (2010)	Zong and Peng (2011)	Lu et al. (2011)	Singh et al. (2012)	Cho and Yi (2013)
Cooperative efficiency	x	x	x	x	x	x	x	x	x	x
Individual rationality		x		x	x	x		x	x	x
Incentive for load transfer					x	x	x	x	x	x
Incentive for load accept and efficiency			x	x						
Incentive for community entry				x					x	

Profit Sharing Mechanism

Developing our mechanism, we took the proposed characteristics within the related literature on cooperation into consideration and addressed decentrally integrated and independent actors in a heterarchical organization. Furthermore, we created the mechanism as an equitable and efficient formula that fairly allocates the profit to the members. We considered a general billing unit as community currency and implemented the discussed incentives into the mechanism. For illustration purpose, Figure 54 shows the model of the load allocation in a community with i (i=1..n) members (M_i), exemplified here with four members ($M_{1\text{-}4}$). Every member has individual values that are independent from the load balancing: the free capacity (Y_i) for the decision of load balancing, the fixed expenses (EF_i) and the variable cost factor (e_i). For further calculations, the cost factor e_i reflects the efficiency of the respective IT service provider. We consider the costs instead of the prices, because we need a direct influence on the efficiency, without causing price dumping. Taking the cost allocation problem for resource consumption into account, we consider a generalized unit to measure the job load (x). This could be logged service invocations (Brandl *et al.*, 2007) or another measurable unit.

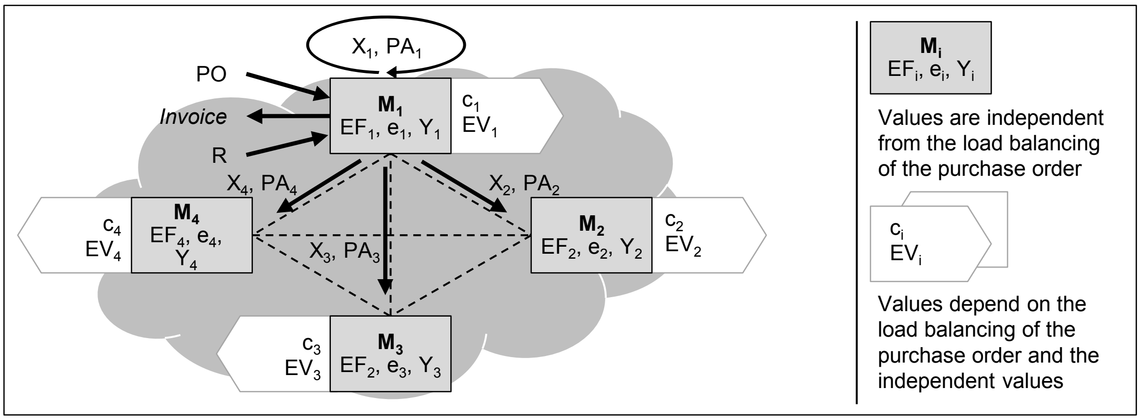


Figure 54: Load and Profit Allocation within a Community Cloud

The member M_1 receives a data processing order (purchase order PO). The member can decide to transfer the load of PO (or parts of it) to other members in the community. The decision can be triggered by a capacity bottleneck or by the incentives given with the profit sharing formula in the case that another member could process the load more efficiently. After the decision, the PO will be allocated to the members (X_i) and M_1 possibly has a claim (c_1) to receive a compensation (C_1) for the transfer. With the data processing of the load, variable costs occur (EV_i). To compensate the resulting effort for all members involved in the data processing of the job, these operating costs would need to be covered in any case. The cost factor (e_i) describes how much a unit (x) of the purchase order (PO) will cost for each member M_i. A member has the option to optimize this factor with a special investment in hardware and building efficiency (EI_i). Finally, M_1 may charge its customer and gets the revenue (R) for the processed order. This revenue is the basis for the profit sharing mechanism that calculates the incentives for each member and determines their individual profit allocation (PA_i).

Putting the basic conditions into mathematical formulations, the following functions and equations describe the load balancing situation (see Figure 55). The parts of the purchase order can be allocated to different members of the community (1). In the best case, all allocated parts of the load order should sum up to the whole purchase order; otherwise, the order is not processed completely and a penalty fee applies. The individual allocated units cannot be more than the respective free capacity. The variable expenses depend on the allocated part of the job and the cost factor (2). The fixed expenses serve as parameter for various defined costs that occur with the community joining (3). For the successful load processing, M_1 receives an amount of revenue that depends on the negotiated payment for the order and the number of the processed load order units (4). The revenue first covers all variable costs of the members that are induced by the load processing of the order (5). The resulting gross profit represents the overall profit goal (related to design goal 1). In addition, this profit needs to be fairly allocated to the community cloud members. Based on the goals, we translated the incentive premises into the following profit sharing system. First, the profit serves for the compensation of the transferring member in proportion to the transferred load (6). It is suggested that the compensation will apply only in case of an efficiency-driven decision without a capacity shortage. The resulting net profit (7) is divided based on a quantifier (ratio for share in profits) between the efficiency share (8) and the basic financing (9). While the efficiency share (8) only addresses the members of the community that process the delivered load units, the basic financing amount (9) is granted to all potential members. The quantifier for this allocation is variable and can be freely shifted regarding different weightings of goals and strategies. Finally, the profit allocation summarizes the entire payments as individual profit for each member (10). This formula is the target function for the individual profit (related to design goal 2). The interdependencies between the different formulations reveal the independent input parameters that serve as adjusting screws (see Annex, Figure 71).

Formulas	Legend / explanations
(1) Allocated units $X_i = b_i \cdot X$ [x] $X \leq PO$, $X_i \leq Y_i$	X: processed units [x] b_i: share in allocated units [0;1] PO: purchase order [x] Y_i: free capacity units [x]
(2) Variable expenses $EV_i = e_i \cdot X_i$ [€]	e_i: cost factor [€/x]
(3) Fixed expenses EF_i [€]	e.g. opportunity costs, administration costs
(4) Revenue $R = r \cdot X$ [€]	r: revenue factor [€/x]
(5) Gross profit $PG = R - \Sigma(EV_i)$ [€]	*Overall profit*
(6) Compensation $C_1 = c \cdot c_1 \cdot PG$ [€]	c: compensation rate [0;1] c_1: compensation worthiness {0,1}
(7) Net profit $PN = PG - C_1$ [€]	*Basis for the profit sharing*
(8) Efficiency share $ES_{i>1} = p \cdot PN \cdot b_i/\Sigma(b_{i>1})$ [€]	p: ratio for share in profits [0;1]
(9) Basic financing $BF_i = (1-p) \cdot PN \cdot 1/n$ [€]	n: number of community members
(10) Profit allocation $PA_i = C_i + ES_i + BF_i$ [€]	*Individual profit*

Figure 55: Functions and Equations of the Profit Sharing Model

4.3.5 Evaluation of the Profit Sharing Mechanism

To verify the designed incentive mechanism of the profit sharing formula, we first conducted a numerical simulation to evaluate the design goals of the cooperative efficiency and the individual rationality. Then we simulated the described community situation and compared different profit sharing strategies.

Numerical Proof of the Incentive System

To evaluate the **cooperative efficiency**, we compared the gross profit of a community processing with the individual processing and concluded that a community processing is more productive as long as the cost factor of the community is less than the cost factor of the transferring member. For example, the community member M_1 receives a load order (X=1000) that is remunerated with one monetary unit per load unit (r=1) and M_1 has a cost factor e_1=0.9. An individual processing would bring 100 monetary units while a processing in the community can enable a higher overall profit if the community has a cost factor better than 0.9 ($e_i \leq 0.9$)

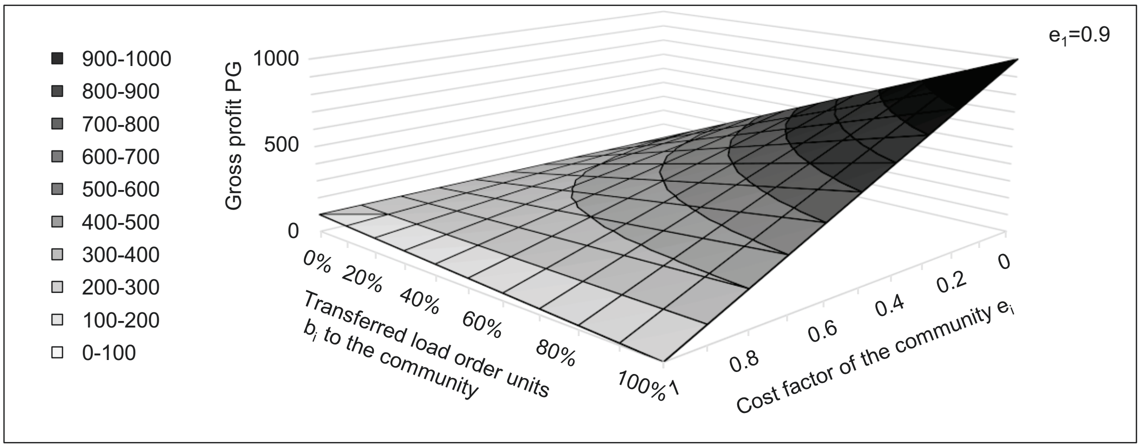


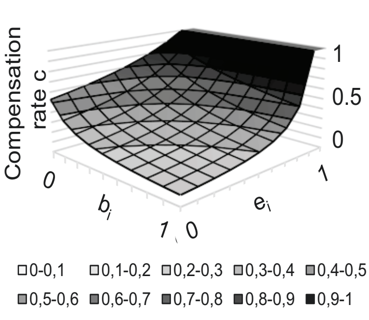
Figure 56: Numerical Proof of the Cooperative Efficiency (Design Goal 1)

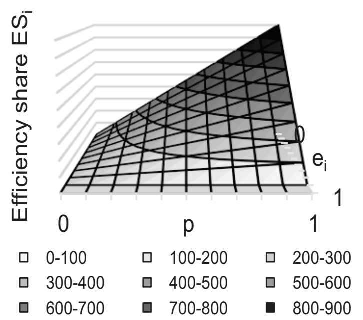
The **individual rationality** is considered with the three incentives of the incentive system. The first incentive is the *compensation* that is granted to a community member who delivers a load order to the community. In a real world context, the likelihood of the future capacity allocation would also be part of the member's decision-making process. After the transfer, the individual capacities would still be free to take another order. We leave this likelihood discussion open for the game simulation because we are not able to calculate the statistical distribution of the load orders. In our case, the transferring member needs to weigh up between its profits from individual processing compared to the compensation in the community. In the example above, the individual profit PA_{indiv} will be 100 monetary units. The following combination of factors realize an equal compensation C_1=100 monetary units for M_1 (see Figure 57).

The second incentive is the *efficiency share* that favors members who have the best efficiency with lower costs per load unit and. They are preferred for the load allocation and provide the cost savings; therefore, they should participate in the profit in particular. We weighed the considered investments to reach a better efficiency with the given incentive. Here again, we excluded the evaluation of the likelihood of future load order sizes for the moment. Continuing with the example given above, the figure shows the amounts of the efficiency incentive for the member that accept the load (see Figure 57). The respective share for each member depends on its actual part in processing the load. If one member processes the whole load, it gets the total amount of the efficiency share.

The third and last incentive is the *basic financing* that rewards all members that put their resources at the disposal of the community. The members receive compensation for their additional fixed costs caused by the community cloud. We compared the reciprocal value of the ratio for share in profits with the basic financing that covers the average fixed costs. Here as well, we can display the amount of this incentive depending on the given parameters of the example above with a number of members in the community n=4 (see Figure 57). The members can use this as decision basis for their joining to the community.

Compensation	Efficiency Share	Basic Financing
$C_1 \geq$ individual profit allocation PA_{indiv} $\Leftrightarrow c \cdot c_1 \cdot PG \geq R - EV_1$ $\Leftrightarrow c \geq (R - EV_1) / (c_1 \cdot PG)$	$ES_i \geq$ efficiency investment EI_i $\Leftrightarrow p \cdot PN \cdot b_i \geq EI_i$ $\Leftrightarrow p \geq EI_i / (PN \cdot b_i)$	$BF_i \geq$ fixed costs EF_i $\Leftrightarrow (1-p) \cdot PN \cdot 1/n \geq EF_i$ $\Leftrightarrow p \leq 1 - [(n \cdot EF_i) / PN]$
Example: Compensation C_1 (e_1=0.9) = 100	Example: Efficiency Share ES_i (b_i=1)	Example: Basic financing BF_i (b_i=1)





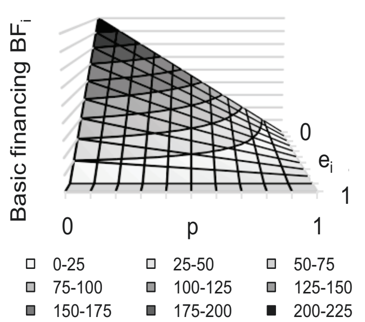


Figure 57: Numerical Proof of the Individual Rationality (Design Goal 2)

To complete the numerical example, the transferring member M_1 with a cost factor of e_1=0.9 receives a compensation of 100 monetary units. If it is given that the accepting member(s) earn at least the same proportional profit and all members are funded with a basic financing of 25 monetary units each (p=0.5), the community needs a gross profit of 300 monetary units to cover all the incentives. This is possible, if the accepting member(s) have an average cost factor of e_i=0.7 and the whole load order is processed by the community.

Game-based Validation of the Incentive System

Within previous research, we developed a business board game that simulates the case of the actual described community cloud (see Figure 58) (Labes, 2014). This game is a novel evaluation method for testing realistic behavior in a simulated situation and supports IT decision-makers in developing and testing strategies in a new and uncertain environment. It offers the possibility to analyze which strategies or rules are successful with different profit sharing mechanisms. Therefore, we performed a second workshop with IT providers and used this game to evaluate the profit sharing mechanism by testing its acceptance within the target audience.

