REAL ESTATE DEVELOPERS AS CIRCULAR SERVICE PROVIDERS

Imardo de Blok | Master Thesis | February 2018

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Cover photo:
The Boutique Office (source: OVG Real Estate)

COLOFON

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"People who are unable to motivate themselves must be content with mediocrity, no matter how impressive their other talents"

Andrew Carnegie

FOREWORD

In the spring semester of 2014, I graduated from my HBO studies into architectural engineering with a thesis about the Circular Economy. The relating research project was about the implementation of a circular business model into an adaptive re-use project towards a residential function (Hereijgers & De Blok, 2014). At the end of this graduation project the question arose; *how* these service-based products could be implemented in real estate development projects. The urge to answer this question only increased when following the MBE master track at the TU Delft, since this the education focussed on managerial processes related to real estate and the built environment. Therefore, I took the chance to graduate with a master thesis about my favourite subject.

The opportunity to graduate at OVG Real Estate arose in the meanwhile as they was eager to gain more knowledge about the role of the real estate developer within circular real estate development projects. This meant that I could use case studies from OVG Real Estate and provide in return scientific empirical advice to further implement 'products as services' in their real estate development projects. This would add up to their newly developed corporate strategy, which focusses on service provision.

Acknowledgements

Conducting this research was not possible without the help and support of people that were directly and indirectly involved. First of all, I would like to thank my mentors Erwin Heurkens and Ruben Vrijhoef for their guidance throughout the research process. I am grateful for the personal and constructive support of Erwin, his support helped me to smoothen the research process and he often reminded me about the importance of taking a step back when necessary. The critical view and input of Ruben is appreciated very much, as it increased the overall quality of the research and this report.

I would like to thank Constantijn Berning of OVG Real Estate as well. He gave me the opportunity to graduate at OVG Real Estate. This internship provided me with the opportunity to conduct this research and also meant a lot for my personal and professional development. The supervision meetings we had supported me in many aspects. The personal feedback and pleasant discussions helped me to focus on the end-goals and –products of this research. I am grateful for this mentorship.
The input and time from the interviewees, members of the expert panel and colleagues from OVG Real Estate is highly appreciated. It was impossible to conduct this research without them and I enjoyed all the interesting conversations, discussions and interviews a lot.

A special mention goes to my friends (from Delft, Tilburg, Stockholm and Zeeland) and fellow students for the fun years, amazing activities, awesome trips and having the privilege of studying together at the TU Delft and KTH. Last but definitely not least, I would like to thank my family for their everlasting support all those years, this has meant a lot to me.

With this research, I endeavour to complete the Mastertrack Management in the Built Environment of the Faculty of Architecture & the Built Environment. This research forms the final piece of my educational career that ends with obtaining the Master of Science degree at the Delft University of Technology. From April onwards, I will start working for OVG Real Estate where I can – finally – apply all the things I have learned during the educational journey. I am looking forward to this next chapter!

I hope you will enjoy reading this report!

Imardo de Blok
Delft, February 2018

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EXECUTIVE SUMMARY

Real estate developers as circular service providers

MSc Thesis
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Mastertrack: Management in the Built Environment - Graduation laboratory: Circular Urban Living Labs
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ABSTRACT

Purpose: The implementation of Product-Service-Systems (PSSs) in real estate development project could support the shift of the real estate sector towards a more Circular Economy. With the implementation of these system responsibilities of products remain with the suppliers of these products. This incentives suppliers to design products which fit in closed material loops. Much attention was paid by scientists and practitioners about the implementation of these PSSs in practice. However, a knowledge gap still exists about how Product-Service-Systems function on an operational level in real estate development projects. Therefore, actors in the real estate sector do not know how to implement PSSs in real estate development projects. The central role of the service provider (i.e. former real estate developer) is hereby seen as important since this actor that would manage the overall performance of a servitized building and steers the development of it. The objective of this research is therefore to (1) conceptualize the functioning of circular Product-Service-Systems on an operational level and (2) develop conceptual working models that could be used by real estate developers to perform the role of the circular service provider.

Research question: How could a circular service provider interact with service suppliers and customers in order to implement circular Product-Service-Systems in real estate development projects?

Methodology: The research process consisted of fours steps. The first step relates to the development of concepts. An explorative literature review and several explorative interviews were conducted within this step. The second step comprehended a systematic literature review in order to gain insight in existing theories. The third steps related to practices, whereby three case studies were conducted and analysed. The fourth step related to the synthesis, hereby theories were built around four business tactics, which in the end led to the generation of a proposition in the form of empirical lessons.

Findings: As Product-Service-Systems aim at meeting end-users needs, service value is created over time. This implies that a mindset change within the real estate sector is needed in order to servitise real estate development projects. Organizations in the real estate sector should hereby aim at long-term value creation for customers and collaborate with partners. Actors within the supply chain should opt for equal partnership and form networks of organizations around a specific goal.

Conclusion: The role of the service provider is hereby to find the right partnerships and ensure incentives will be directed towards thig long-term service delivery. The form and content of these partnerships is essential in order to implement Product-Service-Systems successfully. The service provider could establish this by using the developed 'Interaction Model'.

Limitations: Three case studies from one real estate development company have been analysed as not many servitized project are available. The validity of findings is increased by using different sources of data and research techniques (triangulation).

Key words: *Product-Service-Systems, Service provider, Real estate development, Circular Economy, Servitization*

INTRODUCTION

According to the United Nations (2017), the next decades the entire world population will grow, which increases the demand for the already constrained natural resources. The United Nations (2017) hereby mention that: "If we (i.e. earthlings) don't act to change our consumption and production patterns, we will cause irreversible damage to our environment". The construction and real estate sector plays an important role in this since these sectors are responsible for one third of the total global energy use, uses 40% to 50% of all the raw materials every year and produces 40% of solid waste streams (Antink, Carrigan, Bonneti, & Westaway, 2014). The introduction of circular economic principles in the real estate sector could therefore be a proper instrument to stop the depletion of the world's natural resources and unsustainable raw materials consumption. This Circular Economy (CE) aims to "replace the 'end of life' concept of the linear economy [...] and aims for the elimination of waste through the superior design of materials, products systems, and, within this, business models" (Ellen MacArthur Foundation, 2013b, p. 7). Herewith, the CE could make an end to the global resource depletion caused by the real estate sector.

The implementation of so-called Product-Service-Systems (PSSs) in real estate development projects could be a way to shift the current real estate sector towards a Circular Economy, because with the implementation of PSSs the responsibilities over products and related services is arranged differently compared to current practices. This means that the responsibilities over products remains with the suppliers of that product, including the end-of-life processing (Stahel, 2006). Besides this, the introduction of servitized products will also change the way suppliers offer products since these products would be designed in such a way that they will provide the highest user value towards their user (Ellen MacArthur Foundation, 2013b; Kazemi, 2016; Mont, 2002; Prins, Mohammadi, & Slob, 2015; Tukker, 2015; Van den Brink, 2016).

Products as services

The concept of products as services was introduced by Walter Stahel in 1989, he advocated a service society, whereby the value of utilization is at the heart of economy. This advocates a performance driven orientation where the user pays for utilisation of a product. Hereby (1) the object of sale is the performance and not the product itself, the customer satisfaction is the end-result, (2) liability of the quality of the overall performance remains at the seller, (3) payment is done when the performance is delivered and is based on the quality of the delivered service (no fun no money), and not at the moment when products are transferred and (4) service has to be provided in situ, instead of produced centrally. Therefore Product-Service-Systems' (PSSs) can be defined as "a marketable set of products and services capable of jointly fulfilling a user's need" (Goedkoop, Van Halen, Te Riele, & Rommens, 1999). The implementation of these Product-Service-System implies that a physical product is connected to a non-physical service.

Real estate as a service

The definition of a servitized building could be made when the abovementioned definition of a PSS and the definition of a building are brought together. According to Van den Brink (2016, p. 12) "A collection of products that together form an entity that can be described as a building. A building is as such a collection of interrelated products at different scale levels" (Van den Brink, 2016, p. 12). Thus, a collection of products forms the building, which delivers a performance and a subsequent service to the user(s) of this building. Hereby products become service products and because a building is a collection of interrelated products a building becomes a service.

More knowledge is needed

According to Van den Brink (2016) the role and position of the real estate developer might fade when real estate development projects become servitized. Currently, real estate developers play a central role within the real estate development process and it can be assumed that this party does not want to forfeit its position in the real estate sector and transforms into a 'service provider'. The service provider would be the actor

that manages the overall performance of a servitized building by aligning the demands of the users of the building with the services offered and is placed in between the supplying parties, clients and the other stakeholders in the project organization (Ellen MacArthur Foundation, 2013a; Van den Brink, 2016). Herewith service provider have a central and 'steering' position within servitized real estate development projects, which align with the current tasks of 'traditional' real estate development projects (Miles, Berens, & Weiss, 2007). It is therefore believed that real estate developers have a driving force in order to push the implementation of these innovative Product-Service-Systems in real estate development projects (Rood, 2015; Van den Brink, 2016).
In science, there is a knowledge gap about the implementation of Product-Service-Systems in real estate development projects. This knowledge gap exists because – according to Reim, Parida, and Örtqvist (2015) - a research gap exists how to successfully implement PSS business models on an operational level since the PSS literature has not discussed business related to PSS-business models extensively.
This results in practice in a situation whereby actors are willing to implement these servitized business models, but have difficulties in implementing these servitized business models at the organizational level.

Moreover, the graduation company (a real estate developer of office buildings, based in The Netherlands) is developing and implementing a new business model during the research process. This business model aims for a changing real estate market in which the offering of services stands central, hereby the graduation company shifts towards the role of the service provider. However, the way these services are being delivered is not based upon the use of Service-Systems because (1) the graduation company does not have the proper knowledge to implement Product-Service-Systems in their real estate development projects, (2) and not enough suppliers are available that that provide these 'circular services' (C. Berning, personal communication, September 20, 2017).