To incentivize the cooperative behavior that supports profit maximization, we tested the profit sharing mechanism. The players played the game three times with different strategies:

- » **Egoistic strategy:** The first strategy describes an egoistic behavior where the players only process and accept the loads to maximize their personal profit.
- » **Cooperative strategy:** The second strategy aims at a cooperative and altruistic behavior by having the players develop a community strategy in advance to maximize the overall profit.
- » **Profit sharing strategy:** The last strategy is driven by an egoistic behavior whilst considering the incentivizing profit sharing mechanism.

Figure 58: Game Board of the Simulation Game

Within the game, the players move on a game board and receive load order jobs that they should process. Each player has a personal board that symbolizes its data center and shows the capacity to process the load order units (9 capacity units). Within each round, the players can invest for optimize the efficiency of their capacity units (IT and building) to get a better cost factor per unit (the players start with a cost factor of 100). A capacity unit that is in maintenance mode is not available for load processing.

While moving on the game path, different events will influence the load processing (e.g. “Heat: The temperature is rising and causes extra cooling effort for your IT. Your costs per processed unit increase by 5.”, or “Decreasing energy costs: The energy price at the energy stock market drops. Your costs per processed unit decrease by 5.”, or “Server infrastructure failure: Problems with your IT infrastructure force you to deliver your received load order to the community.”). The received loads vary in their load volume (2 to 10 load units) and revenue payment (90, 100 or 110 per load unit). The decision about the load characteristics is random and implemented with cards on a deck. Within the game process, the players decide to process the load on their own or to deliver it to the most efficient player(s) in the community. Without the profit sharing mechanism, each member earns the profit (revenue payment minus costs) of the load units processed on their own infrastructure. The billing takes place at the end of each round. For further information, please check the original publication of the game (blinded reference).

In pursuing the different strategies, we found varying goals of the members as well as perceived risks and opportunities for each decision within the pursued strategy (see Table 27).

Table 27: Goals, Risks, and Benefits for the Different Strategies within a Community Cloud

Strategy	Capacity optimization	Load transfer	Load acceptance
Egoistic strategy	• Individual goal: Each member wants to increase the efficiency to earn a higher future profit. • Risk: The maintenance bears the risk of a penalty fee if an underpaid load order or a large sized load order cannot be transferred to the community. • Opportunity: Being more efficient brings a higher priority for transferred loads. A lower utilization at the other members decreases the risk of a penalty.	• Individual goal: Each member wants to transfer a load in case of a capacity bottleneck, a loss with the load order, or problems with the own infrastructure. • Risk: A member needs to pay a penalty if a load job cannot be processed or transferred. • Opportunity: Underpaid load orders would be processed by another member if other future load orders were not likely.	• Individual goal: Each member wants to utilize its capacities in case of underutilization. • Risk: A member needs to weigh up the capacity and the potential penalty of a future load order that cannot be processed with already occupied capacities. • Opportunity: A member needs to weigh up the revenue of the transferred load and the potential revenue of future load order.
Co-operative strategy	• Overall goal: The members need to increase the efficiency to earn a higher future profit. • Risk: The profit increase through efficiency is slow because of conservative optimization decisions in favor of a lower risk of penalties. • Opportunity: In case of low utilization, not every member needs to increase efficiency (back-up member).	• Overall goal: A member is required to transfer the load if another member is more efficient. • Risk: An underpaid load may cause a higher loss compared to the penalty fees (transfer is not profitable). • Opportunity: The transfer allows the highest profit that can be made within the community.	• Overall goal: A member is required to accept a load if it is the most efficient member with free capacities. • Risk: The cost factor could change and the acceptance would not be the optimum anymore. Loss and penalties are shared. • Opportunity: The acceptance enables the highest profit within the community.
Profit sharing strategy	• Individual goal: Each member wants to increase the efficiency to earn a higher future profit. • Risk: The optimization strategy should be conservative due to a lower acceptance incentive of a transfer and therefore a higher risk of penalties. • Opportunity: See egoistic strategy. In our example, the optimization process is comparably as fast as with the egoistic strategy.	• Individual goal: Each member wants to transfer a load in case of a capacity bottleneck, a loss with the load order, problems with own infrastructure or if another one is more efficient. • Risk: The compensation incentive decreases the profit that serves as incentive for the accepting member(s). • Opportunity: The compensation incentive enables the load transfer to the most efficient member within the community.	• Individual goal: Each member wants to utilize its capacities in case of underutilization. • Risk: See egoistic strategy. The acceptance rate will be low if the utilization is high or the differences in efficiency are small so that the surplus profit allows only small incentives for the accepting and the joining members. • Opportunity: See egoistic strategy

To compare the results of the three games, the characteristics of the loads had the same sequence in every game play. In every strategy, the players decided their optimization effort and considered transfer and acceptance decisions. Within the egoistic strategy they decided independently, in the community collectively and for the profit sharing strategy, the players also decided in advance on the ratio for sharing the profits (p=0.75). The supporting calculation tool for the game process is shown in the Annex (see Figure 72).

Finally, we compared the financial results of the different strategies but without a claim for generality (see Figure 59). Following the egoistic strategy, the members took the risk of penalty fees for unprocessed orders and optimized their resources early to earn a higher surplus profit. They had a high utilization of their capacities and transferred load units only if it was necessary. The altruistic strategy had the members behaving more conservatively and therefore offered a smaller surplus profit due to a lower degree of optimization. On the other hand, the low risk resulted in smaller penalties. While the transferred load was very high, the utilization is similar to the other strategies. The game play with the profit sharing strategy resulted in the highest overall surplus profit and its optimization decisions led to a good average cost factor at the end of the game. The incentive system caused a medium transfer load ratio and a high utilization but also high penalty fees.

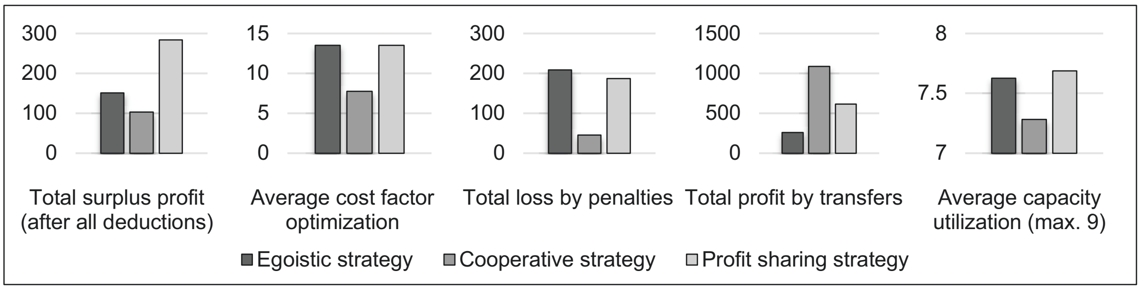


Figure 59: Comparison of the Game Results for Different Strategies in a Community Cloud

4.3.6 Conclusion and Outlook

In this article, we provided a profit sharing formula for syncretic rent-seeking in community clouds that meets the providers' needs and implements an incentive system to foster a stable and efficient value creation in a community cloud (see research question 1). We analyzed the robustness of the formula using a numerical simulation. To evaluate the incentive effect of the mechanism for a preferred community value creation (see research question 2), we conducted an experimental game simulation workshop with four Heads of IT and compared the results of an egoistic, a cooperative and the proposed profit sharing strategy.

As implications for the practice, we will share our experiences and the feedback from the IT professionals. In general, the community offers an ideal solution to optimize individual capacities without a system shut down. The egoistic strategy inspires the members to take more risks because they behave like individuals that only need to care for themselves. A backup possibility within the community is not reliable and they would only use the community as a temporary solution to optimize their own infrastructure. A cooperative strategy with altruistic behavior has a high coordination effort but offers options for special community cloud scenarios. For example, with a low utilization the members could agree that one member would not need to optimize its resources in order to use these only as back-up resources in very rare cases. A profit sharing mechanism that meets the requirements of the providers is working well if they consider the implementation of the incentives as follows:

» The **transfer incentive** is a compensation that enables the most efficient processing for a load order. This incentive only works if it amounts to the same as the lost profit from individual processing (except when the likelihood of future load orders is very high). If the incentive is implemented to meet this requirement, it markedly decreases the other incentives.

» As for the **accepting incentive**, the incentivizing effect works well if the efficiency disparity between the members is very high or the utilization of capacities of the accepting members is very low. The participating players recognize the chance of higher profits and prioritization for future loads and transfers. However, the risk of penalties for unprocessed load orders is still present.

» The **joining incentive** only works if the load transfers in the community are very high or the fixed costs are very low. This promotes the other incentives to reach a high load order volume within the community. Furthermore, it means that the members need to keep down their fixed costs, e.g. opportunity costs. Therefore, future scenarios should enable a completely hybrid use of the infrastructure for the communities' internal and external business.

Regarding the overall profit, the surplus profit through the efficient load processing would grow if the capacities were more under-utilized. In this case, high efficiency leads to even low paid orders being accepted in order to utilize the resources and this in turn increases the overall profit.

In realizing such a community processing with a profit sharing mechanism, there are some challenges that need to be considered in advance. First, the load job must be a fine-grained standardized and distributable cloud service. The members need a comprehensive monitoring system with access to significant key performance indicators, fed by sensors in the infrastructure of the IT service providers. Moreover, the relative cost factor must be measureable in proportion to a defined unit of the job load.

For further research, we propose an investigation of long-term scenarios. Our assumption is that the overall profit can be maximized with a renunciation of the individual profit. In a game over period with many rounds, the community members could punish the derogative behavior of uncooperative members. With these consequences in mind, every community member would act in an efficiency-driven and community-friendly manner and the overall profit could be maximized with lower incentives.

5 General Discussion

The final chapter summarizes and discusses the contributions of the research work in the publications regarding the two research objectives. Concluding, recommendation for action and directions for further research were derived.

5.1 Contribution to the Research Questions and Interrelations

The following section summarizes the contributions to the research questions for both research goals and illustrates the integrated relations between the results.

5.1.1 Stable Guidelines for Cloud Business Model Development

Within the search for stable guidelines and success factors that support the business model development of cloud service providers, a systematic study of the related work was established for business models in cloud computing. The results combined the quantitative coverage of the business model components in the cloud literature with a qualitative analysis to reveal future research directions (chapter 3.1). It could be shown that no article dealt with cloud business models in a holistic and in-depth approach. Some authors considered various classifications schemes of cloud service providers on a superficial level. Others focused on single business model components only. Nearly no literature was available dealing with the business strategy component of a cloud business model. Despite, an uneven coverage of the cloud service levels highlighted SaaS as core value, but the value proposition component was considered only superficially. Because of a complex value network in cloud computing, the relevance of a partner network is given; nevertheless, it is rarely addressed in the literature. Especially business model components regarding the finance level of cloud service providers (costs and revenue streams) are well advanced; e.g., several authors developed models and mechanisms for cost calculations and pricing. Based on the qualitative findings and the quantitative coverage regarding business model aspects in the cloud literature, further research directions where developed that focus on revenue models, partner networks, cloud strategies, and SaaS.

State-of-the-art in cloud business model science (RQ A.1):

The state-of-the-art in the related literature considers cloud computing in combination with business models only in a selective or superficial way.

Research gaps were identified in the ***partner network*** *and the* ***business strategy****.*

Business model components that undergo a higher relevance within a cloud focus are the ***partner network****,* ***financial models****, and* ***SaaS-based value proposition****.*

In order to complement the literature perspective of a state-of-the-art with experiences of the practice, an analysis of the business models of cloud service providers in the cloud market was conducted (chapter 3.2). Based on the findings in the literature, a cloud business model framework with 103 characteristics in eight categories (partner network, resources & activities, costs, business strategy, core value proposition, target market, distribution & customer relationship, revenue) was developed to serve as analysis unit for the investigation of systematically selected 29 cloud business models of cloud providers. The cloud market selection comprises (i) large companies (e.g. Amazon, IBM, and Microsoft) that provide the whole portfolio of cloud services, (ii) some specialized firms (e.g. Salesforce or VMware) and (iii) a few small storage and synchronization providers (e.g. Dropbox or SugarSync). A frequency analysis of the implementation of each business model characteristic in the business models of the selected companies confirmed that all networking and community aspects are rarely addressed in practice as well. In search of stable guidelines within these business models, a cluster analysis revealed four common patterns in the business model characteristics. These common patterns are specific combinations of characteristics that can characterize favorable cloud provider meta types.

State-of-the-art in cloud business model practice (RQ A.2):

*A developed **cloud business model framework** with eight categories and 103 characteristics was the basis for an initial analysis of 29 selected cloud business models.*

*The evaluation of the state-of-the-art of cloud business models in practice showed a large variety of business model implementations but a rare focus on **cooperation**.*

Common patterns in the characteristics indicate favorable cloud provider meta types.

To evaluate the success factors of cloud business models, a second in-depth business model study investigated such factors in the literature and analyzed the business model characteristics regarding indicators for success (chapter 3.3). The success-related business model characteristics can serve as indication for operationalization for the success factors given by the literature. The literature analysis revealed 18 critical success factors of business models, where the authors almost unanimously highlighted the product or service and its quality as well as innovation and differentiation aspects. The statistical correlation analysis of the business model characteristics regarding the indicators for success revealed 39 significantly success-related characteristics. Again, these characteristics exposed the core product or service and its quality as success factor, but highlighted also a high vertical integration and synergy effects as factors for success. An analysis regarding the meta types of cloud providers showed that experienced market players do have the most successful business models, while small newcomers have difficulties to be competitive.

Success Factors of Cloud Business Models (RQ A.3):

*The literature analysis and the correlation analysis of the business model characteristics regarding indicators for success revealed the **product or service and its quality**, **innovation and differentiation** aspects, a **high vertical integration**, and **synergy effects** as the most important success factors of business models in cloud computing.*

Using the resulting larger and more graded database, the original cluster analysis of the common patterns in the business model characteristics was renewed (chapter 3.4). The new patterns specified the former analysis and revealed three common provider types: (A) specified providers of hybrid and branch solutions, (B) newcomers with aggregation services, and (C) experienced providers of highly standardized mass-market services. The correlation analysis revealed type A as the most successful business model whereas type B were disadvantaged. Within an interview-based evaluation, 12 expert IT managers confirmed the results of the success factor study with their practical experience. They stated an innovative and high qualitative core value as well as the identification of the target market as the most critical success factors. Considering the success of the meta types of cloud providers, newcomers (B) should primarily focus on their strategy and their target customers, and take advantage of their size to develop agile software-based cloud services. The experts independently and unanimously stated that cooperation between newcomers is a valuable option to survive in the cloud market. Market newcomers need to develop and implement innovative business models where the time-to-market is more relevant than the risk of loss of knowhow in a partner network. In contrast, highly standardized providers (C) should primarily take care of their customer relationship and their pricing models to increase the revenue with transparent services. Finally, specialized providers (A) should concentrate on continuous innovation and premium customer service.

Successful Cloud Business Model Types (RQ A.4):

*The **most successful** cloud business model type describes **specialized cloud service providers** with branch solutions in hybrid environments and premium customer support. **Continuous innovation** and **individual customer service** ensure success.*

***Less successful newcomers** in the cloud market need to focus on **innovative strategies**, **value proposition**, and **target customers** and examine **cooperation** possibilities.*

***Standardized mass-market providers** with **limited success** need **appropriate pricing models** and **high customer care** to increase their success from economies of scale.*

5.1.2 Cooperation as a Success Factor within Cloud Computing

As the comprehensive literature review and business model analyses revealed a research gap and a business need, a detailed and focused research was conducted, considering cooperation as a success factor within cloud computing. This research should especially support the disadvantaged small and new providers in the cloud market and increase their success.

In order to examine the value of cooperation for cloud service providers, an analysis of 13 network theories was conducted to reveal common cooperation values (chapter 4.1). The results indicated cost savings, interdependencies, increased market strength, resource access and economies of scale as the basic values of cooperation networks. A community cloud framework was developed based on the common values as categories assembled with network characteristics. The framework was used as an evaluation method for the value of cooperation of 16 existing cloud communities in practice. The analysis indicated that cooperation between cloud providers had a higher value compared to cooperation between customers of cloud services.

Evaluation framework for cooperation value of networks (RQ B.1):

*A framework for the evaluation of a cooperation value considered **cost savings**, **interdependencies**, increased **market strength**, **resource access** and **economies of scale** as categories, assembled with characteristics of networks to assess an existing network.*

***Provider cloud communities** showed a **higher value** than customer cloud networks.*

The research assessed provider-based communities with a high cooperation value, but such communities are scarcely implemented in practice. The underrepresentation is caused by several technical, organizational, and legal challenges, but also on individual uncertainty regarding the situation in a community cloud and the cooperativeness of the community members. To answer this intrapersonal challenge, an interactive business board game was developed, which can serve as community cloud simulation environment (chapter 4.2). The game described a rule design for an environment with simulated purchase orders, individual properties, external events, strategies, and decision-making processes regarding cooperation. The game contributed to an elaborated and realistic user experience in a complex cooperative situation and helped to develop strategies in a community cloud. The players can simulate strategies and test the complex decision-making process before they take decisions in practice, i.e. in a contract-related productive mode of the community cloud. The game was tested within an evaluation workshop with expert IT managers, who highly appreciated the game and confirmed an increased individual cooperativeness.

Interactive simulation environment for cooperation in community clouds (RQ B.2):

*An interactive community cloud board game describes a **rule design** for an environment with **simulated purchase orders**, **individual properties**, **external events**, and **strategies** as well as **decision-making processes**.*

*The game successfully contributed to an **elaborated and realistic user experience** in a complex **cooperative situation**.*

A limitation – the lack of financial incentives – was identified during the expert workshop and was addressed. Therefore, a financial incentive system that promotes the cooperative behavior in a community cloud was developed and implemented (chapter 4.3). The basic design goals described cooperative efficiency and individual rationality as precondition for syncretic rent-seeking behavior with high cooperation and high competition. This promotes continual progress supported by the values of a network cooperation. Based on the design goals, a mathematical profit sharing mechanism was developed, which described an incentive system allocating the jointly produced surplus profit to the cooperating members. The incentive system included compensation to the member that transferred a purchase order to the community to reach a higher profit optimum with a shared processing.

The second incentive was an efficiency-based profit share for the accepting members in the community with a higher efficiency causing the higher profit. The third incentive was an equal share as basic financing to all participating members in the community. An evaluation with the developed simulation game showed that the developed profit sharing mechanism significantly enhanced the cooperativeness of the players and increased the overall profit compared to an egoistic or a cooperative strategy without profit sharing.

Incentivizing profit sharing mechanism for cooperative value creation (RQ B.3):

An incentivizing profit sharing mechanism allocates the surplus profit through cooperative behavior with incentives and compensations to the members of a community cloud to meet the design goals of ***cooperative efficiency*** *and* ***individual rationality****.*

The incentive systems includes a ***compensation*** *for the transferring member, an* ***efficiency share*** *for the accepting members, and an* ***equal share*** *as basic financing.*

5.1.3 Integration of the Research Results

The present literature review of a cloud business model revealed the components dealing with a partner network, financials, and a SaaS-based value proposition to have a high relevance in a cloud business (chapter 3.1). It turned out that research on the component of partner networks is especially scarce. Therefore, filling the research gap in this field can deliver valuable knowledge for the actors on the cloud market and the research field itself. Additionally, based on the cloud business model framework developed in this study, all partner aspects (e.g. in cooperation, strategy and financials) were shown to be underrepresented in practice (chapter 3.2). An analysis of the business models regarding indicators for success revealed critical success factors (chapter 3.3) and assessed newcomers in the cloud market as the least successful cloud providers so far (chapter 3.4). The success of the cloud provider types was related to different components in the business model, where the least successful providers should evaluate networking opportunities with partners among others (chapter 3.4).

The interrelations between the results of the literature analysis (research gap), the business model study in practice (business need), and the discovered success factors for the revealed cloud provider meta types can be summarized in the business model representation (see Figure 60, own representation). The overview exposed a special need for an in-depth research focus on the partner network within a cloud business model. The partner network showed the highest business need as it is highly critical to success for the least successful cloud provider type and underrepresented in cloud business models within theory and practice. Therefore, this research field showed the best potential for further research and allowed the highest impact of research results.

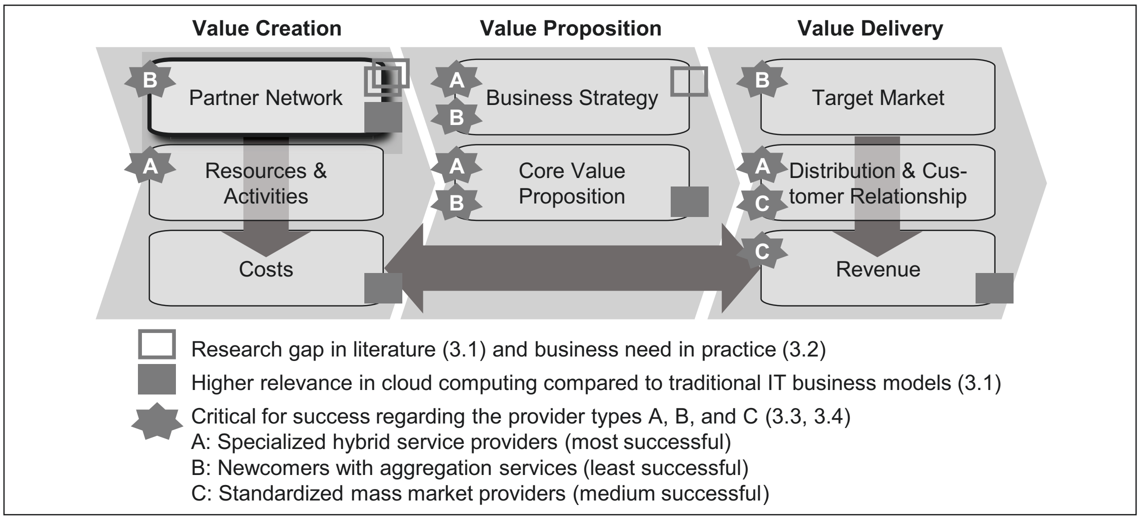


Figure 60: Integrated Results of the First Research Objective

Besides the business model analyses and success factor research, the present thesis developed different artifacts that address the partner network component in cloud business models: A cooperation value framework was designed to evaluate the value of a cooperative network and confirmed networks as valuable especially for cloud service providers (chapter 4.1). Within the developed community cloud game, cloud providers can test strategies and decisions within a simulated community cloud to increase their individual cooperativeness (chapter 4.2). Financial incentive systems were shown to further enhance the cooperativeness. A profit sharing mechanism was developed that gives financial incentives to the members of a cooperation network (chapter 4.3). The developed and evaluated artifacts can be used to support cooperation networks between cloud service providers in order to improve their corporate competitiveness.

The developed artifacts of the research work can be classified regarding the solution maturity and the application domain maturity of the design science research (DSR) knowledge contribution framework (see Figure 61, own representation based on Gregor and Hevner, 2013). Compared to existing basic classification approaches of cloud computing, the developed cloud business model framework (chapter 3.2) served for a more detailed analysis of cloud business models and can be classified as an improvement. In contrast, the focus on cooperation in cloud computing is a scarcely researched domain; therefore the developed artifacts contribute to overcome a low level of application domain maturity. The evaluation framework for cooperation and the profit sharing mechanism were constructed by adapting theories from other, mature research fields such as cooperation theories (chapter 4.1 and 4.2). Hence, they were classified as exaptation with a high level of solution maturity. However, as the community cloud simulation game (chapter 4.3) was constructed as a different way to approach a new problem, it was characterized as invention.

The present thesis followed a systemized approach diving deep into the topic of business models of cloud providers and its success factors to discover an important research gap and business need. The developed artifacts contributing to this gap were started on a general level and specialized to solve determined open issues. The variety of applied research approaches allowed a broad and valuable impact on to the topic in theory and practice.

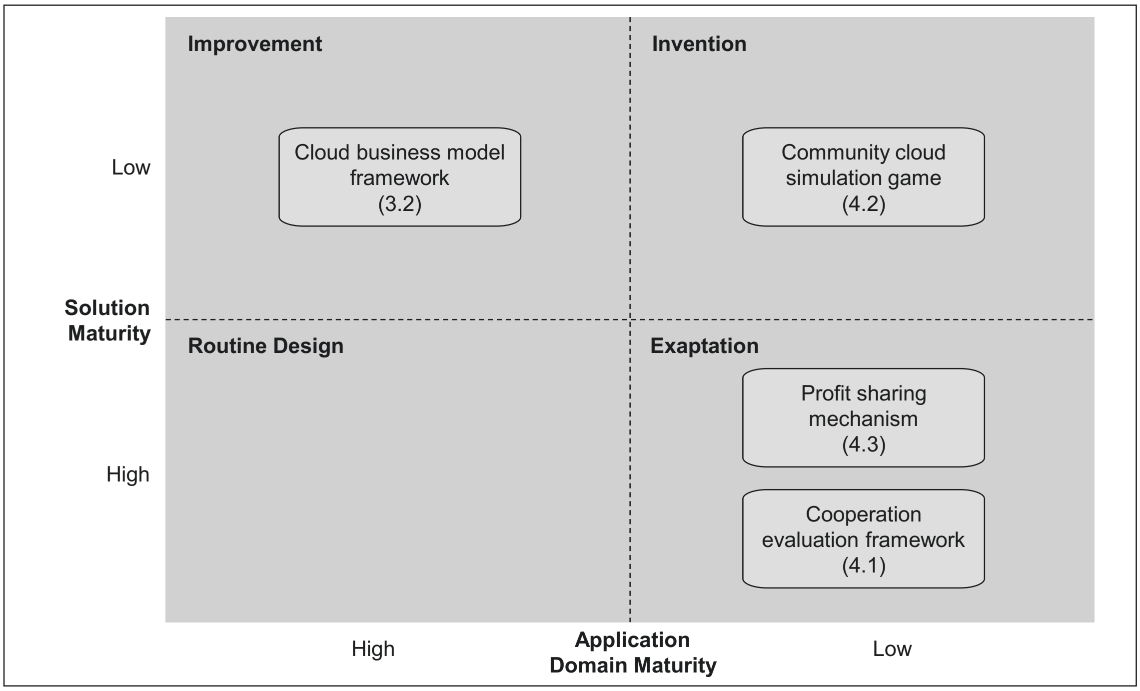


Figure 61: Classification of the Developed Artifacts in the Knowledge Contribution Framework

5.2 Recommendations for Practitioners

The research of this study can be used to formulate recommendations for practice. These recommendations address the design of the business models of cloud service providers. The next section summarizes the practitioner-related contributions (with reference to the research sections) along the components of a business model and proposes a component for cooperation based cloud business models.

5.2.1 Recommendations for Cloud Provider Business Models

The **partner network** for cloud service providers is a complex value network with various different provider roles that offer standardized and modular services (3.1). Therefore, other cloud services can easily be purchased as resources to create an own cloud service (3.2, 3.4). The literature research confirmed a partner network as success factor in particular for cloud business models (3.3, 3.4).

- » Cooperation between cloud providers offers mutual benefits regarding economies of scale, cost savings, market strength, interdependencies, and access to resources and knowhow (4.1).
- » Cooperating cloud providers have the highest benefits in communities of many small or medium-sized and local or regional cooperating parties, in an active and close relation with an unlimited temporal existence, sharing batch jobs on the value creation side and have an internal centralized management (4.1).
- » Resources, knowhow, and partners in similar fields were assessed as particularly critical to the success of a cloud provider business model (3.3).