Problem statement

Real estate developers do not know how to interact with service suppliers and customers to implement Product-Service-Systems in order to realise circular real estate development projects, since there is not enough knowledge available in science and practice about (1) the functioning of Product-Service-Systems on an operational level; and about (2) the position and the role of the service provider within the project organization of circular real estate development projects.

Research objective

Conceptualize the functioning of circular Product-Service-Systems on an operational level and develop conceptual working models that could be applied by real estate developers to perform the role of the service provider within the project organization of circular real estate development projects.

Research question

How could a circular service provider interact with service suppliers and customers in order to implement circular Product-Service-Systems in real estate development projects?

BACKGROUND

In order to conduct this research, a management perspective is taken. Management in the built environment and the management of a project implies acting towards a certain goal. According to Daamen (2010) actors in (urban) development practice are in constant search for effective and efficient 'strategies' needed to produce successful outcomes of projects and reach these (Heurkens, 2012). This instrumental view on management implies "the total process of planning, decision-making and administering of all aspects of an action or system from its inception to its termination" (Bruil & Heurkens, 2012, p. 26). Therefore, it is important to analyse the whole spectrum of management activities related to development processes.
The conceptual steering model of De Leeuw (2002) is chosen to do this. The conceptual steering model is not a representation of reality, but provides a conceptual model that explains all sorts of mechanism occurring in project (Heurkens, 2012). Several concepts from the

Conceptual Steering Model are defined and operationalized so it could be used as the conceptual framework in this research.

Context: The context refers to the different levels of surrounding of which a certain empirical object is part of (Heurkens, 2012). In this research relates context to the conditions in which the implementation of PSSs takes place.

Inter-organizational system: The inter-organizational system represents different aggregation levels of organizational structures, formal and informal relationships and roles between different actors (Heurkens, 2012). The focus in this research lies on the relationships between (1) the supplying parties, (2) demanding parties and (3) the system integrator (Vrijhoef & De Ridder, 2005). Which are in this research respectively the (1) 'service supplier' (i.e. organization that performs a service with an underlying physical product), (2) the 'customer' (i.e. organization that makes use of the delivered services) and (3) the 'service provider' (i.e. organization that integrates services as delivered by the service suppliers and delivers them towards the customer).

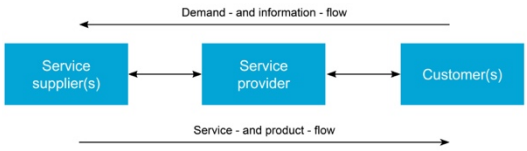

Figure I: Inter-organizational system (Segerstedt & Olofsson, 2010; Vrijhoef & De Ridder, 2005)

Process system: The process system relates to the whole development process in order to deliver and / or manage the real estate development project. The process system in real estate development projects are sometimes referred to as black boxes and are considered as port of systems whereby only relations between the black box and its context are relevant (Heurkens, 2012).

Internal management measures: Internal management measures are aimed at influencing the structure or objectives of the project (De Leeuw, 2002). This means that internal management measures are used by actors to realize certain objectives. Four sets 'PSS business tactics' were recognized as useful to operationalize the 'internal management measures' of this research. These tactics are derived from the literature review of Reim et al. (2015) and are (1) Contracts, (2) Network, (3) Marketing and (4) (Product and service) Design. Business tactics can be defined as "company's residual choices at an operational level after deciding which business model to apply" (Reim et al., 2015, p. 66). The business tactics link decisions on a strategic-level with decision on an operational-level and are used by companies to create, deliver and capture value on an operational level.

External management measures: external management measures are used to influence the structure or objectives of the project surroundings (De Leeuw, 2002).

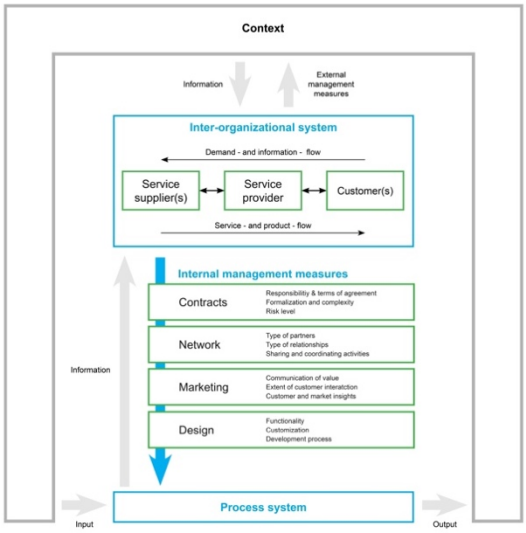

Figure II: Conceptual framework (own ill.)

METHODOLOGY

This research is qualitative (Bryman, 2012), has an explorative character (Kumar, 2014, p. 11) and consists of four main research parts: Concepts, Theories, Practices and Synthesis.

Part 1: Concepts

The first step relates to the development of concepts. Hereby the main research gap is explored, and the research problem, research objective and research question are formulated. Next to this, in this part general knowledge about the topic is gained. This is done with an explorative literature review and several explorative interviews (Bryman, 2012). It should be noted that this part of the research had a very iterative character (Edmondson & McManus, 2007).

Part 2: Theories

In order to get a full overview of the existing theories and existing knowledge, a literature review is used. Since little academic literature is available about the implementation of Product-Service-Systems in the real estate sector, a meta-ethnography method is used whereby the master theses of former MBE-students were the main source (Bryman, 2012). Based on the used sources in these theses, a more in-depth literature review was made.

Part 3: Practices

In order to create a better understanding of the application of PSSs in the current real estate sector and gain insight in the current interaction between involved actors in servitized real estate development project, case studies were conducted. An information-oriented selection procedure (Yin, 2014) has been used to sample appropriate case studies for this research. This procedure was based upon a criterion sampling (Flyvbjerg, 2006) and expected information to be derived from the case (Bryman, 2012, p. 419).

Based on this selection criteria three case studies were selected, being (1) Triodos Bank, (2) Basisweg and (3) The Boutique Office. The next sources of evidence were used to conduct the case study research: (1) Participant observation, (2) Semi-structured interviews and (3) Documentation (Yin, 2014). The researcher was able to do this since the researcher conducted a graduation internship at the real estate developer of these projects during the research process.

Part 4: Synthesis

The outcomes of the case studies provide input for the synthesis of this research project wherein theories were built. This process of theory building is based upon the theory building approach of Eisenhardt (1989). This theory building approach leads to the generation of a proposition, which functions as the main findings of this research. This approach is also partly inspired upon the research strategy used in the dissertation of Vrijhoef (2011).

LITERATURE STUDY

A literature study has been conducted in order to get an overview of the existing theories and existing knowledge related to this topic. The business tactics as given by Reim et al. (2015) are used in order to structure the literature study and latter parts of this research.

Contracts: defines "[...] the responsibilities of the involved parties during a specific contractual period. Key aspects herein are the delivered performance of the service, incentives and risk allocation" (Reim et al., 2015; Selviaridis & Wynstra, 2015). Three categories of business models and related contracts could be recognized: (1) Product-oriented services, (2) Use-oriented services and (3) Result-oriented services, these business models show a spectrum that vary from product ownership towards pure 'products as services' (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38).

Network: refers to how actors "[...] use their network relationships with external partners to ensure PSS business models are implemented successfully" (Reim et al., 2015, p. 70). When PSSs are implemented in real estate development project, the complexity of processes would increase while the need of different parties working together will increase (Prins et al., 2015; Selviaridis & Wynstra, 2015; Van den Brink, 2016). According to Vrijhoef and De Ridder (2005), especially supplying parties should shift towards more integrated production and business formats.

Marketing: This tactic "[...] communicates the PSS offer's value to customers, while also capturing customers 'needs and requirements" (Reim et al., 2015, p. 73). In a PSS business world, there is an "[...] anticipation of market demands and trends with integrated concept design", hereby "[...] market and client information is lead into the supply chain" (Vrijhoef, 2011, p. 239).

(Product and service) Design: This aspect relates to how actors "[...] design product and services to meet the diverse needs of customers and successfully implement PSS business models" (Reim et al., 2015, p. 71). This leads to a situation whereby the supplier is incentivized to develop products that are totally pre-designed and pre-developed, but still be flexibility to cope with changes in the demand of the customers (De Ridder & Vrijhoef, 2007).

CASE STUDIES

Triodos Bank - Façade as a service

Triodos Bank is a financial institution that provides finance for companies, institutions and projects that create added value for society, environment and/or culture. Because of their expansion they decided to develop a new office at domain De Reehorst in Zeist.

A central theme in the redevelopment of the domain and the development of the building was to 'close loops' in multiple ways. The chosen building materials for the building are therefore very sustainable and fit in closed material loops. However, during the lengthy development phase, several new 'trends' in society arose and the development team reconsidered the used Program of Requirements. From this reconsideration the decision was made to incorporate principles of the Circular Economy by trying to incorporate 'new ownership models' on a 'core layer' of the building. This resulted in a decision to try circular business models on the façade of the building (C. Berning, Personal communication, September 20, 2017).

The main obstacles in this case study were that (1) the design of the building was already made and (2) contracts between the real estate developer and the contractor were already fixed.

Contracts: Because of (1) the already existing made agreements and (2) because it is not possible to split the ownership of a façade from the rest of the building with the use of superficies *(opstalrecht)* the only solution to servitize the façade was to use obligatory provisions *(obligatoire voorzieningen)* between the service supplier and Triodos Bank. These provisions would arrange the maintenance, repair, monitoring and circular take-back of the façade by the service supplier. Although many tasks and responsibilities are transferred towards the service supplier, the intention is to keep the used contracts as open and flexible as possible. By doing this, the interests of involved parties could remain assured in the future and the increased risk profile for the supplier could be diminished.