- » Especially newcomers and small providers benefit from cooperation for decreasing the time to market and in taking advantage of their agile business structure to compete with experienced providers (3.4).
- » Practitioners can use the developed evaluation framework for cooperation to assess a planned community implementation (4.1).
- » Cloud providers can develop inter-organizational strategies to shape the market (3.1) and establish a high partner-based vertically integrated service, which was revealed as a success factor of cloud business models (3.3, 3.4).
- » Providers can also cooperate as part of a high privacy promise in the value proposition that can be implemented with a separation of the cloud service provider and the encryption provider in a network (3.1).
- » In creating a network that is beneficial for all members, it is important to take care of the superior design goals: cooperative efficiency and individual rationality (4.3). If necessary, a financial compensation mechanism should be considered (4.3) or partner-based revenue streams, where e.g. a membership fee is related to success (3.3).
- » To increase the cooperativeness, a simulation game of the planned situation is valuable to test strategies and decisions (4.2). The developed community cloud game can serve as template for similar projects.

The **resources and activities** component describes a diverse field on the technical as well as the business level (3.1). With standardized cloud services, activities of comparing and aggregating existing services become more popular as basis for an added value (3.1). In this case, infrastructure resources are less success-related for cloud providers because either they already exist at the provider's or customer's side or they can easily be accessed through purchase (3.4) or in partner cooperation (4.1).

- » On the technical resource level, infrastructure hardware and virtualization software are the basic resources for the creation of a cloud service on a platform or software level (3.1, 3.2). Infrastructure resources are a basic requirement and their availability and reliability is mandatory for success (3.3).
- » Moreover, knowhow, technology skills, and productive employees are critical to success (3.3).
- » Due to the easy access to big data with cloud services, data as a resource have an increasing importance and activities such as database management and data analysis are necessary to create benefit for the customer (3.1).
- » Cloud providers need to address technic-related activities. Consumption measurement, implementations, data migrations, updates, and security upgrades are mandatory (3.1).
- » On the business level, especially activities such as capacity planning, SLA management and the management of risks and compliance are important (3.1).

» Besides the success-driving in-house production of the main service (3.3), integration and consulting activities are often part of the value creation (3.2) and assessed as critical success factors (3.3).

» Cloud providers should consider active decision-making and management commitment as critical success factors (3.3, 3.4).

» A game-based test environment can be used as valuable simulation tool to increase the understanding and commitment (4.2) or to implement and test new mechanisms (4.3).

The **costs** of cloud services are primarily variable operational costs (3.2). For flexible cloud-based resources that are paid per use, the costs have a higher transparency but also an increasing complexity (3.4).

» Costs of the provisioning of cloud services should be calculated with a total cost of ownership (TCO) approach (3.1) to calculate a comprehensive cost causation.

» Cost savings and economies of scale are critically related to the success of a cloud business model (3.3).

» For smaller providers and newcomers, a network cooperation supports cost reductions and economies of scale (4.1).

» Established providers should take care that their cost lead enabled by economies of scale is difficult for the competition to catch up with (3.4).

» The costs with investment decisions and cooperation strategies can be simulated within a game-based simulation approach to reveal how the profit can be increased (4.2, 4.3).

The **business strategy** of a cloud business model can be formulated regarding the organizational focus on an individual or inter-organizational area and regarding the organizational process on modification of existing structures or the creation of new constructs (3.1). The inter-organizational approach for partner networks is not widely used in practice and best practices are rare (3.2). Providers primarily expand their business on a horizontal level and enter the cloud market with a knowhow transfer of a related business (3.2).

» An active market design based on a market expansion with knowhow transfer on a vertical diversification level was assessed as very successful for a cloud business model (3.3).

» The focus on innovation and differentiation towards competitors is a relevant success factor in the flexible and standardized cloud business (3.3).

» Especially for newcomers in the cloud market that need to differentiate their business from the experienced competitors, a high strategy focus is fundamental (3.4).

» Newcomers should focus on agile, lean, and specialized cloud services, probably inspired by the US market (3.4) or build networks to increase their market strength (4.1).

- » Providers can evaluate the value of an inter-organizational strategy with the developed cooperation framework (4.1).
- » A game-based simulation approach creates an environment to test strategies and their impacts on a behavioral (4.2) and financial level (4.3).

The **core value proposition** describes a high diversity of different provided cloud services on the infrastructure, platform, or software level and with different provisioning models graded from private to public (3.1, 3.2). Cloud services are highly standardized, centrally managed, and ubiquitously accessed via a network (3.1). In practice, the most frequently addressed customer experience was scalability, as well as cost and time savings, while the providers rarely mentioned sustainability (3.2).

- » The portfolio and quality of the value proposition was the most frequently mentioned success factor in a general and in a cloud focused business model to strengthen the customer loyalty (3.3, 3.4).
- » Cloud services of computing and platforms have the highest correlation to success (3.3). The involvement of the customers can increase the value of the service (e.g. collaboration networks) (3.1).
- » Provider can offer additional services such as the integration and consulting services, to increase their success (3.2).
- » A universal or lean vertical integration was assessed as critical to success in the literature (3.3). A manifold depth and width of cloud services is success-related in practice and confirmed the high provider integration that addressed the success-related customer experience of consolidation (3.3).
- » Providers need to address the critical success factors of flexibility of services, provider interoperability as well as security and privacy aspects (3.3).
- » Hybrid and private cloud models were assessed as most critical to success (3.3).
- » A smooth running transformation between off-premise and on-premise solutions formed a unique attribute that increases the success of cloud providers (3.4).
- » For small and medium-sized providers, it is important that the business model cannot be easily imitated by a competitor (3.4).

The **target market** describes the markets and customers that are addressed by the cloud service. The market can be differentiated between mass, branch, and niche markets (3.2), where cloud providers often focus on the mass market while niche markets are rarely addressed (3.2). Within the markets, small and medium-sized enterprises (SME) are the main customer type, followed by major enterprises, public sector, and consumers (3.2).

- » The literature mentioned a segment adjustment as success factors of a cloud business model (3.3). Cloud providers should differentiate at least between private and business customers and offer proper pricing models to gain a higher revenue (3.1).
- » The most success-related market focus are branch markets and SME customers (3.3, 3.4).

- » A focus on customer communities could be valuable, e.g. by offering a service for groups with the same needs and legal requirements (4.1).
- » Especially newcomers in the cloud market need to critically define their target customers or find markets with wealthy clients (3.4).

The **distribution and customer relationship** defines value transfer channels and the type of customer care. In this scope, customer services such as self-service, an online profile, a community, customer support, and monitoring tools are very common in the providers' business models (3.2).

- » A high customer care, SLAs, customer interaction and communication, and the image were often mentioned as success factors of a business model especially in cloud computing (3.3, 3.4).
- » With the integration of the customers in the value creation, the customer relationship has an increased relevance (3.1). Especially for large and standardized providers, the customer contact is critical to success and needs personal appearance and emotional addressing of the customers (3.4).
- » A transparent presentation of the cloud services SLAs is mandatory to create a trust basis to the customers (3.1).
- » The compliance to standards ensures interoperability and allows an unlimited combination of cloud services and providers (3.1).
- » The analysis of success factors in practice also revealed traditional communication models and on-site interaction as critical to success (3.4). These findings indicate that especially traditional and personal contact methods strengthen the trust in new, complex, and unstable environments (3.3, 3.4).

The **revenue** component in cloud computing changed from fixed prices to variable pay-per-use charging (3.1). In practice, subscription and usage-based payment models were most common, while partner-based and indirect revenue streams were rare (3.2). In some cases, providers received commission fees for the intermediation of customers (3.2). Revenue streams were primarily skimmed by the main services (3.2).

- » The charging of a cloud service is a critical success factor for a cloud business model (3.3) and providers should develop revenue models that include dynamic pricing and take account of scaling effects (3.1).
- » The most success-related revenue types in practice were the one-time charge, usage-based payments, and membership fees from partners (3.3, 3.4).
- » Providers should consider revenue streams from supplementary services, as their relation to success is higher than that of the main service (3.3).
- » Especially large and standardized providers need to define an appropriate pricing model for their complex services and should focus on an increased transparency (3.4).

5.2.2 Recommendations and Perpetuating Thoughts for Cloud Cooperation

Within a cooperation-based business model, the partner network component has to be emphasized in particular. The value of the cooperation can be analyzed with the network value framework (4.1) and tested within an interactive simulation environment (4.2). According to the consideration of the cooperation value, cooperation appeared differently in components on the value creation and the value delivery side. Due to the higher abstraction level of resources and activities on the value creation side, this is usually not the focus to develop a unique selling proposition. In contrast, the components on the value delivery side are more complex and enable customer advantages through differentiation (Brandenburger and Nalebuff, 1997). The higher the distance of the business model activities to the customer, the higher are synergy effects of cooperation. The more customer-oriented the activities, the higher are the image risks of cooperation. This means that cooperation is primarily located at the value creation side of a business model, while the value delivery side is characterized by competitive behavior (see Figure 62). In the words of Brandenburger and Nalebuff (1997) this situation is summarized as follows:

> *"Business is cooperation when it comes to creating a pie and competition when it comes to dividing it up".*

Because of the shared value creation activities in cooperation, an internal mechanism for the fair allocation of values and profits between the members is required (4.3). It can be implemented with an additional business model component for **internal profit sharing** (see Figure 62, own representation). This component addresses the value proposition and contribution as the internal attractiveness of a business for each cooperation partner. Direct partners such as customers, suppliers, and investors, but also indirect partners such as customers of customers, investors of a supplier or the public can participate in the network. The component defines how each value proposition will be compensated to ensure sustainable value cooperation.

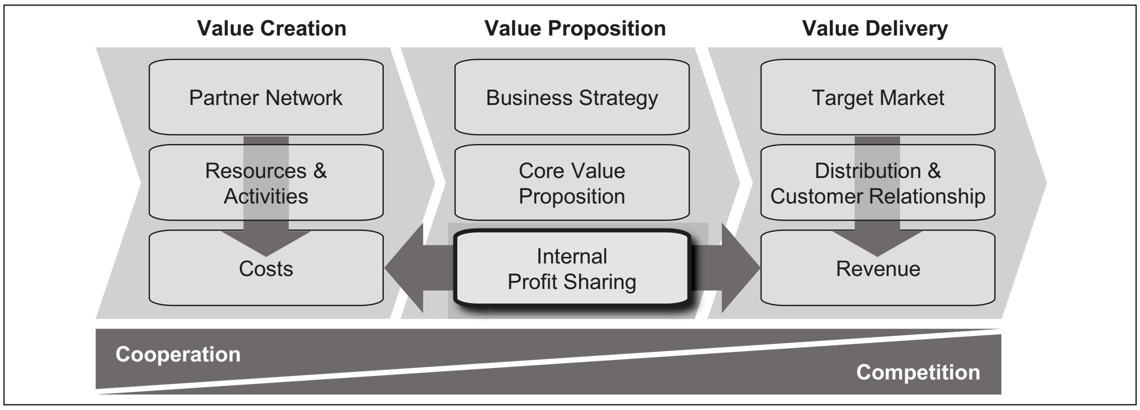


Figure 62: Cooperation-based Complement in the Business Model Concept

Moreover, the core value proposition that usually described only values for the customer of the cloud services was expanded by values for the providers (see Figure 63). Within a community cloud, the providers benefit from an extended cloud service portfolio and an optimized IT provisioning. The customers of a provider-based community cloud profit from higher flexibility, availability and a wider portfolio of available cloud services.

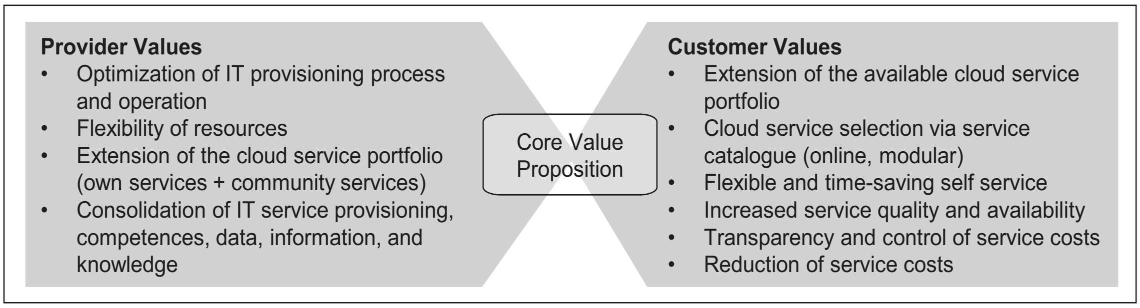


Figure 63: Extended Value Proposition through Cooperation in Cloud Computing

Based on the findings of the thesis, cooperation in cloud computing could be set up with different scenarios. The following scenarios can serve as some inspirations for cloud service providers and their option to create a community cloud (see Figure 64, own representation).