Network: The service provider used a network-strategy based upon trust and cooperation to reach this. This was necessary since the amount of risk for the service supplier increases a lot with this structure. This implied that the involved parties first talked about the vision on circularity, the common interests and hereafter about the organizational aspects.

Marketing: It is believed in the project that the TCO (Total Cost of Ownership) related to the façade could decrease because of the integration of tasks and responsibilities by service suppliers. Secondly, it will also become more easy to implement new innovative façade techniques in the future, because the client and the supplier are still in contact with each other. Hereby an internal yield that would be created by the more efficient maintenance could be used to pre-finance these upgrades but could also be used for the expenditures related to the take-back of the façade.

In retrospect, the 'circular' goals could be obtained with the use of these obligatory provisions, but this strategy is actually quite inefficient. If circular business models would have been incorporated earlier in the project, much more possibilities to reach the circular ambitions would be present. This could have created more innovative inter-organizational principles. On the other hand, maybe the most important aspect in this case study is the extended involvement of the supplying parties. This makes it much easier to give the façade a second life.

Basisweg - Comfort & Energy as a Service

The Basisweg project contains the redevelopment of a 55.000m² building that was originally built in 1974. The design of the building is characterized by the repetition of office-units that together form a circle. Hereby big free floor fields are created. The graduation company (i.e. real estate developer) bought the building recently from a pension fund in order to redevelop it.

During the design phase, the idea arose to procure the HVAC installation as a service from an energy company. Hereby use-oriented service contracts would be used for the energy generation assets'(i.e. solar panels, heat/old-generation system) and product-oriented service contracts for the 'release system' (i.e. climate ceilings, air channels, monitoring systems etc.).

Marketing: The motivation to incorporate these new kind of business models for the real estate developer is twofold: Firstly, it lowers the needed since investments in the servitized HVAC system are not needed anymore. Secondly, the future building owner receives a guaranteed performance (and maintenance) over the installations during the contract period (R. Rampersad, personal communication, September 27, 2017). The energy company steps into this project because they are searching for new partnerships in order to extend their business model (J. Feuth, personal communication, September 22, 2017).

Contracts: The energy company will form a joint venture with an underlying SPV (Special Purpose Vehicle) in order to servitize the HVAC installations. This joint venture will consist of the mentioned energy company, an installation advisor and an installation company. The ownership of the HVAC installations will be put within this SPV, which herewith becomes a fund. This integration of tasks, responsibilities, liabilities and ownership has several advantages, such as: (1) bottom-up commitment will be created within the joint venture because of 'pain and gain' sharing, (2) cumulative risk margins at the supply side will be eliminated and (3) expertise of different parties will be integrated, which creates a higher performing PSS.

Network: Although the supplying parties become responsible for the design, realisation, maintenance and operation of the HVAC installation, the role of the real estate developer remain important as well during the development phase. The real estate developer used an approach based upon co-creation with the supplying parties. This created a proper synergy between the involved parties, which is necessary in these innovative long-term projects. Hereby, the real estate developer could still 'be in the lead' within their own project while the interest of the other parties were secured as well.

Design: The early involvement of the supplying parties affected the design process. Since these parties were involved earlier, the role of the architect was more to integrate the different design solutions into a coherent and integrated building (Van Noord, personal communication, September 21, 2017). Secondly, it also created a better integration of the expertise and still many contractual options were available.

The Boutique Office - Real estate developer as service provider

The third case study also comprises the redevelopment (and extension) of an existing building. During the development and realisation period, a new business strategy was implemented within the real estate developer of the project. The Boutique Office hereby served as a 'launching project' of this new business model, which aims at the provision of services towards the users of the building. Hereby acts the real estate developer as a service provider within this project.

Contracts: Real estate developers 'normally' sell buildings after completion and leave their buildings behind. However, in this case the real estate developer is not able to do this anymore since they will also exploit The Boutique Office. Therefore conducted the real estate developer a sort-of "Sale-and-Leaseback agreement" with an investor, whereby a split is made between the casco and the fit-out of the building using a triple-net agreement. Hereby, the ownership of the casco (and other 'essential building components') is transferred towards the investor while the fit-out remains with the real estate developer. This fit-out could hereby be procured by the real estate developer 'as a service' (T. Ummels, personal communication, October 02, 2017).

Network: Interesting within this case was that the real estate developer procured products that are essential for the operation of the building as an 'in-house service'. Hereby, the service supplier is a subsidiary of the real estate developer.

Marketing: By becoming a service providers, the tasks of the real estate developer are integrated with the tasks of the current asset manager. As a result, a more integrated service provision approach towards customers could be delivered, whereby space to work is delivered instead of casco office floors. This decreases the amount of tasks of the customer that are traditionally executed by the corporate real estate manager and/or facility manager.

Design: The real estate developer (as service provider) steers the development, realization and exploitation period of The Boutique Office. The feedback derived from the exploitation period could be used to develop a blueprint for these new kind of office buildings within the new strategy of the real estate developer. With this

product blueprint, the service provider integrates the design, development and exploitation of the complete building with each other (T. Ummels, personal communication, October 02, 2017). Hereby the service provider places himself in the lead of value creation towards the customer.

Cross-case analyses

A cross-case analyses was made in order to learn from the conducted case studies. With this cross-case analyses, the information derived from the case studies was categorized back into the four business tactics. Hereafter a pattern matching technique is used to identify similarities and difficulties, with the aim to build theories (Eisenhardt, 1989; Yin, 2014). The outcomes of the cross-case analyses form the empirical findings of this research.

Confronting theory to practice

The empirical findings derived from the case studies are confronted with the existing theories in order to build theories. This was the second last step in the process of theory building as described by Eisenhardt (1989).

The empirical findings relating to the business tactics 'Contracts' showed many similarities with the existing theories. However, new insights were created about the way service providers could mitigate risks at the side of the service supplier and could create trust and common understanding with the use of the right contracts.

Aspects related to the tactic 'Network' which were not seen in the theoretical study but emerged from the case studies related to the usage of joint ventures by service suppliers. Hereby these parties would use an SPV in order to deliver 'integrated PSSs'. The role of the service provider was also more clarified.

Existing theoretical knowledge relating to the marketing tactic was perceived as rather abstract. The empirical findings provided more insight in the added value created by the integration of the development phase and the exploitation phase by the service provider.

Some aspects found in the existing theories relating to the business tactic 'Design' were not found back in the empirical findings, such as the theory that customers could easily change their demands during exploitation and service suppliers would hereby be adapting their delivered products. On the other hand, the empirical findings added up to the existing knowledge by providing insight in the development process of the implementation of PSSs and the way service providers could create service 'product blueprint' by using their market and user insights.

PROPOSITION

The last step of the theory building process of Eisenhardt (1989) is the shaping of a proposition. This process related to the identification and verification of relationships between theory and the empirical findings derived from the case studies. (Eisenhardt, 1989; Vrijhoef, 2011). The proposition is developed in the form of empirical lessons, which could be used by real estate developers to interact with service suppliers and customers in order to implement Product-Service-Systems in real estate development projects. These lessons are grouped per side of the supply chain and per business tactic.
During the analyses it turned out in order to implement PSSs, different conditions are necessary as well. Conditional lessons are therefore developed that aim to shape a different context, which should make it easier for the real estate developer to implement PSSs.

Empirical lessons

Interaction with service suppliers

Lesson 1: Sale and lease-back

A service provider should conclude a sale-and-leaseback with an investor for the casco of the building to extend his responsibilities into the exploitation phase. individual PSS contact could hereafter be used to procure the servitized fit-out of the building.

Lesson 2: Co-creation

The service provider should use a network strategy based upon co-creation, whereby the creation of trust and the incorporation of multiple interest stands central. This approach should lead

to equal partnerships and high-quality Product-Service-Systems.

Lesson 3: Connection for innovation
The service provider should challenge the supplying parties to keep implementing new techniques in the delivered products. These innovative solutions should increase the performance of the delivered Product-Service-System during the entire contract period.

Lesson 4: Integrated implementation
The service provider should incorporate service suppliers as early as possible in the development process. The early involvement of supplying parties should lead to the integrated implementation of PSSs in a servitized building. A balance should be found between the overall architectural quality of the building and the functionality of PSS in terms of service provision and circular design.

Interaction with customers
Lesson 5: Translating & integrating
The service provider translates the demands of the customer as specified in Service Level Agreements into specific performance requirement for service supplier(s). Vice versa, the service provider integrates the delivered PSSs by the service supplier into an integrated building in order to developer a servitized real estate development project.

Lesson 6: Direct partnership
The service provider should opt for a more direct partnership with the customer in or der to gain more market insight into the customer's preferences.

Lesson 7: Service delivery mindset
The service provider should base the provided services on the market information gained from the direct contact with the customer. This leads to a mindset change based upon long-term service delivery towards the customer instead of short term revenue creation.

Lesson 8: Service packages
The service provider could integrate the market information relating to customer's preferences into a universal service blueprint that could be used for other development. A blueprint could provide several service packages, which aim at providing flexible office space concepts according to the demands of customers over time.

Conditional lessons
Lesson 9: Vertical & horizontal integration
Service suppliers should vertically and / or horizontally integrate within the supply chain in order to be able to deliver Product-Service-Systems

Lesson 10: Online material databanks
Service suppliers should put their materials into online building material databanks in order to provide insight in deliver product towards external parties. Internal yield could be used to prefinance costs related to product take back. The re-take of products becomes herewith financially attractive.

Lesson 11: Special Purpose Vehicles
Service suppliers could use a Special Purpose Vehicle to mitigate risks related to bankruptcy and finance the supplied materials.

The overall research findings are presented in Table I. The findings presented in this table apply mostly to the first research objective.
The 11-empirical lesson are combined with each other in order to create an 'Interaction model', which provides an answer to the second research objective. This model is presented in Figure III.