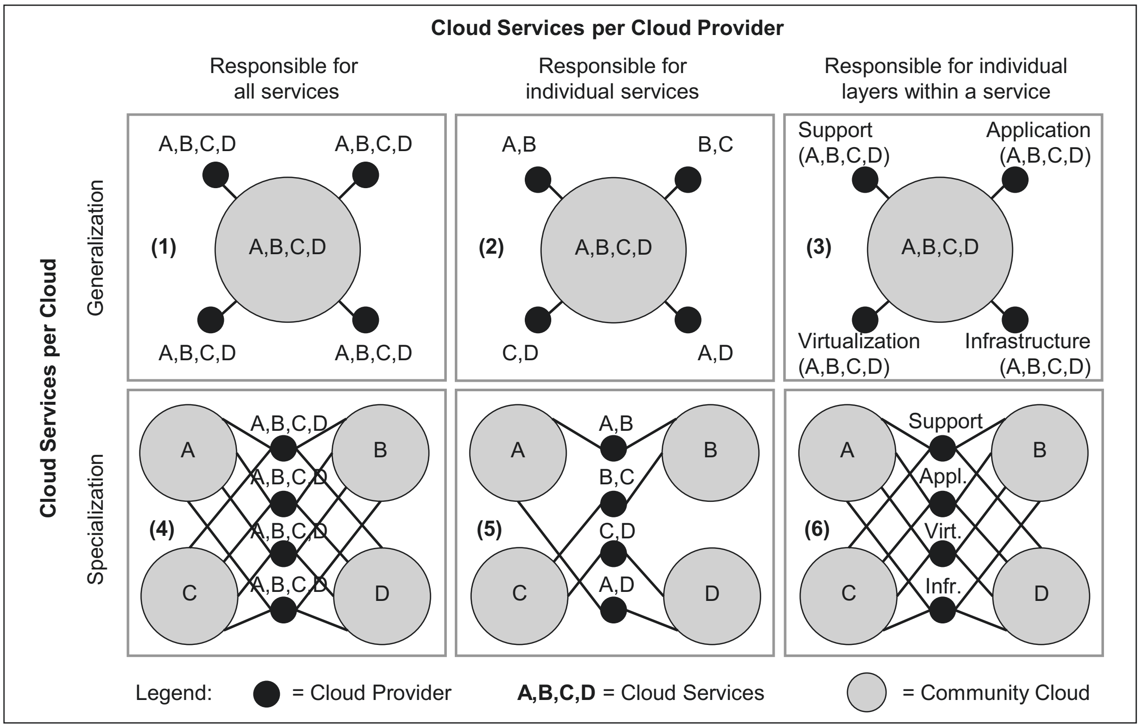


Figure 64: Community Cloud Scenarios for Cooperation between Cloud Service Providers

A community cloud between providers can be distinguished regarding the number of cloud services that are provided in one cloud and the providers' scope of responsibility for the cloud services. A generalized community cloud does not have a special limitation to distinct cloud services and appears as "provider community". Within the community, the members are responsible for all services (1), individual services (2), or only layers of the services (the mentioned layers are examples) (3). Another option is to focus on specific cloud services within a cloud and create different "service communities" for each cloud service. The providers are related to the clouds completely (4), to individual clouds only (5), or to all clouds with the responsibility of single service layers (6). The "provider community" types are applicable if e.g. the cloud services benefit from a shared database. The "service cloud" types are a suitable setup if e.g. legal constraints prohibit a mixture of data or other resources of different cloud services.

The first scenario (1) describes a provider network on a horizontal level where all the partners agreed to the same standard cloud services within a virtual community cloud that they provide to their customers (e.g. infrastructure services). In this case, the potential of load balancing between the providers is very high in cases of capacity shortage, system crash, or other transferring needs. The drawback is that the competencies for all services must be present at all cloud providers, which does not enable economies of scale. Moreover, the harmonization effort of the services could be very high depending on the level and complexity of the service (applications will have a higher effort than infrastructure services).

The second scenario (2) shows a virtual community with different cloud services but only a selective support of the providers for the cloud services (e.g. business applications). Not every member has all competencies for each cloud service. Each service is supported by different providers to ensure redundancy, better scaling and load balancing. The scaling and balancing option is not as flexible as in the first scenario, but the harmonization effort is decreasing.

In the third scenario (3), the competencies for the community cloud services are not at the same level, it describes a rather vertical provider network. The competencies can be distributed along the layers of a service architecture or using other relevant competencies. Each provider should be responsible for several layers or competencies to ensure redundancy, service scaling and balancing of the services. The services must be highly standardized to enable a flexible allocation of layers. Economies of scale are rather based on the vertical allocation of competencies as on horizontal load balancing.

The fourth scenario (4) describes the same distribution as in the first scenario but the services are separated in single clouds. The advantage of the high load balancing potential and the disadvantages regarding the harmonization effort and the limited saving potential are similar as in scenario (1). The cloud providers are completely related to all service clouds and build a community cloud around each particular service. This enables to address specific requirements with the services in each community cloud (e.g. a higher data protection).

Within the fifth scenario (5), the cloud providers are related to selected community cloud services only and do not need to have competencies for each cloud service. Each provider supports at least two community clouds to ensure the redundancy, scalability, and load balancing of services but the flexibility is not as high as in the scenario before.

The last scenario (6) is similar to the third scenario and providers are responsible for competencies on a vertical level. The cloud services are separated in different specialized communities and the providers are related to the communities to support the cloud services with their responsibilities. Each provider should have two or more expert responsibilities to ensure redundancy, flexible scaling, and balancing of loads.

5.3 Limitations, Current Developments, and Future Research

Based on the integrated findings, the remaining limitations of the present thesis and current developments in the research field, six main research areas related to business models of cloud service providers were identified.

Research on the topic **partner network** was revealed as gap in the literature (3.1) and practice (3.2) but was shown to have a critical relation to success for cloud service providers (3.3, 3.4). Accordingly, this topic was addressed in this thesis (4.1, 4.2, 4.3), but the research did not cover all issues and challenges. For instance, several challenges on organizational, technical, or legal level (Schoedwell *et al.*, 2014; Toosi *et al.*, 2014) remain unstudied. Such, cooperation between cloud providers still represents a valuable and important research topic in the field of cloud computing being increasingly identified: A recently published classification of cloud cooperation showed the huge potential of cooperation in cloud computing and propose further research directions (Grozev and Buyya, 2014). First studies already evaluated, how an entire value network can be migrated into the cloud (Demirkan and Goul, 2013; Schoedwell *et al.*, 2014) and how resource allocation can increase the benefits in a cloud provider cooperation (Kaewpuang *et al.*, 2013). Other authors focused on economic models of cloud cooperation (Haas *et al.*, 2013) and simulation tools to design a dynamic inter-cloud setting (Sotiriadis *et al.*, 2013). However, especially the federated approach of cloud cooperation needs further research and common formats (Mezgar and Rauschecker, 2014). Based on the findings of the thesis, the following research topics and questions are suggested:

- » A deeper case study research on community clouds and other cloud cooperation in practice will complement the results of this research.
- » A specific question would be to automate the strategy simulation in long-term cooperation scenarios. This will help to analyze if additional incentives are a long-term instrument to increase the cooperativeness of the community members.
- » An extension of the simulation analyses should be considered regarding a variation in the number of partners, which will reveal the influence of the community size on cooperativity.
- » The cooperation scenarios as developed in section 5.2.2 represent a starting point for a comprehensive community cloud evaluation.
- » An in-depth analysis with a comparison between horizontal and vertical cooperation levels could be a research direction, as during the expert consultation, it was stated that horizontal provider cooperation would be not as valuable and successful as vertical cooperation (3.4).

The **cloud strategy** of cloud service providers was underrepresented in the literature (3.1), but was revealed as another main aspect in the success factor analysis (3.3). Considering the four strategy stages (1) “Working in Today’s World”, (2) “Building for the Future”, (3) “Implementing the Future”, and (4) “Realizing the Vision” (Shen *et al.*, 2013), most cloud companies only try to manage a secure stage one (Seshasaayee and Subramanian, 2013). However, cloud computing could enable new demands, open new markets and attract new customer segments (Berman, Saul, J *et al.*, 2012). On this potential, not many research was conducted (Hahn *et al.*, 2013). Especially in new markets – as the cloud market –, a successful strategy has a critical importance (McDonald and Eisenhardt, 2014).

» Further research can analyze the transfer of existing strategy development theories to the field of cloud strategies. It will be interesting to examine differences in the strategy building process between traditional IT and the cloud business.

» Further analyses can address the experts' statements that continuous innovation and special services have a high risk but high prospects for success as well (3.4).

In general, the existence of a business model is critical to the success of a firm (McDonald and Eisenhardt, 2014). Appropriate **key indicators** are important to measure the success of a business model. The key indicators for business model success are an under-investigated research field. Some authors reflected indicators such as service adoption and service coverage for the market performance (Kastalli *et al.*, 2013) or combined innovation capability, customer participation and service quality as measures for firm performance (Ngo and O'Cass, 2013). As indicated by the research analyses in this thesis, larger companies have higher prospects for success compared to smaller companies (Headd, 2003). In that case, financial indicators and a complex combination of different indicators can predict the success of a business (Levanon *et al.*, 2015). In contrast, young markets, where companies did not declassify much information or did not reached the break even so far, there should be additional indicators related to the potential success of a business. Soft indicators such as employee satisfaction (Louise, 1996) or trust between the provider and the customer (Garrison *et al.*, 2012) are recommended if financial factors lack evidence.

» An in-depth analysis of success indicator combinations especially for new and small providers on the cloud market could be a valuable future research direction.

Further **business model analyses** are valuable to extend the research results of this thesis. As the conducted studies were based on secondary data, the results should be complemented with investigations that gather additional primary data. Today, no other comparative business model studies are known from the literature.

» Further business model analyses regarding success should distinguish between large and small cloud providers.

» Additional distinctions e.g. between the service level focus (IaaS, PaaS, SaaS) and regarding the provisioning model (public, private, hybrid, community) should be performed to evaluate the impact of these factors on business model success.

The **hybrid combination** of cloud services showed a significant correlation to the success of a cloud business model in both, the business model analyses and the expert interviews. Some experts mentioned that managing different services and devices, on-premise and off-premise, will be the future focus of business models of cloud providers. Current literature confirmed hybrid cloud computing as a highly secure and trustful provisioning model (Biswas *et al.*, 2014) with prospects for success in the future (Rao *et al.*, 2015; Garrison *et al.*, 2015). Risk management, transparency and compliance are the basic requirements a provider of hybrid cloud services needs to consider (Jenkins, 2013). Other authors already examined how cloud providers can manage the interfaces and integration of different services and resources (Li *et al.*, 2013; Breiter and Naik, 2013).

» Regarding a hybrid cloud business model, the future analysis of different combinations of private and public cloud structures was identified as research topic.

» It should be examined whether the hybrid trend is valid for long-term business models or if it will be obsolete in a few years because business companies possibly do not have own IT resources anymore.

The reference to the **customer perspective** in the conducted research work showed an impact of a trustful relationship and personal contact on the provider's success. A well performed, but highly standardized customer relationship is not as successful as individual service. Such an intensive customer focus is not scalable (Davis, 1989) and will not fit into the future of open cloud services. Many studies analyzed the adoption process of cloud computing in the customer companies (Nuseibeh, 2011; Khajeh-Hosseini *et al.*, 2012; Géczy *et al.*, 2012; Henry *et al.*, 2015) and analyzed the quality of experience for a cloud customer (Hoßfeld *et al.*, 2012). However, it was not considered how the customer's perspective on customness and individuality, especially regarding the communication to the provider, would influence the adoption of highly standardized open cloud services in the future.

» Future research could investigate the trade-off between personal customer care and highly standardized and scalable cloud services to reveal insights.

» Additionally, it could be investigated how the customer adoption insights could support the development of long-term cloud strategies.

Summing up, the proposed future research directions address (1) further analyses of partner networks, (2) the strategy development for a cloud business model, (3) key indicators to measure the success of small cloud business models, (4) specified business model analyses, (5) the sustainability of the hybrid cloud provisioning model, and (6) the customer's perspective on cloud adoption (see Figure 65, own representation).

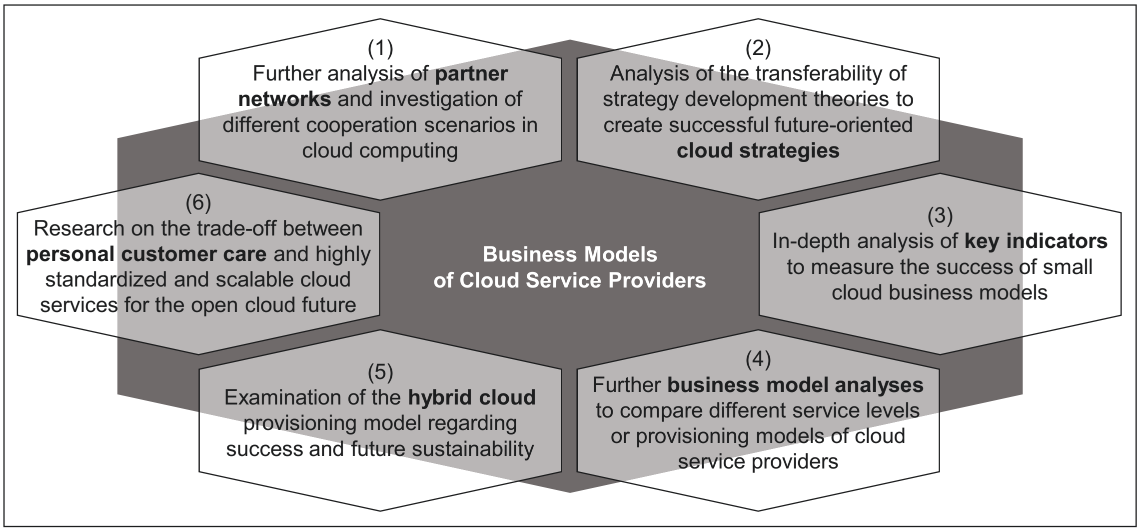


Figure 65: Directions for Future Research in Relation to Cloud Business Models

Annex

The following table shows the whole list of publications that were published (*submitted**) for and in parallel to this dissertation project.

Table 28: Full Publication List

Type	Title	Authors	Published *(Submitted*)*	Year
Journal Article	Success Factors and Clusters of Cloud Business Models	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow	Journal of Business and Information Systems Engineering (BISE)	*2016*
	Profit Allocation for Cooperative Business Models in Cloud Computing	Stine Labes, Rüdiger Zarnekow	*Journal of Electronic Markets (EM)* Rejected for resubmission*	*2016*
	Herausforderungen und Erfolgsfaktoren der Migration in eine Community Cloud für die öffentliche Verwaltung	Stine Labes, Björn Schödwell, Rüdiger Zarnekow	HMD – Praxis der Wirtschaftsinformatik	2014
	Erfolgreiche Kombinationsmuster in Cloud-Geschäftsmodellen.	Stine Labes, Rüdiger Zarnekow	Industrie Management	2013
Conference Article	Community Clouds for Provider-based and Customer-based Collaboration in the Public Sector	Stine Labes, Rüdiger Zarnekow	Proceedings of the Americas Conference on Information Systems (AMCIS)	2015
	Success Factors of Cloud Business Models	Stine Labes, Nicolai Hanner, Rüdiger Zarnekow	Proceedings of the European Conference on Information Systems (ECIS)	2015
	A game-based evaluation model for a successful cooperation in cloud computing	Stine Labes	Proceedings of the Informatik Konferenz – Jahrestagung der Gesellschaft für Informatik. Lecture Notes in Informatics (LNI) P.232	2014
	Classification Framework for Analyzing Business Models of E-Marketplaces	Christopher Hahn, Stine Labes, Rüdiger Zarnekow	Proceedings of the Multikonferenz Wirtschaftsinformatik (MKWI)	2014
	Common Patterns of Cloud Business Models	Stine Labes, Koray Erek, Rüdiger Zarnekow	Proceedings of the Americas Conference on Information Systems (AMCIS	2013
	Literaturübersicht von Geschäftsmodellen in der Cloud	Stine Labes, Koray Erek, Rüdiger Zarnekow	Proceedings of the International Conference on Wirtschaftsinformatik	2013
	Standardization Approaches within Cloud Computing: Evaluation of Infrastructure as a Service Architecture	Stine Labes, Alexander Stanik, Jonas Repschläger, Odej Kao, Rüdiger Zarnekow	Proceedings of the Federated Conference on Computer Science and Information Systems (FedCSIS)	2012
Book Article	Geschäftsmodelle im Cloud Computing	Rüdiger Zarnekow, Stine Labes	Wirtschaftsinformatik in Wissenschaft und Praxis (Festschrift für Hubert Österle). Springer Verlag Berlin Heidelberg	2014
	Geschäftsmodelle im Cloud Computing	Stine Labes, Christopher Hahn, Koray Erek, Rüdiger Zarnekow	Digitalisierung und Innovation. Springer Fachmedien Wiesbaden	2013
Project Report	Geschäftsmodell, Aufbau und Prozesse im GGC-Lab	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2015
	Steuerungsmechanismen im GGC-Lab	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2015

Project Report	Kommunikation und Interaktion bei Cloud Services	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2014
	Auswahl von Fachanwendungen für den Betrieb im GGC-Lab	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2014
	Cloud Computing in der Öffentlichen Verwaltung	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2013
	Anforderungen an einen Cloud-Dienst	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2013
	Rechtliche Rahmenbedingungen von Cloud-Diensten	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2013
	Konzept und Bewertung von Cloud Computing	Stine Labes	Rechenzentren und Cloud Computing – Ein aktuelles Handbuch für die Öffentliche Verwaltung. Heise Verlag	2012
	Rechtliche Rahmenbedingungen in der Öffentlichen Verwaltung: Rechtliche Rahmenbedingungen von Cloud-Diensten.	Stine Labes	Projektberichte IKM Band 10. Universitätsverlag der TU Berlin	2013
	Grundlagen des Cloud Computing: Anforderungen an einen Cloud-Dienst.	Stine Labes	Projektberichte IKM Band 09. Universitätsverlag der TU Berlin	2013
	Grundlagen des Cloud Computing: Cloud Computing in der Öffentlichen Verwaltung	Stine Labes	Projektberichte IKM Band 08. Universitätsverlag der TU Berlin	2013
	Grundlagen des Cloud Computing: Konzept und Bewertung von Cloud Computing	Stine Labes	Projektberichte IKM Band 01. Universitätsverlag der TU Berlin	2012
Others	Cloud Computing – Nutzen bewertet	Stine Labes, Rüdiger Zarnekow	Kommune21 – E-Government, Internet und Informationstechnik	2013
	E-Government: Fachanwendungen im GGC-Lab	Stine Labes	MittelstandsWiki.de	2013
	Geschäftsmodell und Anreizsysteme – Nachhaltigkeit und Kostensparen mit der Community Cloud	Stine Labes	VITAKO Intern Nr. 6	2013
	Auswahl der Fachanwendungen für das GGC-Lab	Stine Labes	VITAKO Intern Nr. 3	2013
	Anforderungen an die Cloud	Stine Labes	VITAKO Intern Nr. 1	2013
	E-Government: Cloud-Geschäftsmodelle für kommunale Rechenzentren – Das GGC-Lab testet Verwaltungswolken	Interviewer: Sabine Phiipps	MittelstandsWiki.de	2013
Review Activities	Americas Conference on Information Systems (AMCIS) 2012 and 2013			
	Australasian Conference on Information Systems (ACIS) 2013			
	Australian Journal on Information Systems (AJIS) 2015			
	European Conference on Information Systems (ECIS) 2015			
	Hawaii International Conference on Systems Science (HICSS) 2012 and 2014			
	International Conference on Economics of Grids, Clouds, Systems and Services (GECON) 2013			
	International Conference on Information Resources Management (Conf-IRM) 2012			
	International Conference on Information Systems (ICIS) 2015			
	International Conference on Wirtschaftsinformatik (WI) 2013 and 2015			
	Multikonferenz WIrtschaftsinformatik (MKWI) 2014			
	Pacific Asia Conference in Information Systems (PACIS) 2013 and 2015			

The following figure (own representation based on the mentioned authors) displays basic business model theories that were used for the theoretical foundation of business models.

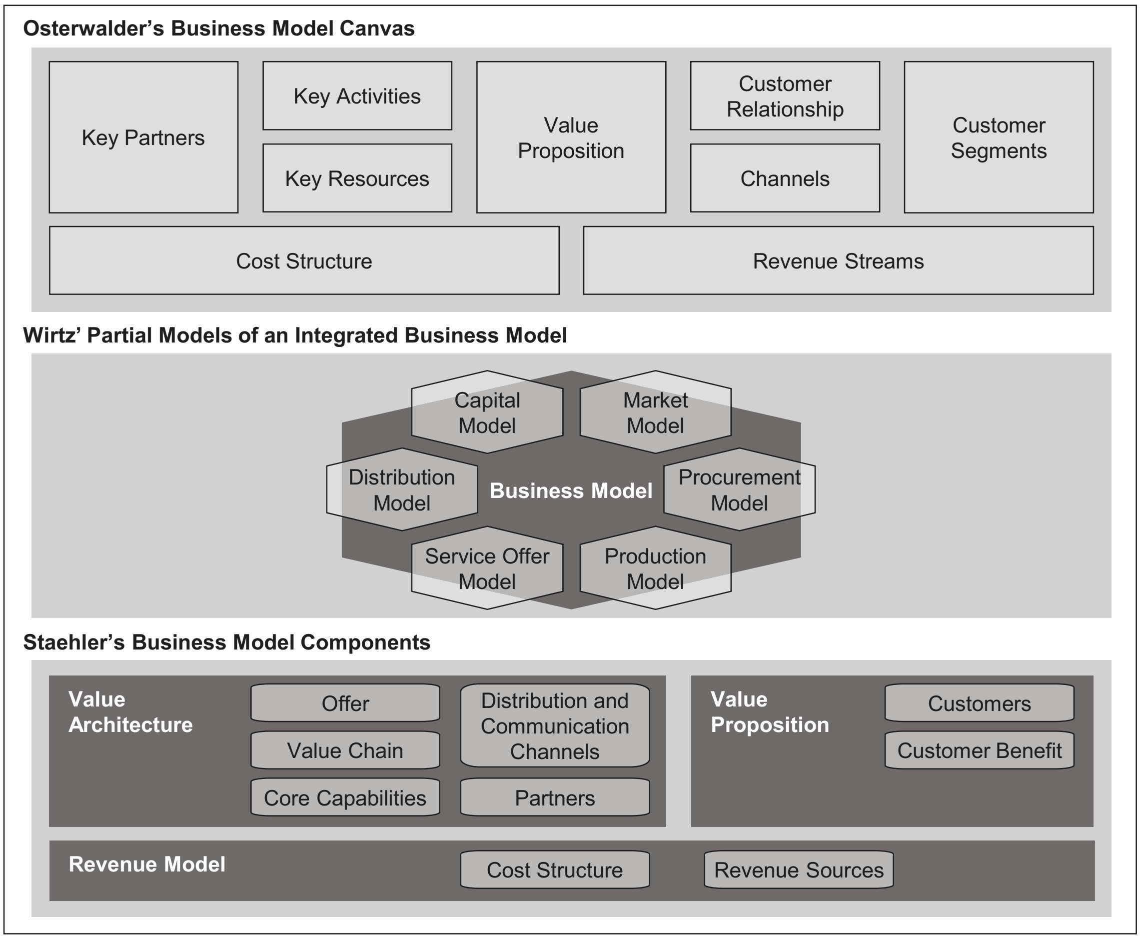


Figure 66: Business Model Theory Examples

The following table lists all business model characteristics of the business model framework and gives a detailed explanation for each of these.

Table 29: Characteristics of the Cloud Business Model Framework in Publication 3.2

No.	Characteristic	Explanation
1	Market adaption	Company acts individually at the market and adapts existing concepts
2	Market design	Company acts individually at the market and takes a pioneering role
3	Market diffusion	Company acts in a community at the market and adapts existing concepts
4	Market co-construction	Company acts in a community at the market and takes a pioneering role
5	New in market	Company is a new formation in the IT market
6	Market expansion	Company expands an existing business
7	Knowhow transfer	Company can use existing knowhow for the market entry
8	Horizontal diversification	Company provides cloud services at the same value added stage
9	Vertical diversification	Company provides cloud services at different value added stages
10	Lateral diversification	Company provides cloud services that are not related with each other
11	Storage service	Company provides virtualized online storage e.g. for synchronization
12	Computing service	Company provides virtualized servers for online load processing
13	Network service	Company provides special network services (e.g. CDN)

14	Development environm.	Company provides development servers for online coding and testing
15	Development tool	Company provides development tools for online coding and testing
16	Software service	Company provides online software applications
17	Business process	Company provides complete online business process services
18	Database service	Company provides additional database services
19	Search service	Company provides additional search services
20	Billing service	Company provides additional billing services for developed applications
21	Messaging service	Company provides additional chat services
22	Data processing	Company provides additional data processing and analysis services
23	Administration	Company provides additional tools for the administration of the service usage
24	Market place	Company provides additional market place service for developed applications
25	Manifold width	Company provides a wide-ranging product variety
26	Limited width	Company provides a small-ranging product variety
27	Manifold depth	Company provides a high product assortment depth
28	Limited depth	Company provides a low product assortment depth
29	Integration service	Company provides additional services for the implementation of the services
30	Consulting service	Company provides additional services for the consulting regarding the services
31	Human resource	Company provides additional human specialists for on-site services
32	Individual support	Company provides additional services for individual premium support
33	Private cloud	Company provides cloud services on dedicated private servers (single tenancy)
34	Community cloud	Company provides cloud services for groups of cooperating customers
35	Hybrid cloud	Company provides cloud services with a mix of private and public infrastructure
36	Public cloud	Company provides cloud services on public servers (multi tenancy)
37	Consolidation	Company promotes united services for the customer IT (e.g. all-in-one service)
38	Structuring	Company promotes structured compilations of services (e.g. clear assortment)
39	Standardization	Company promotes standardization (e.g. Standardized products or interfaces)
40	Flexibility	Company promotes the flexible booking, usage, and termination of services
41	Scalability	Company promotes rapid up and down scaling of services (e.g. server or storage)
42	Cost savings	Company promotes financial savings compared to traditional IT services
43	Time savings	Company promotes time savings compared to traditional IT services
44	Sustainability	Company promotes a higher sustainability compared to traditional IT services
45	Customization	Company promotes flexible customization of the services (e.g. regarding processes)
46	Security	Company promotes high security and data protection
47	Ecosystem	Company cooperates intensively in a partner ecosystem
48	Strategic alliance	Company cooperates on a medium level with strategic alliances
49	Loose cooperation	Company cooperates on a low level with loose network cooperation
50	Purchase	Company does not cooperate with partners, it purchases other services
51	Technology partners	Company cooperates with partners that provide technology (e.g. research)
52	Business partners	Company cooperates with partners that provide business opportunities (e.g. customers)
53	Consulting partners	Company cooperates with partners that provide consultancy
54	Complementary field	Company cooperates with partners that complement the own services
55	Similar field	Company cooperates with partners that have similar services
56	Substitutive field	Company cooperates with partners that have substitutive services
57	Hardware resources	Company uses hardware resources to generate services (e.g. storage, server)
58	Software resources	Company uses software resources to generate services (e.g. firmware, tools)
59	Network resources	Company uses network resources to generate services (e.g. hubs, traffic contingency)