EXPERT PANEL

An expert panel was held in order to internally and externally validate the research findings. This session had the form of a focus group (Bryman, 2012, p. 504), whereby a group discussion was held around several statements *(stellingen)* that related to the used business tactics. Statements were selected around subjects that were (1) mentioned in the case studies, but were not easy to underpin or provide proper conclusions about, or (2) the outcomes of the case study research were different than the outcomes of the literature study. In order to ensure that both an internal ánd external validation took place, experts were selected that were involved during the research and experts that were not. In order to gain differ-

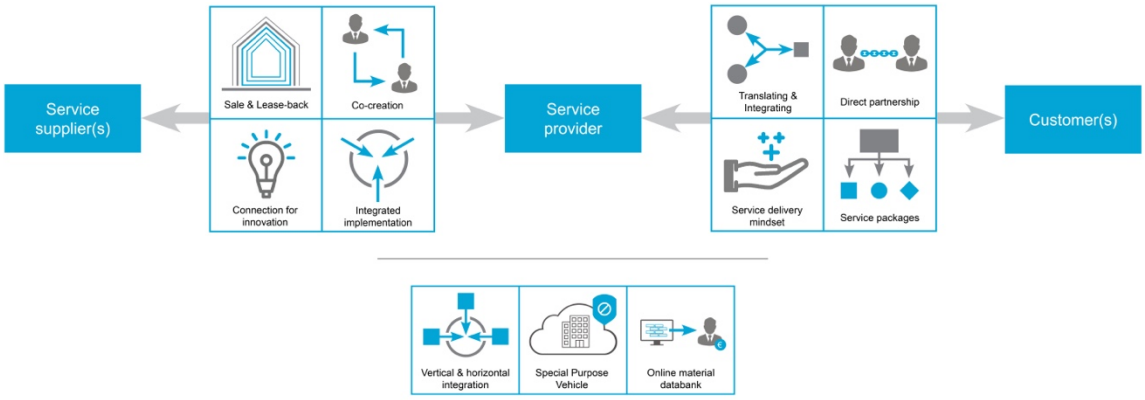

Figure III: Interaction model (own ill.)

ent perspectives upon the outcomes of the analyses people were selected that could be classified as 'customer', 'service supplier' and 'service provider'.

The expert panel validated most of the research findings in the held discussion and even added some more insights. However, some panel members disagreed with for example the structure of the clustered service suppliers, and the preferred type of contracts used for a certain PSS. These contradicting views could be explained by the position and role of these experts in the real estate sector and project supply chain. Hereby not taking the overall supply chain into account.

CONCLUSION

Product-Service-Systems are longitudinal relation processes which could support the implementation of a Circular Economy. During which products and performances on a variety of scale level are integrated, whereby the products is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's needs over time.

Product-Service-Systems are integrated systems of products that connect services to delivered products. The integrated service delivery could be established by partnering between the service suppliers themselves and between the service supplier(s) and the service provider. This mutual dependency increases the need for these parties to work together closely.

Since the service provider is the central organization within servitized real estate development projects it is his task to make sure these parties interact properly. Hereby it is the task of the service provider to select the proper service supplier and cluster them based on their interests in service provision, potential delivered services and preliminary service propositions.

The extended involvement of the service provider makes it possible to derive information about customers' preferences and put it together in order to create a blueprint for service provision. Standardized service packages could be delivered out of these blueprint which should offer servitized office solutions that provide flexible contract terms and flexible conditions.

The main added value of these kinds of servitized office concepts is the unburdening *(ontzorging)* of the customer while a more competitive offer is being delivered. This competitiveness is being created because of the believed higher quality of building during the entire exploitation phase for a stable, predictive and equal / lower service fee compared to more traditional office concepts.

The current real estate developer could transform itself into a circular service provider to align the demand side with the supply side of servitized buildings and vice versa. Hereby takes this actor besides a central 'development role' during the real estate development process, also a 'managerial role' during the exploitation phase of a servitized building.

Also, parties that make decisions regarding the design of the building are involved and responsible during the entire exploitation phase of a building towards the end-of-life phase of a building. Therefore, decisions about products and the technical design of the building could be made in such a way that it becomes very easy to give products a second life using a closed material loop. If the underlying service-contracts are also

designed in such a way that it becomes economically attractive and feasible to give these products a second life, the chance that (servitized) products will be placed in a closed loop increases.
Herewith is the implementation of a Circular Economy in the real estate sector more ascertained.

DISCUSSION

Discussion on theory

The existing theories provided a rather abstract view on the way PSSs could be implemented in practice and what the influence of this implementation would be on involved actors. The insights gained by this research deepen the existing knowledge by focusing on the role of the service provider within servitized real estate projects.

Discussion on practice

The character of the three conducted case studies was quite different because of the nature of the implemented PSS and the project context. The empirical findings cover therefore the four business tactics of this research, although it should be noted that due to the scope of this research project the focus lies most on the business tactics contracts and network.
The case about the new office for Triodos Bank created the most knowledge regarding the contractual aspects of PSSs and the supportive approach of the service provider. The 'Basisweg' case provided insight in the way multiple service suppliers could collaborate in order to deliver an integrated PSS and the marketing value created with the implementation of servitized products. 'The Boutique Office' provided an example how real estate developers could transform themselves into service providers.

The case study around Triodos Bank proved that simple obligatory provisions might be enough to 'secure' circularity of delivered products. Therefore, could the added value of PSSs be questioned since they tend to be complex. However, these PSSs seem to be necessary since these systems provide many chances for suppliers to extend their business models. If these extra chances would not be created, suppliers will presumably not accept these guarantees for material take-back in the form of obligatory provisions.

The feasibility of the use of SPV's could questioned as not much empirical evidence is available about the functioning of these entities. Some studies mention that financiers calculate with high yields when products are being finance din these SPVs, which makes it not attractive to use them.

The asset manager or the contractor could possibly take the role of the circular service provider as well. However, the graduation company (i.e. a real estate developer) is the only company - as far as the researcher knows – that proved it is capable of taking this role.

LIMITATIONS

This research is limited by the amount of available case studies in the real estate sector suitable for this research, this resulted in a situation whereby the involved real estate developer in the three conducted case studies is the same organization. Secondly, the three case studies were at the moment the research took place all in the development phase. Therefore, apply the outcomes of this research to a lesser extent to the role of the service provider and other actors during the exploitation phase. Thirdly, because of the focus on the development phase remains the interaction between the customer and the service provider a bit in the background. Fourthly, it is still uncertain whether the studied PSSs will eventually be implemented in real life in the Triodos Bank case and the Basisweg case.

Validity and reliability

Construct validity is ascertained with the use of the business tactics as defined by Reim et al. (2015) to operationalize this research. These business tactics were created based upon a systematic literature review about the implementation of PSSs in several fields. Internal validity is established with the use of the 'building theories'-method as described by Eisenhardt (1989) and Vrijhoef (2011). The external validity is tried to obtain with the use of interviews with people

from different organizations and the use of an expert panel. Several research protocols are created and executed in order to increase the reliability of this research.

RECOMMENDATIONS[1]

Service suppliers are recommended to rethink their own value proposition within the supply chain. These parties could gain a stronger position within this chain if they offer integrated services instead of physical products, hereby extending their business model and taking responsibility over their own products.
The researcher recommends that **service providers** use their central position within real estate development projects to (1) challenge service providers to innovate and offer their products as services, (2) do this by implementing small pilot projects, (3) use knowledge from these pilot projects in order to innovate and further expand the implementation of PSSs.
Customers receive the recommendation to think about the added value of the real estate they use. Hereby thinking about what they really need, which added value this creates for them and what they would be 'willing to pay' for it. The trend of servitization could hereby be very beneficial for them.

In order to make the implementation of PSSs possible should **legislative authorities** rethink their position towards new ownership models. This should make it possible to detach certain products from buildings in a juridical sense.

Future research could focus on:
(1) The implication of servitized products during the exploitation phase of real estate development projects. This could create additional insights in the role of the service providers and the impact and added value of servitized real estate for the customer.
(2) The role of data in order to optimize building exploitation and the service concept offered by the service provider.
(3) The usage of SPVs or other entities to finance servitized products.
(4) Online building material passports and indicators for 'circularity.

[1] The references of the Executive summary are combined with the references of the Dutch summary.

Table I: Tabulated research findings

	Service supplier	Service provider	Customer
Contracts	- Extended responsibilities - Vertical integration - Horizontal integration - Continuous (i.e. life-cycle) value delivery - Responsible for integrated service delivery - Reduction of transaction costs - Risk increase - Risk reduction by: - Usage of internal yield - Creation of SPVs - Open form of contracting - Data sharing - Option for demolition - New business opportunities - From price-based to performance-based mindset - Contract as asset, instead of physical product	- Demand and supply integration - Deliver services to customer - Translate demands into performances - Purchase services from suppliers - Collaborative approach - Support innovation at suppliers' side - Trust building - Investments in structure + skin of the building - Servitization of the 'inner layers'	- Based on Performance requirement / KPIs - Functions as Service Level Agreement - Periodic payments to service provider - Service packages - Based on office space / workplaces - Flexible contract duration - Flexible contract conditions
Networks	- Collaborative responsibility for service delivery - Internalization of neighbouring activities - Forming of consortia / joint ventures - Use of SPV to: - Handle ownership of products - Decrease risk - Finance products - Reduce transaction cots - Create bottom-up commitment	- Manage the real estate development process - Stakeholder management - Integration of delivered services - Trust building / co-creation - Determination of clusters - Determination of inter-organizational structure - Determination of used contracts - Selection of appropriate service suppliers - Focusing on co-creation - Manage the building operation - Integrate task of developer and asset manager	- Finding partnerships that opt for same goals
Marketing	- Closer relationship with customer / provider - Communication of added value through transparency - Transparency in delivered performance - New way of value delivery of towards the customer - TCO reduction for more straightforward products - Integral value delivery approach for complex PSS	**Suppliers' side:** - Demands on a higher aggregation level - Guaranteed performance - Investment reduction - Future improvements in products - New valuation approaches based on TCO **Customer side:** - Take over tasks from customer - Analyse market demands - Analyse customer preferences - User-centered approach - Offering of flexible service concepts - Flexible lease term - Relationship building Competitive advantage because better price / quality ratio	- Determination of demanded services - Changing of demands - Demands on a higher aggregation level - Unburdening by all-in services - Fees based upon TCO - Task reduction - Guaranteed performance - User-centered approach - Increased performance of services - Sustainable footprint - Competitive offer (higher quality, lower fees) - Value delivery based upon customer needs - Value delivery difficult to compare with traditional approaches - High-quality building maintenance and operation
(Product and service) Design	- Usage of modular or standardized components - Design for future disassembly - User-centered supply chain - Early incorporation in design process increases performance of products	- Platform for joint decision-making - Changing demands of customer - Early involvement of service suppliers - Development of a product blueprint - Lean development	- Service design based on customer preferences - Product blueprint aiming at 'general' customer' demands - Service package offering in product blueprint