60	Data / Content	Company uses data or content to generate services (e.g. information database)
61	Knowhow resources	Company uses knowhow to generate services (e.g. hosting and technology knowhow)
62	Human resource	Company uses human resources to generate services (e.g. personal support)
63	Production activities	Company produces the whole services on their own
64	Aggregation activities	Company aggregates existing services (via purchase or partners)
65	Aggregation + Add-on	Company aggregates existing services and adds an additional value
66	Comparison & Cat.	Company compares and categorizes existing services (no marketplace)
67	Integration activities	Company integrates services into the IT landscape of a customer
68	Consulting activities	Company advises customers in the cloud service procurement
69	Initial costs	Company has initial acquisition costs (e.g. hardware, development)
70	Fix operational costs	Company has fixed operating expenses (e.g. human resources, rent)
71	Variable operat. costs	Company has variable operating expenses (e.g. cloud licenses, electricity)
72	Mass market	Company focus at the mass market
73	Branch market	Company focus at specific branches (e.g. healthcare, banking)
74	Niche market	Company focus at niche markets (e.g. Linux user)
75	Major enterprises	Company focus on major enterprises
76	SME	Company focus on small and medium-sized enterprises
77	Start-ups	Company focus on start-ups
78	Public sector	Company focus on the public sector
79	Consumer	Company focus on private consumers
80	Internet connection	Company communicates with customers via the internet
81	Telephone line	Company communicates with customers via telephone
82	Print media	Company communicates with customers via print media
83	Personal interaction	Company communicates with customers via personal interaction (e.g. shop)
84	Web interface	Company distributes the service via web interface (e.g. browser)
85	Mobile interface	Company distributes the service via mobile interface (e.g. smartphone app)
86	On-site interaction	Company distributes the service via on-site interaction (e.g. integration, human support)
87	Self-service	Company offers on-demand self-service booking
88	Online profile	Company offers to create and configure a customer profile
89	Community	Company offers an online community platform for customers
90	Support	Company offers basic support to customers (hotline, email)
91	Monitoring	Company offers an monitoring tool to the customers for administration of bookings
92	Transparent SLAs	Company offers transparent service level agreements (e.g. availability, reliability)
93	Main service	Company generates revenue streams with the main service
94	Supplementary service	Company generates revenue streams with the supplementary services
95	One-time-charge	Company generated revenue through one-off payments for the service usage
96	Subscription	Company generated revenue through subscription-based payments
97	Reservation	Company generated revenue through fee-based reservation option
98	Pay-per-use	Company generated revenue through usage-based payment
99	Spot	Company generated revenue through spot prices for underutilized time slots
100	Free	Company offers free basic service usage
101	Sponsoring	Company generates revenue through sponsoring by partners
102	Advertising	Company generates revenue through advertising for partners
103	Commission	Company generates revenue through commission fees for referrals to partners
104	Share of turnover	Company generates revenue through share of turnover for referrals to partners
105	Membership	Company generates revenue through membership fees

The following figure shows the clustering process in the first business model analysis.

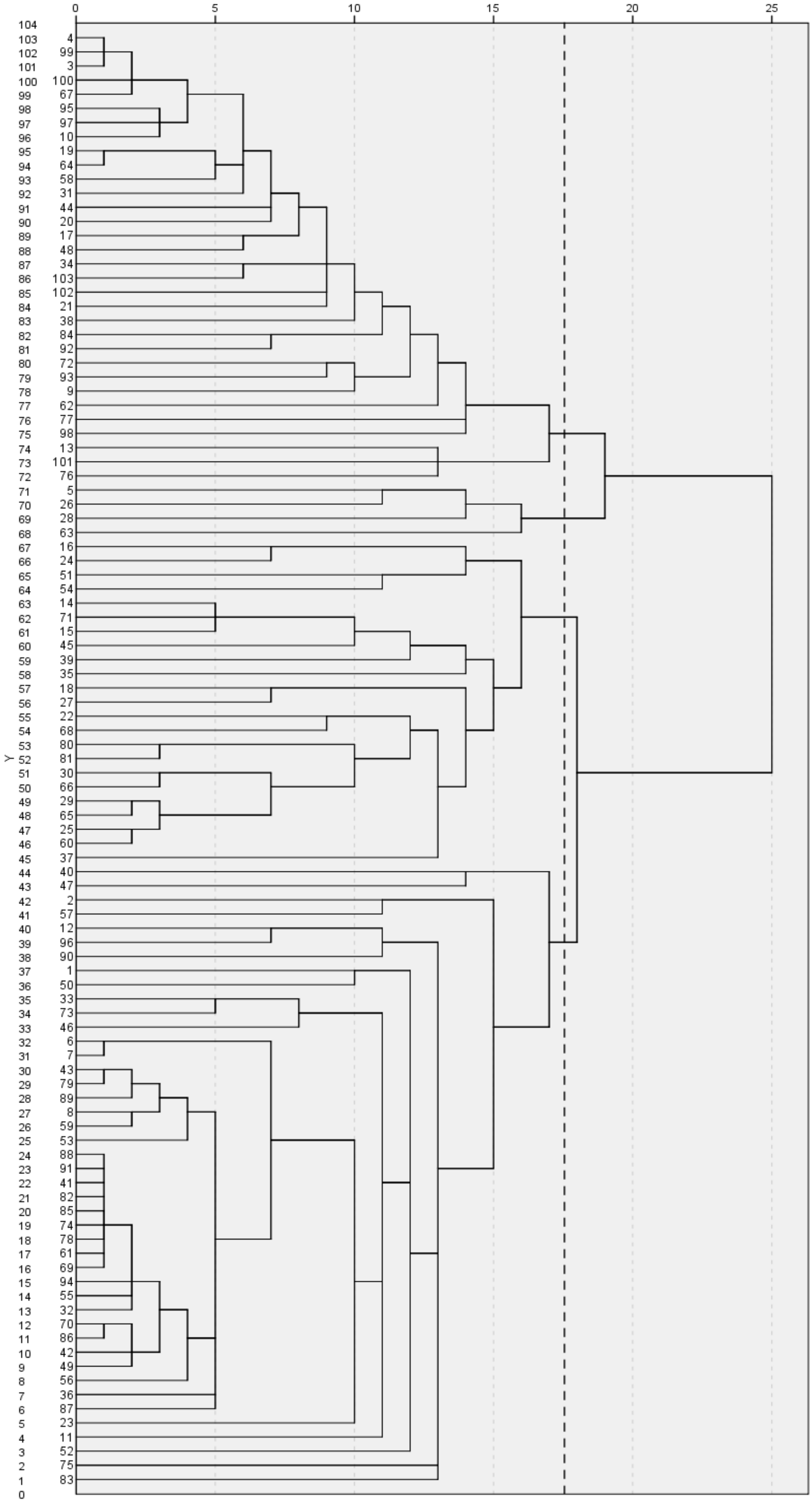


Figure 67: Dendogram of the Hierarchical Cluster Analysis in Publication 3.2

The following table shows the rankings that were the basis for the selection of the cloud providers included within the cloud business model study.

Table 30: Rankings of Cloud Service Providers in Publication 3.3

No.	Ranking Name	Year	Companies	Source
1	SearchCloudComputing	2012	10	http://searchcloudcomputing.techtarget.com/pho-tostory/2240149039/Top-10-cloud-providers-of-2012
2	BTC Logic Infrastructure	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
3	BTC Logic Foundation	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
4	BTC Logic Platform	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
5	BTC Logic Network	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
6	BTC Logic Applications	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
7	BTC Logic Security	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
8	BTC Logic Management	2010	10	http://www.btclogic.com/documents/BTCLogic_Top-Ten_Q12010.pdf
9	Cloudreviews Managed Hosting	2013	10	http://www.cloudreviews.com/top-10-managed-cloud.html
10	Cloudreviews Cloud Storage	2013	10	http://www.cloudreviews.com/top-10-cloud-storage.html
11	Cloudreviews Cloud Apps	2013	10	http://www.cloudreviews.com/top-10-cloud-apps.html
12	Cloudreviews Cloud Hosting	2013	10	http://www.cloudreviews.com/top-10-cloud-hosting-ser-vices.html
13	HostMonk Hosting	2013	13	http://www.hostmonk.com/ranks/popularity/cloud
14	Cloud Directory Cloud Hosting	2013	20	http://www.clouddir.com/mostpopular/
15	Talkincloud Cloud Service Pro-vider	2013	20	http://talkincloud.com/tc100
16	Convios Study - private user Ger-many	2012	10	http://web.de/presse/img/me-dia/5d616dd38211ebb5d6ec52986674b6e4.pdf
17	Cloudhostingreviewer Cloud Hosting	2012	4	http://www.cloudhostingreviewer.com/
18	Forrester Private Cloud Vendors	2011	10	http://platformcomputing.blogspot.de/2011/05/
19	Cloud Storage Finder - Cloud Storage	2013	10	http://www.top10cloudstorage.com/
20	Cloud Storage Finder - Cloud Hosting	2013	10	http://www.top10cloudstorage.com/
21	CloudStorageReviews.co	2013	5	http://www.cloudstoragereviews.co/
22	Cloud Computing Advices - Top 10 Cloud Companies	2013	10	http://cloudcomputingadvices.com/
23	businessBee - 5 Best Cloud Ser-vice Providers	2013	5	http://www.businessbee.com/
24	Business Insider - 10 Most Im-portant Companies in Cloud Computing	2013	10	http://www.businessinsider.com.au/10-most-important-in-cloud-computing-2013-4?op=1#a-word-about-clouds-1
25	Gartner - Cloud Storage Provid-ers	2013	10	http://www.networkworld.com/article/2162466/cloud-computing/gartner-top-10-cloud-storage-providers.html
26	CRN - Top 10 Enterprise Cloud Service Companies	2013	10	http://www.crn.com/slide-shows/cloud/240152878/the-top-10-enterprise-cloud-services-companies.htm
27	CloudStorageBest - Top 10 Cloud Storage	2013	10	http://www.cloudstoragebest.com/top-10-cloud-storage/

The following table shows a full list of business model characteristics with its correlations to the indicators for business model success.

Table 31: Correlation of the Business Model Characteristics in Publication 3.3

Characteristics	EBIT margin	Inlink count	Coverage	Average Rating
Web interface	N/A	N/A	100%	1.911
Manifold width	.681 ***	.447 ***	51%	.867
One-time-charge	.534 ***	.113	22%	.267
Database service	.513 ***	.254	31%	.311
Monitoring	.509 ***	.187	67%	.733
Consolidation	.506 ***	.153	33%	.422
Print media	.496 ***	.204	36%	.333
Knowhow transfer	.492 ***	.318 *	76%	1.111
Administration	.485 ***	.214	67%	.889
Knowhow resource	.485 ***	.271	73%	1.044
Consulting activities	.462 ***	.050	44%	.444
Hybrid cloud	.460 ***	.006	47%	.600
Manifold depth	.448 ***	.126	47%	.622
Consulting service	.447 ***	.127	56%	.800
Similar field	.433 ***	.285	60%	.622
Human resource	.426 ***	.345 **	53%	.622
Pay-per-use	.411 ***	.037	49%	.733
Network resource	.405 ***	.079	53%	.644
On-site interaction	.391 ***	.107	31%	.356
Vertical diversification	.383 ***	.322 *	49%	.622
Development environment	.380 **	.310 *	51%	.667
Hardware resource	.379 **	.100	84%	1.378
Private cloud	.368 **	.154	58%	.622
Market expansion	.366 **	.327 *	69%	.756
Business process	.365 **	-.098	11%	.111
Integration activities	.363 **	.078	40%	.422
Supplementary service	.347 **	.297 *	22%	.244
Fix operational costs	.340 **	.201	100%	1.778
Integration service	.333 *	.143	42%	.467
Branch market	.327 *	.036	51%	.578
Production activities	.315 *	.122	84%	1.578
Computing service	.300 *	.102	53%	.933
Market co-construction	.291	.166	4%	.089
Community	.290	.558 ***	69%	.800
Human resource service	.286	.201	11%	.111
Personal interaction	.270	.028	36%	.356
Individual support	.266	.389 ***	80%	1.156
Data processing	.256	.202	38%	.556
Sponsoring	.256	.163	2%	.022

Storage service	.250	.114		62%	1.022
Messaging service	.249	.479	***	44%	.511
Flexibility	.248	.126		80%	.978
Network service	.241	.055		44%	.600
Public sector	.240	.029		51%	.778
Aggregation activities	.233	.067		31%	.289
Development tool	.232	.332	*	44%	.467
Search service	.229	.432	***	7%	.111
Transparent SLAs	.226	-.114		58%	.756
Comparison & Categorization	.225	.432	***	7%	.089
Market place	.218	.289		47%	.711
Billing service	.215	.335	**	24%	.244
Purchase	.182	-.171		7%	.067
Membership	.181	.300	*	22%	.222
Consulting partners	.181	.174		40%	.467
Sustainability	.173	.137		36%	.400
Cost savings	.171	.369	**	84%	1.156
Support	.149	.263		100%	1.200
Major enterprises	.138	.199		80%	1.067
Technology partners	.130	.095		84%	1.178
Commission	.124	-.247		7%	.067
Data / Content	.121	.292		13%	.133
Telephone line	.111	.155		89%	.933
Standardization	.109	.225		84%	1.044
Reservation	.104	.042		4%	.044
Ecosystem	.098	.067		56%	.978
Time savings	.097	.142		91%	1.311
Market adaption	.095	-.258		31%	.400
Niche market	.091	.159		7%	.089
Strategic alliance	.085	-.030		62%	.822
Mass market	.067	.136		98%	1.822
Community cloud	.045	-.144		7%	.067
SME	.030	.371	**	100%	1.311
Scalability	.021	-.089		100%	1.222
Free	.019	.193		56%	.600
Advertising	-.003	.216		9%	.089
Lateral diversification	-.023	.244		2%	.022
Substitutive field	-.024	.159		31%	.356
Spot	-.025	.001		4%	.067
Initial costs	-.028	-.040		24%	.244
Online profile	-.033	.142		89%	.867
Complementary field	-.044	.071		96%	1.644
Market design	-.051	.360	**	71%	1.133
Internet connection	-.058	-.186		100%	1.911

Business partners	-.064	-.135	78%	.822
Security	-.074	-.339 **	100%	1.422
Share of turnover	-.116	.116	2%	.044
Customization	-.117	-.279	22%	.333
Self-service	-.129	.259	82%	1.511
Software resource	-.130	.049	91%	1.444
Loose cooperation	-.177	.108	80%	1.044
Software service	-.181	.051	84%	1.289
Subscription	-.194	.109	96%	1.600
Market diffusion	-.220	-.274	7%	.133
Public cloud	-.234	-.070	98%	1.378
Structuring	-.235	.045	56%	.689
Aggregation + Add-on	-.244	-.174	31%	.467
Consumer	-.249	.026	38%	.489
Main service	-.253	-.109	100%	1.800
Horizontal diversification	-.257	-.336 **	49%	.511
Variable operat. costs	-.271	-.225	98%	1.067
Start-ups	-.277	.236	82%	.889
Mobile interface	-.287	.159	69%	.889
New in market	-.406 ***	-.199	31%	.356
Limited depth	-.534 ***	-.181	53%	.889
Limited width	-.630 ***	-.457 ***	49%	.756

The following figure shows the clustering process of the second business model study that results in the meta types of cloud business models.