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MANAGEMENT SAMENVATTING

Vastgoedontwikkelaars als circulaire dienstverleners

MSc Thesis
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Mastertrack: Management in the Built Environment - Afstudeerlab: Circular Urban Living Lab
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OVERZICHT

Doel: Het implementeren van Product-Service-Systemen (PSSs) in vastgoed ontwikkelingsprojecten kan de transitie van de vastgoedsector richting een Circulaire Economie mogelijk maken. Met de implementatie van dergelijke systemen blijven de verantwoordelijkheden rondom een product bij de originele leverancier hiervan. Dit stimuleert leveranciers om hun producten zo te ontwerpen dat ze passen binnen een gesloten materialenkringloop. Ondanks dat er veel aandacht is besteed door onderzoekers en vaklieden aan het toepassen van PSSs in praktijk, is er nog steeds weinig kennis hoe deze PSSs werken op een 'operationeel niveau'. Daarom weten partijen in de vastgoedsector ook niet hoe ze deze PSSs moeten toepassen in vastgoedprojecten. De centrale rol van de service provider (voormalige projectontwikkelaar) is hierbij belangrijk aangezien deze partij de geleverde prestaties van een 'verdienst' gebouw manage en de ontwikkeling ervan stuurt. Het doel van dit onderzoek is dan ook om (1) de werking van Product-Service-Systemen op een operationeel niveau te conceptualiseren en (2) om conceptuele werkmodellen te ontwikkelingen die kunnen worden toegepast door ontwikkelaars om de rol van de service providers binnen circulaire vastgoedprojecten in te nemen. **Onderzoeksvraag:** Hoe kan een circulaire service provider handelen om samen met service supplier en consumenten circulaire Product-Service-Systemen te implementeren in vastgoedontwikkelingsprojecten? **Methodologie:** Het onderzoeksproces bestond uit vier stappen. De eerste stap relateerde aan het ontwikkelen van concepten. Hiervoor is een exploratief literatuuronderzoek uitgevoerd en zijn enkele exploratieve interviews gehouden. Bij de tweede stap is een systematisch literatuurstudie uitgevoerd om inzicht te krijgen in bestaande theorieën. De derde stap relateerde aan praktijk, waarbij drie case studies werden onderzocht en geanalyseerd. De vierde stap bestond uit de synthese, waarbij theorieen werden gebouwen rondom vier business tactics. Dit leidde tot de ontwikkeling van een voorstel *(proposition)* in de vorm van empirische lessen.
Bevindingen: PSSs als doel hebben om te voorzien in de behoeften van gebruiker, waarbij 'service'-waarde gecreëerd over een bepaalde periode. Dit betekent dat een veranderde mindset binnen de vastgoedsector nodig is om te komen tot verdienste vastgoedontwikkelingen. Partijen in de vastgoedsector moeten daarom zichzelf het doel stellen om te focussen op het creëren van waarde over een lange periode, in plaats van het maken van winst op korte termijn. Partijen in de toeloeveringsketen moeten daarom zoeken naar gelijke partnerschip en het creëren van netwerken die samenwerken rondom een gelijk doel.
Conclusie: De rol van de service provider is hierbij om te zoeken naar geode samenwerkingsvormen waarbij stimulansen worden gecreëerd die aansturen op lange-termijn waarde-creatie. De vorm en inhoud van deze samenwerking is hierbij cruciaal. Echter, deze kunnen gevonden worden door het toepassen van het in dit onderzoek ontwikkelde 'Interactie model'.
Limitaties: De drie onderzochte case studies hadden dezelfde projectontwikkelaar omdat er niet veel case studies in aanmerking kwamen om dit onderzoek op uit te kunnen voeren. De validiteit van de uitkomsten is verhoogd door het gebruik van verschillende soorten bronnen en onderzoekstechnieken (triangulatie).

INTRODUCTIE

Volgens de United Nations (2017) *(Verenigde Naties)* zal de wereldpopulatie sterk groeien de komende decennia, hiermee wordt de vraag naar de reeds schaarse grondstoffen alleen maar groter. De United Nations (2017) vermeldden hierbij dat: "Als wij (aardbewoners) niet handelen om onze consumptie en productie patronen te veranderen, zullen we onomkeerbare schade toebrengen aan ons milieu (vertaald, red.)" The vastgoed- en bouwsector spelt een grote rol in dit probleem omdat deze sectoren verantwoordelijk zijn voor één derde van het totale energieverbruik op aarde, 40% tot 50% van alle grondstoffen verbruiken en 40% van alle afvalstromen produceren (Antink, Carrigan, Boneti & Westaway, 2014). Het introduceren van een Circulaire Economie in de vastgoedsector zou een goed middel zijn om dit niet-volhoudbare manier van grondstoffenverbruik en halt toe te roepen.. De Circulaire Economie (CE) heeft als doel om "de lineaire economie te vervangen en […] en hiermee afval niet meer te laten bestaan door het anders ontwerpen van materialen, productie systemen en business modellen (vertaald, red.)" (Ellen MacArthur Foundation, 2013a, p. 7). Hiermee zou de CE een eind kunnen maken aan een gedeeltelijke uitputting van de aarde veroorzaakt door de vastgoedsector.

Het implementeren van zogenoemde Product-Service-Systemen (PSS) in vastgoedontwikkelings-projecten zou een middel kunnen zijn om de transitie van de huidige vastgoedsector richting een Circulaire Economie mogelijk te maken. Dit omdat met de implementatie van PSS de verantwoordelijkheden van producten en gerelateerde diensten anders is geregeld dan in de huidige praktijk. Dit betekent dat de verantwoordelijkheden van verschillende geleverde producten binnen deze projecten bij de leverancier van dit product blijft liggen, inclusief de verwerking ervan aan het einde van de levensduur (Stahel, 2006). Hiernaast betekent de introductie van geservicede producten ook dat de manier waarop leveranciers producten aanbieden ook zal veranderen, waarbij deze producten op zo'n manier worden ontwikkelt dat ze de hoogste gebruikswaarde naar hun gebruiker zullen leveren (Ellen MacArthur Foundation, 2013b; Kazemi, 2016; Mont, 2002; Prins et al., 2015; Tukker, 2015; Van den Brink, 2016).

Producten als diensten

Het concept 'producten als diensten' is geïntroduceerd door Walter Stahel in 1989, hij voorzag een dienstenmaatschappij, waarbij gebruikswaarde de ken van de economie vormt. Dit pleit voor een prestatiegerichte economie, waarbij een gebruiker betaalt door het gebruik van een product. Hierbij worden (1) prestaties verkocht en geen fysieke producten, (2) de aansprakelijkheid gerelateerd aan de kwaliteit van de geleverde services blijft bij de verkopen, (3) betalingen worden gedaan op basis van de kwaliteit van de prestaties die het product leven en (4) een service moet ter plekke worden geleverd, in plaats van centraal geproduceerd. Op basis hiervan kunnen Product-Service-Systemen (PSSs) worden gedefinieerd als ""Een verkoopbare reeks producten en diensten die in staat zijn om gezamenlijk te voorzien in de behoefte van een gebruiker (vertaald, red)" (Goedkoop et al., 1999). De implementatie van deze PSSs impliceert hiermee dan ook dat een niet-fysieke dienst wordt aangesloten op een fysiek product.

Vastgoed als een service

De definitie van een 'geserviced' gebouw kan worden gemaakt wanneer de bovengenoemde definitie van een PSS en de definitie van vastgoed (een gebouw) bij elkaar worden gebracht. Volgens Van den Brink (2016, p. 12) is een gebouw "Een collectie van producten die samenwerken als één entiteit (vertaald red.)". Daarmee wordt een gebouw een collectie van producten die samenwerken op verschillende schaalniveaus (Van den Brink, 2016, p.12). Dus, een collectie van producten vormt een gebouw welke een prestatie levert en daarmee direct ook een bepaalde dienst naar diens gebruikers. Hiermee worden producten dienstproducten en omdat een gebouw een collectie is van zulk soort intergerelateerde diensten, wordt een gebouw een dienst.

Tekort aan kennis

Volgens Van den Brink (2016) zal de rol en positie van de huidige vastgoedontwikkelaar verdwijnen wanneer vastgoedprojecten worden geserviced.

Tegenwoordig speelt een vastgoedontwikkelaar een centrale rol binnen vastgoedontwikkelingsprojecten. Het kan daarom worden aangenomen dat deze partij zijn huidige positie in de sector niet wil kwijtspelen en zichzelf daarom zal transformeren en daarmee de rol van de service provider aannemen. Deze service provider is de partij die de algehele prestatie van een geserviced gebouw zal managen door het uitlijnen van de vraag van de gebruiker met de geleverde services bij de service supplier. Hiermee krijgt de service provider opnieuw een centrale plaats tussen de leverende partijen, klanten en andere stakeholders binnen projecten en kan deze ook direct sturen (Ellen MacArthur Foundation, 2013a; Van den Brink, 2016). Dit komt overeen met de huidige taken van de 'traditionele' vastgoedontwikkelaar binnen vastgoedontwikkelingsprojecten (Miles et al., 2007). Daarom wordt er vanuit gegaan dat de huidige vastgoedontwikkelaar de partij juist partij is om de implementatie van PSSs in vastgoedontwikkelingsprojecten te stimuleren (Rood, 2015; Van den Brink, 2016).

Echter, in de wetenschap is er een kennishiaat gerelateerd aan de implementatie van Product-Service-Systemen in vastgoedontwikkelingsprojecten. Dit hiaat bestaat omdat er – volgens Reim et al. (2015) – een 'onderzoekshiaat' bestaat hoe PSS-business modellen succesvol kunnen worden geïmplementeerd omdat de PSS literatuur zich niet richt op PSS-business modellen.

Dit creëert een situatie waarbij marktpartijen weldegelijk welwillend zijn om dienst-gerelateerde modellen te implementeren in vastgoedprojecten, maar niet goed weten hoe ze deze modellen moeten implementeren op een operationeel niveau.

Het afstudeerbedrijf (een Nederlandse ontwikkelaar van kantoorgebouwen) is tijdens het onderzoeksproces bezig met het ontwikkelen en implementeren van een nieuw business model. Dit model richt zich op een veranderende vastgoedmarkt waarbij het leveren van diensten *(services)* centraal staat, hiermee neemt het afstudeerbedrijf de rol in van een service provider. Echter, deze diensten worden niet geleverd op basis van het gebruik van Product-Service-Systemen omdat (1) het afstudeerbedrijf niet over de juiste kennis beschikt hoe ze deze modellen moeten implementeren en (2) omdat er nog niet genoeg leveranciers beschikbaar zijn die 'circulaire diensten' aanbieden (C. Berning, persoonlijke communicatie, 20 September 2017).

Probleemstelling

Vastgoedontwikkelaars weten niet hoe ze moeten handelen met service suppliers en consumenten om Product-Service-Systemen te implementeren en hiermee circulaire vastgoedontwikkelingsprojecten te realiseren, dit omdat er niet genoeg kennis beschikbaar is in de wetenschap en praktijk over: (1) het functioneren van Product-Service-Systemen op een operationeel niveau en over: (2) de positie en rol van de service provider binnen de projectorganisatie van circulaire vastgoedontwikkelingsprojecten.

Onderzoeksdoel

Het conceptualiseren van het functioneren van circulaire Product-Service-Systemen op een operationeel niveau en het ontwikkelen van conceptuele werkmodellen die kunnen worden gebruikt door vastgoedontwikkelaars om de rol van de service provider uit te kunnen voeren binnen de projectorganisatie van circulaire vastgoedontwikkelingsprojecten.

Hoofdvraag

Hoe kunnen circulaire service providers handelen om samen met service suppliers en consumenten Product-Service-Systemen te implementeren binnen vastgoedontwikkelingsprojecten?

ACHTERGROND

Om dit onderzoek uit te kunnen voeren is een management perspectief genomen. Management binnen de gebouwde omgeving omvat veelal het managen van een projecten richting een bepaald doel. Volgens Daamen (2010) zijn partijen binnen (gebieds-)ontwikkeling altijd op zoek naar effectieve en efficiënte strategieën die leiden tot succesvolle uitkomsten (Heurkens, 2012). Deze instrumentele benadering van management omvat het "totale proces van planning, besluitvorming en het toepassen van alle aspecten rondom een actie of systeem vanaf diens aanvang tot beëindiging (vertaald, red.)" (Bruil & Heurkens, 2012, p. 26). Daarom is het van

belang om het hele spectrum van management activiteiten rondom ontwikkelingsprocessen binnen vastgoed te analyseren.

Het 'Conceptual Steering Model' *(conceptueel sturingsmodel* van De Leeuw (2002) is gekomen om dit te doen, dit conceptueel model representeert niet de realiteit maar levert een conceptuele blik op allerlei soorten mechanismen binnen projecten (Heurkens, 2012). Verschillende concepten die voorkomen binnen het Conceptual Steering Model worden gedefinieerd en verduidelijkt in deze paragraaf zodat ze kunnen toegepast in dit onderzoek.

Context: Relateert aan verschillende omgevingsniveaus waarvan het empirisch object onderdeel van is (Heurkens, 2012). In dit onderzoek relateert de context aan het milieu waarin de implementatie van een bepaalde PSS plaatsvindt.

Inter-organisatorisch systeem: Het inter-organisatorisch systeem vertegenwoordigt verschillende aggregatieniveaus van organisatiestructuren, formele en informele relaties en rollen tussen verschillende partijen. De focus van dit onderzoek ligt op de relatie tussen (1) de leverende partijen, (2) de vragende partijen en (3) de 'systeemintegrator' (Vrijhoef & De Ridder, 2005). Deze zijn in dit onderzoek respectievelijk de (1) service supplier (de partij die een dienst aanbiedt op basis van een onderliggend fysiek product), (2) de consument (de partij die gebruik maakt van een geleverde dienst) en (3) de service provider (de partij die geleverde diensten bundelt en levert aan de consumenten).

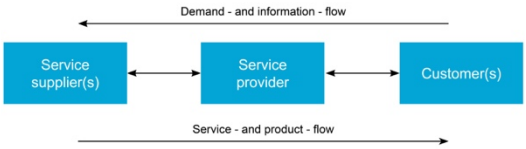

Figure IV: Inter-organisatorisch model [Engels] Segerstet & Olofsson, 2010; Vrijhoef & De Ridder, 2005)

Proces systeem: Het proces systeem relateert aan het gehele ontwikkelingsproject om een bepaald project te ontwikkelen en / of te managen. Dit soort processen worden vaak aangeduid als 'black boxes', die functioneren als 'subsystemen' waarbij alleen de relatie tussen de context en de black box zelf relevant is (Heurkens, 2012).

Interne management ingrepen: Deze ingrepen zijn bedoeld om de inhoud of doelen van een project te beïnvloeden (De Leeuw, 2002). Dit betekent dat interne management ingrepen worden gebruikt door partijen om bepaalde doelen te bereiken. Om dit onderzoek te kunnen operationaliseren zijn vier zogenoemde 'business tactics' erkend. Deze business tactics stammen af van het literatuuronderzoek van Reim et al. (2015) en behelzen (1) Contracten, (2) Network, (3) Marketing en (4) Ontwerp (van Product en Dienst). Deze business tactics kunnen gedefinieerd worden als: "De keuzen van een bedrijf op een operationeel niveau nadat bepaald is welk business model te implementeren" (Reim et al., 2015, p. 66). Deze tactics verbinden hiermee keuzes op een strategisch niveau met een operationeel niveau en worden gebruikt door bedrijven om waarde te creëren, leveren en behouden op een operationeel niveau.

Externe management ingrepen: Externe management ingrepen worden gebuikt om de inhoud en doelen van de projectomgeving (de context) te beïnvloeden (De Leeuw, 2002).

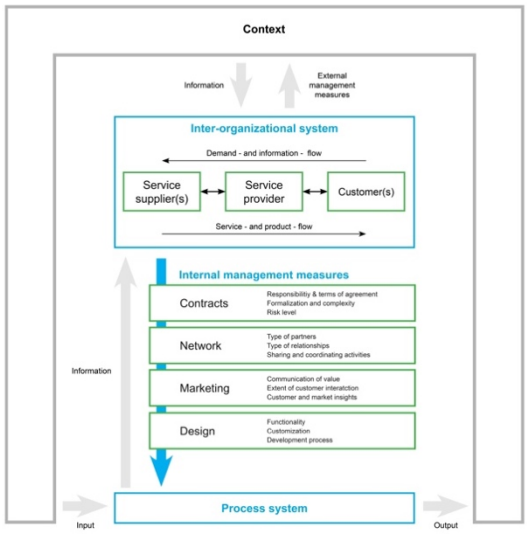

Figure V: Conceptueel model (eigen ill.; Engels)

METHODOLOGIE

Dit onderzoek kan worden gecategoriseerd als kwalitatief (Bryman, 2012), heeft een exploratief karakter (Kumar, 2014, p. 11) en bestaat uit vier onderdelen: Concepten, Theorieën, Praktijk en Synthese.

Deel 1: Concepten

De eerste stap relateert aan het ontwikkelen van concepten. In dit deel worden het onderzoekshiaat onderzocht en worden het onderzoeksprobleem, doelstelling en hoofdvraag geformuleerd. Daarnaast word in dit deel algemene kennis gerelateerd aan het onderwerp vergaard. Dit is gedaan met behulp van een exploratief literatuuronderzoek en het houden van verschillende exploratieve interviews (Bryman, 2012). Het dient vermeld te worden dat dit deel van het onderzoek een erg iteratief en exploratief karakter had (Edmondson & McManus, 2007).

Deel 2: Theorieën

Een literatuurstudie is gemaakt om een compleet beeld te krijgen van de beslaande theorieën en kennis van het onderwerp. Omdat er maar een beperkte hoeveelheid literatuur beschikbaar is gerelateerd aan het implementeren van Product-Service-Systemen in de vastgoedsector is een meta-etnografie (Bryman, 2012) gemaakt van master thesis' van voormalige MBE-studenten met een gerelateerd onderwerp. Uit deze meta-etnografie is een meer diepgravende literatuurstudie gemaakt.