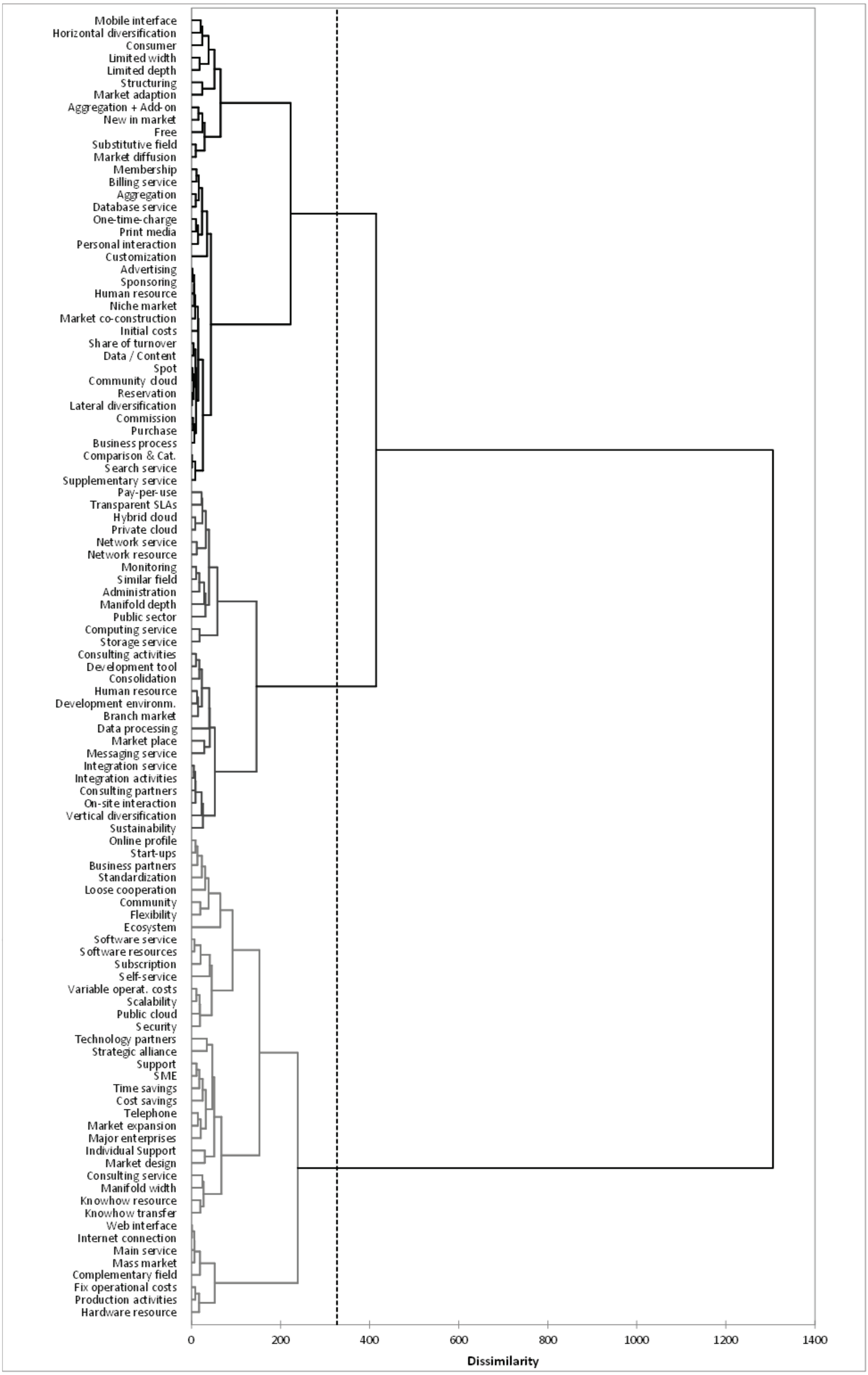


Figure 68: Dendogram of the Hierarchical Cluster Analysis in Publication 3.4

The following figure (own representation) shows the questions of the interview guide for the evaluation of the results of the business model study.

CLOUD EXPERTS INTERVIEW GUIDE

1. The literature review revealed success factors in the different components of a business model. Which components of a business model (see table) of a cloud service provider would you consider as most critical to success? Please arrange the business model components in a rank order (column 1) to answer the question and explain your thoughts.
2. Do you think that the ranking is changing if you consider especially big (2a) or small (2b) cloud providers? Please adjust your rank order (column 2a and 2b) and explain your thoughts.
3. Do you think that a general business model without the cloud focus has different priorities of success factors within a business model? Please adjust your rank order (column 3) and explain your thoughts.

Business Model Components	1	2a	2b	3
Business strategy, e.g. innovation, differentiation, vertical integration (lean or universal), flexible governance				
Partner Network, e.g. special focus on partner relationships				
Resources and Activities, e.g. productivity, know how, reliable infrastructure, active decision making, management commitment				
Costs, e.g. savings, synergies, investment intensity, capital				
Value Proposition, e.g. product portfolio, quality, security, flexibility, reversion, interoperability, privacy, data control				
Distribution and Customer Relationship, e.g. customer interaction, care, communication, image, service level agreements, customness				
Revenue Model, e.g. charging, prices				
Target Market, e.g. market position, market attractiveness, market growth, market competition, segments adjustments				

4. The business model analysis revealed three generic business model types with different prospects for success. Do you agree with these three types and their success? Please modify the assessment if you have a different impression and explain your thoughts (column 4).

Type	Business Model Type	Success	4
A	a) Market newcomer or small providers with aggregation services b) Partner-based communities with traditional distribution channels and partner-based revenue models (heavily underrepresented within the analysed business models)	Low	a) b)
B	Experienced providers with standardized public cloud services created on own resources for the mass market and a well-developed customer relationship	Medium	
C	Specialized provider with branch solutions in hybrid cloud provisioning models and active support for the integration of the service on a high trust level	High	

5. What could be the cause that providers of type A have low success?
6. What are your recommendations for providers of type A to generate success?
7. What could be the cause that providers of type B have medium success?
8. What are your recommendations for providers of type B to increase their success?
9. What could be the cause that providers of type C have high success?
10. What are your recommendations for providers of type C to ensure their success?
11. What is your opinion which business model type has the best prospects for success in the future? Please explain your thoughts.
12. Do you think it is a valuable option for newcomers or small providers in the cloud market to cooperate with each other in order to succeed in the competition with the successful cloud service providers? Please explain your thoughts.
13. Do you have further suggestions or comments on this topic?

Figure 69: Cloud Experts Interview Guide in Publication 3.4

The following figure (own representation) shows the "prisoners' dilemma" for the community cloud situation with the different strategies of the members. The developed incentive systems in the profit sharing mechanism can help to reach the better but originally instable Pareto equilibrium.

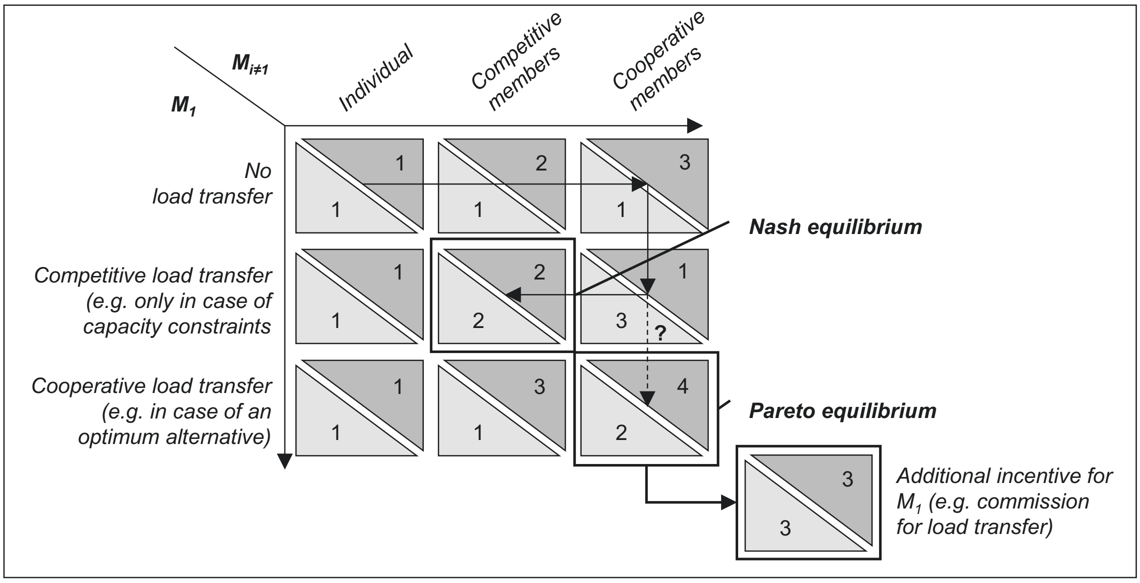


Figure 70: Example for Nash and Pareto Equilibrium with Profit Sharing in Publication 4.3

The following figure (own representation) shows the interdependencies between the different formulations of the profit sharing mechanism and highlights the independent input parameters that serve as adjusting screws.

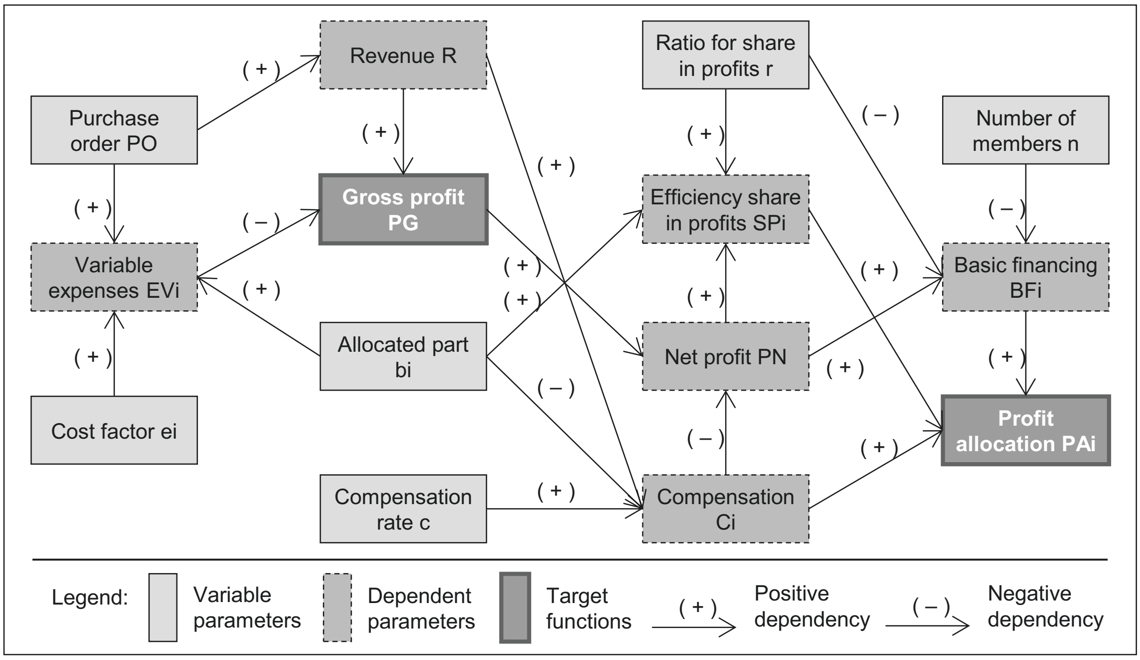


Figure 71: Interdependencies between the Formula Parameters in Publication 4.3

The following figure (own representation) shows the supporting calculation tool for the simulation game that was developed within the research and used in evaluation experiments for the profit sharing mechanism.

Players / Round	A Load units	A Revenue per unit	A Capacity units	A Profit / Account	A Cost factor	B Load units	B Revenue per unit	B Capacity units	B Profit / Account	B Cost factor	C Load units	C Revenue per unit	C Capacity units	C Profit / Account	C Cost factor	D Load units	D Revenue per unit	D Capacity units	D Profit / Account	D Cost factor
1			9	500	100			9	500	100			9	500	100			9	500	100
Optimization Event																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Penalty 10% Fix costs																				
End	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100
2	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100
Optimization Event																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Penalty 10% Fix costs																				
End	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100
3	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100
Optimization Event																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Round 3 - 6 . . .																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Penalty 10% Fix costs																				
End	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100
7	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100
Optimization Event																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Penalty 10% Fix costs																				
End	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100
8	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100	0	0.0	9	500.0	100
Optimization Event																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Load Order Individual Transfer																				
Penalty 10% Fix costs																				
End	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100	0	0.0	0	0.0	100
Final	0	0.0	9.0	500.0	100	0	0.0	9.0	500.0	100	0	0.0	9.0	500.0	100	0	0.0	9.0	500.0	100
Share (%)			25.00					25.00					25.00					25.00		

Figure 72: Game Calculation Tool for Experiments in Publication 4.3

Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material, which has been quoted either literally or by content from the used sources.

Date, Signature

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