Deel 3: Praktijk

In het kader van dit onderzoek is er case studie onderzoek verricht. Doel hiervan was om (1) een beter beeld te krijgen van de huidige toepassing van PSSs in de vastgoedsector en om (2) inzicht te krijgen in de interactie tussen betrokken partijen in dit soort vastgoedontwikkelingsprojecten. Deze case studies zijn geselecteerd op basis van een informatie-gerichte selectieprocedure (Yin, 2014). Deze procedure was hiermee gebaseerd op een criteriumbemonstering (Flyvbjerg, 2006) en de verwachtte informatie die uit deze case studie gehaald zou kunnen worden (Bryman, 2012, p. 419)

.Deze selectieprocedure heeft geleidt tot de selectie van drie case studies, deze zijn (1) Triodos Bank, (2) de Basisweg and (3) The Boutique Office. The belangrijkste informatiebronnen tijdens het case studie onderzoek waren: (1) observatie, (2) semigestructureerd interviews en (3) documentatie (Yin, 2014). De onderzoeker was in staat om deze drie bronnen te gebruiken vanwege een afstudeerstage bij de vastgoedontwikkelaar van deze projecten gedurende het onderzoeksproces.

Deel 4: Synthese

De uitkomsten van het case studie onderzoek vormden de input voor de synthese van dit onderzoeksproject. In de synthese worden 'theorieën ontwikkeld', deze methode is gebaseerd op de 'theory building'-methode van Eisenhardt (1989). Deze methode leid tot de ontwikkeling een 'voorstel' *(proposition)* in de vorm van empirische lessen. Deze vormen de uitkomsten van dit onderzoek. Deze aanpak is gedeeltelijk geïnspireerd op de gebruikte strategie in het proefschrift van Vrijhoef (2011).

LITERATUUR STUDIE

Om een overzicht te verkrijgen over de bestaande theorieën en kennis gerelateerd aan het onderzoeksonderwerp is een literatuurstudie uitgevoerd. Deze literatuurstudie (en komende onderdelen van het onderzoek) is gestructureerd met gebruik van de business tactics verkregen uit de literatuurstudie van Reim et al. (2015).

Contracten: definiëren "[…] de verantwoordelijken van de betrokken partijen gedurende een specifieke contractuele periode. De belangrijkste aspecten hierbij zijn de geleverde prestaties van de diensten, incentives and risicoverdeling (vertaald, red.)" (Reim et al., 2015; Selviaridis & Wynstra, 2015). Drie categorieën business modellen and gerelateerde contracten kunnen worden herkend als Product-Service-Systemen worden geïmplementeerd, deze zijn: (1) product-georienteerde diensten, (2) gebruiks-georiënteerde diensten en (3) resultaat-georiënteerde diensten. Deze business modellen laten een geleidelijk schaal zien van eigenaarschap van een product naar pure 'producten als diensten' (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38).

Netwerken: Refereert naar de manier waarop partijen "[…] hun netwerk relaties gebruiken met externa partijen om ervoor te zorgen dat PSS business modellen succesvol worden toegepast (vertaald, red)" (Reim et al., 2015, p. 70). Wanneer PSSs worden geimplementeerd in vastgoedontwikkelingsprojecten, wordt de complexiteit van diverse prcoessen én de

noodzaak van partijen om meer te gaan samenwerken groter (Prins et al., 2015; Selviaridis & Wynstra, 2015; Van den Brink, 2016). Volgens Vrijhoef and De Ridder (2005) zouden daarnaast leverende partijen geïntegreerde productiemethodes en businessmodellen moeten toepassen om tot een verdienste vastgoedwereld te komen.

Marketing: Deze tactic: "communiceert de geleverde waarde aan consumenten en beslaat ook de behoeftes en wensen van deze consumenten (vertaald, red)" (Reim et al., 2015, p. 73). In een wereld waarin PSSs zouden dominieren, is er een "anticipatie van geintegreerde ontwerpconcepten op behoeftes en trends in de markt", daarbij wordt er "[…] informatie over de markt en klanten terugwaarts in de keten geleid (vertaald, red.)" (Vrijhoef, 2011, p. 239).

(Product en service) Ontwerp: Dit aspect relateert aan de manier waarop partijen: "[…] producten end diensten ontwerpen die samengaan met de wensen en behoeften van consumenten om PSS business modellen succesvol te implementeren (vertaald, red)" (Reim et al., 2015, p. 71). Dit leid tot een situatie waarbij de leverancier wordt aangespoord om producten te ontwerpen die volledig zijn voorontwikkeld, maar nog steeds flexibel genoeg zijn om veranderingen in de behoeften van consumenten op te kunnen vangen (vertaald, red.) (De Ridder & Vrijhoef, 2007).

CASE STUDIES

Triodos Bank – Gevel als een Service

Triodos Bank is een financiële institutie die financiering levert voor bedrijven, instituties en projecten die een toegevoegde waarde leveren voor de samenleving, de omgeving en/of cultuur. Omdat Triodos Bank groeiende is, hebben ze besloten om een nieuw kantoor te ontwikkelen op landgoed 'De Reehorst' in Zeist.

Een centraal thema tijdens de (her)ontwikkeling van het terrein en de ontwikkeling van het gebouw was het 'sluiten van kringlopen' op verschillende manieren. De gekozen materialen voor het bouwen van het gebouw zijn daarom erg duurzaam en passen in dergelijke gesloten systemen. Echter, tijdens het langdradige ontwikkelproces ontwikkelde de trend 'Circulaire Economie' zich. Tijdens een reflectie op het Programma van Eisen nadat het ontwerp al gereed was, werd besloten om principes van de Circulaire Economie toe te passen in het project. Hierbij werd het doel gesteld om 'nieuwe eigendomsmodellen' toe te passen op een 'essentieel gebouwonderdeel', dit resulteerde uiteindelijk in de beslissing om circulaire businessmodellen toe te gaan passen op de gevel van het gebouw (C. Berning, persoonlijke communicatie, 20 September 2017).

The grootste obstakels in deze casestudie waren dat (1) het ontwerp van het gebouw al gereed was en (2) contracten tussen de ontwikkelaar en de aannemer ook al gemaakt waren. Deze contracten moesten wel in stand blijven.

Contracten: Vanwege (1) de reeds bestaande contracten en (2) omdat het niet mogelijk bleek om het eigenaarschap van de gevel van de rest van het gebouw te splitsen met het gebruik van opstalrechten *(superficies)* bleek er slechts één mogelijkheid beschikbaar voor het 'circulair maken' van de gevel. Dit was door extra obligatoire voorzieningen toe te passen bovenop de reeds bestaande contracten tussen de leverancier en Triodos Bank. Deze voorzieningen regelen het onderhoud, reparatie, monitoren en de circulaire terugname van de gevel door de leverancier. Ondanks dat veel taken en verantwoordelijkheden worden verschoven richting de leverancier door deze voorzieningen, is de intentie wel om de contracten zo open en flexibel mogelijk te ontwerpen. Door dit te doen blijven de belangen van betrokken partijen ook nog behartigd in de toekomst en het wordt het hoge risico voor de leverancier enigszins verlaagd.

Netwerk: De door de service provider gebruikte netwerk strategie om dit te bereiken is gebaseerd op wederzijds vertrouwen en samenwerking. Dit betekende in de praktijk dat de betrokken partijen in deze case studie eerst over hun gezamenlijke visie rondom circulariteit praatten, daarna over de gemeenschappelijke belangen en pas later over de organisatorische en contractuele aspecten rondom dit traject.

Marketing: De betrokken partijen geloofden dat de TCO (levensduurkosten) over de gevel lager zouden liggen wanneer deze als een service zou

worden geleverd in vergelijking met een 'traditionele' aanpak. Dit vanwege de integratie van verantwoordelijkheden richting de leverancier. Tevens zou het eenvoudiger moeten zijn om nieuwe technieken toe te passen in de gevel in de toekomst omdat de leverancier en de klant met elkaar in contact zouden blijven. Deze verbeteringen en de circulaire terugname zouden hierbij voorgefinancierd kunnen worden door een interne winst, deze zou gecreëerd worden door de efficiënte onderhoud en exploitatie.

Achteraf gezien konden de circulaire doelstellingen binnen het project redelijk eenvoudig behaald worden door het toepassen van deze obligatoire voorzieningen. Echter, een efficiëntere strategie zou toegepast kunnen worden zijn indien het implementeren van circulaire businessmodellen een eerder aandachtspunt geweest zou zijn binnen het project. Indien dit was gebeurt was de mogelijkheid gecreëerd om innovatievere en meer vergaande inter-organisatorische principes toe te passen binnen het project. Aan de andere kant, juist de langere betrokkenheid van de leverancier en de eigenaar van het gebouw levert de meeste toegevoegde waarde binnen het project om de gevel een tweede leven te geven.

Basisweg
Comfort & Energie als een Service

Het Basisweg project bevat de herontwikkeling van een kantoorgebouw van 55.000m² uit 1974. Het ontwerp van het huidige gebouw wordt gekenmerkt door repeterende kantoorunits die samen een cirkel vormen. Het afstudeerbedrijf kocht het gebouw een aantal jaar geleden van een pensioenfonds om het te herontwikkelen. Tijdens de ontwerpfase kwam het idee op om de klimaatinstallatie als een service in te kopen, hierbij zou een gebruiks-georiënteerde service contract worden gebruikt voor de duurzame energie-opwekkers van het gebouw en product-georiënteerde servicecontracten voor het afgiftesysteem.

Marketing: De ontwikkelaar heeft twee redenen om dit soort nieuwe businessmodellen toe te passen in diens project. Ten eerste verlaagt het de benodigde investeringen in het gebouw omdat het eigenaarschap van de klimaatinstallatie bij de leverancier blijft. Ten tweede, de eigenaar (de ontwikkelaar, of een toekomstige belegger) krijgt een gegarandeerde prestatie gedurende de contractperiode voor een vaste prijs (R. Rampersad, persoonlijke communicatie, 7 September 2017). Het energiebedrijf dat de klimaatinstallatie als een service gaat leveren stapt in het project omdat het op zoek is naar manieren om hun huidige businessmodel uit te breiden (J. Feuth, persoonlijke communicatie, 22 September 2017).
Contracten: Om de klimaatinstallatie als een service aan te bieden zal het energiebedrijf een joint venture vormen met een onderliggende entiteit *(SPV; Special Purpose Vehicle)* waarin het eigenaarschap van de producten wordt geregeld. Deze joint venture bestaat uit het energiebedrijf, een installatie-adviseur en een installateur. Deze integratie van taken, verantwoordelijkheden, aansprakelijkheden en eigendom creëert een aantal voordelen: (1) bottom-up commitment wordt gecreëerd in de joint venture doordat de leverende partijen gezamenlijk verantwoordelijk worden voor de geleverde services, (2) cumulatieve riscio- en winstmarges worden weggespeeld en (3) de expertises van verschillende partijen worden gecombineerd om tot een geïntegreerde en hoogstaande PSS te komen.
Netwerk: Ondanks dat de leverende partijen verantwoordelijk worden voor het ontwerp, realisatie, onderhoud en exploitatie van de klimaatinstallatie, blijft de rol van de ontwikkelaar nog steeds belangrijk gedurende de ontwikkelingsfase. Om tot een goede synergie tussen de betrokken partijen te komen, gebruikte de ontwikkelaar een strategie die gebaseerd is op co-creatie. Hierdoor kon de ontwikkelaar 'in de lead' blijven terwijl de belangen van de leverende partijen nog steeds konden worden behartigd.
Ontwerp: Doordat de leverende partijen vroeg in het ontwerpproces betrokken werden, werd er van de architect verwacht dat hij de producten die geleverd worden door de leveranciers op een goede manier met het ontwerp zouden integreren. Normaalgesproken worden producten pas geselecteerd nadat het ontwerp al klaar is. (E. van Noord, persoonlijke communicatie, 21 September 2017).

The Boutique Office
Ontwikkelaar als service provider

De derde case studie bevatte ook de herontwikkeling (en uitbreiding) van een bestaande kantoorgebouw. Tijdens deze herontwikkeling werd een nieuwe bedrijfsstrategie geïmplementeerd in de huidige bedrijfsstructuur van de ontwikkelaar. The Boutique Office diende hierbij als een startproject voor dit nieuwe businessmodel, welke gericht is op het leveren van services aan de gebruikers van het gebouw. De ontwikkelaar verandert zichzelf dus in een service provider.

Contracten: Projectontwikkelaars verkopen 'normaal gesproken' gebouwen na oplevering aan een belegger en laten ze hierbij 'achter'. Echter, de ontwikkelaar van dit project kan dit niet meer doen omdat zij het gebouw dus ook gaan exploiteren. Omdat de ontwikkelaar het gebouw niet in eigendom wil houden, heeft het bedrijf een 'sale-and-leaseback' constructie afgesloten met een belegger. Hierbij is een splitsing gemaakt tussen het casco en de inbouw met behulp van een triple-net agreement. Daarbij is het casco (en andere 'essentiële gebouwonderdelen) verkocht aan de belegger en blijft de inbouw aan de kant van de ontwikkelaar. Dit creëert ruimte om de inbouw in te kopen als een service (T. Ummels, persoonlijke communicatie, 2 Oktober 2017).
Netwerk: Onderdelen die 'essentieel' zijn voor de exploitatie van het gebouw werden als een soort 'in-house service' gekocht. Hiermee wordt bedoeld dat de service supplier van deze services een dochteronderneming is van de ontwikkelaar.
Marketing: Door te transformeren naar een service provider integreert de ontwikkelaar zijn eigen taken met die van de huidige asset manager. Dit betekent dat een geïntegreerde dienstverlening richting de consumenten kan worden geleverd, waarbij tijdens de ontwerpfase al rekening kan worden gehouden met de exploitatie. Dit betekent ook dat de ontwikkelaar werkplekken aan gaat bieden in plaats van casco kantoorruimtes. Hiermee neemt de ontwikkelaar een groot aantal taken over die traditioneel worden uitgevoerd door de coroprorate real estate manager en/of facility manager.
Ontwerp: De ontwikkelaar (als zijnde service provider) stuurt de ontwikkeling, realisatie en exploitatie van The Boutique Office. De feedback die wordt verkregen tijdens de exploitatiefase kan hierbij worden gebruik voor het ontwikkelen van 'blueprint' die kan dienen als fundament voor het ontwikkelen van nieuwe kantoren door de ontwikkelaar. Hiermee wordt de integratie van ontwikkeling en exploitatie van een gebouw compleet (T. Ummels, persoonlijke communicatie, 2 Oktober 2017). Hiermee plaatst de service provider zich centraal in het proces van waardecreatie richting de consument.

Cross-case analyse

Een cross-case analyse is gemaakt om theorieën te kunnen ontwikkelen uit het verrichte case studie onderzoek. Tijdens deze cross-case analyse werd informeert teruggebracht en gecategoriseerd richting de vier gebruikte business tactics. Hierna is een pattern matching *(patroonovereenkomst)* techniek gebruikt om overeenkomsten en verschillen tussen de case studies te identificeren om hier theorieën uit te verkrijgen (Eisenhardt, 1989; Yin, 2014). Deze uitkomsten van deze cross-case analyse vormen den empirische uitkomsten van dit onderzoek.

BEVINDINGEN

Confrontatie van theorie en praktijk

De empirische uitkomsten verkregen uit het verrichte case studie onderzoek zijn geconfronteerd met de bestaande theorieën. Dit was de voorlaatste stap in het proces om theorieën te ontwikkelen als omschreven door Eisenhardt (1989).

De empirische resultaten gerelateerd aan de business tactic 'contracten' vertoonden veel overeenkomsten met de bestaande theorieën. Ondanks dat creëerden de empirische uitkomsten veel inzicht in de manier waarop service providers risico aan de kant van de service suppliers konden afdekken door middel van de juiste contractvormen.

Aspecten gerelateerd aan 'Netwerken' die niet werden gezien in de bestaande theorieën, maar werden waargenomen in het empirisch gedeelte van het onderzoek hadden betrekking op het vormen van joint ventures door de leverende partijen. Daarbij kunnen SPV's worden ingezet om n geleverde producten te financieren en te beheren.

De huidige theorieën rondom 'Marketing' waren redelijk abstract, de empirische kennis opgedaan uit de case studies bracht meer kennis rondom de toegevoegde waarde voor de service provider en consumenten wanneer PSSs worden geïmplementeerd. Ook werd duidelijk wat de voordelen zijn van het integreren van de ontwikkelingsfase met de exploitatiefase van een gebouw.

Sommige aspecten die werden gevonden in de literatuurstudie gerelateerd aan 'Ontwerp' konden niet worden teruggevonden in de case studies. Voorbeeld hiervan is de mogelijkheid van consumenten om wensen en behoeften te veranderen gedurende de exploitatiefase van een gebouw. Wellicht komt dit door de beperkte scope van de onderzochte case studies. Hierbij is alleen gefocust op de ontwikkelingsfase en niet op de exploitatie en de manier waarop providers een 'service blueprint' kunnen worden ontwikkelen door het gebruik van hun marktkennis. Daarom lag de aandacht minder op de exploitatiefase van een geservicet gebouw.

PROPOSITIE

De laatste stap van het 'theory-building' proces van Eisenhardt (1989) is het ontwikkelen van een propositie. Dit proces relateert aan het identificeren en verifiëren van relaties tussen theorie en de empirische bevindingen (Eisenhardt, 1989; Vrijhoef, 2011). De propositie is ontwikkeld aan de hand van het vormen van een aantal empirische lessen. Deze lessen zouden kunnen worden gebruikt door projectontwikkelaars om Product-Service-Systemen te implementeren in vastgoedontwikkelingsprojecten door middel van de juiste interactie met service suppliers en consumenten. De lessen relateren elk aan een business tactic en aan een kant van de toeleveringsketen, gezien vanaf de ontwikkelaar.
Tijdens de analyse en het verwerken van alle data bleek dat er tevens conditionele veranderingen bij de betrokken actoren nodig zijn om PSSs toe te kunnen passen. Hiervoor zijn conditionele lessen ontwikkeld.

Empirische lessen

Interactie met service suppliers

Les 1: Sale en lease-back

Service providers moeten sale en lease-back constructies sluiten met investeerders/ beleggers voor het casco van het gebouw. Dit om de betrokkenheid en verantwoordelijkheid van de service provider door te trekken richting de exploitatie-fase van een gebouw. Individuele PSS-contracten kunnen hierna worden afgesloten om de inbouw van het gebouw te regelen.

Les 2: Co-creatie

De service provider moet een netwerk-strategie gebaseerd op co-creatie toepassen richting de service suppliers. Het creëren van vertrouwen en het borgen van de verschillende belangen van betrokken partijen. Deze benadering zou moeten leiden tot gelijke samenwerkingsverbanden en hogere kwaliteit van de geleverde PSSs.

Les 3: Connectie voor innovatie

De service provider moeten leverende partijen blijven uitdagen om steeds nieuwe technieken toe te passen in geleverde producten. Deze innovaties moeten de prestaties van de geleverde PSSs hoog houden tijdens de gehele exploitatieperiode.

Les 4: Geïntegreerde implementatie

Service suppliers moeten zo vroeg mogelijk betrokken worden in het ontwikkelingsproces. Het vroeg betrekken van deze partijen leidt tot een geïntegreerd ontwerp waarbij de belangen van de leveranciers al zo vroeg mogelijk behartigt kunnen worden. Er moet tevens een balans worden gezocht tussen de architectonische kwaliteit van het gebouw en functionaliteit op het gebied van dienstverlening en circulariteit.

Interactie met consumenten

Les 5: Vertalen en integreren

De service provider vertaalt de eisen van de consument die vastgelegd zijn in een Service Level Agreement naar specifieke prestatie-eisen voor de te leveren diensten van de service supplier. Vice versa, de service provider integreert de geleverde PSS in een geïntegreerd gebouw.

Les 6: Direct contact
De service provider moet het contact met de consument intensifiëren en zoeken proberen inzichten te verkrijgen in de ware behoeften van deze consument.

Les 7: Mindset gebaseerd op dienstverlening
Het inzicht in de behoeften van consumenten leidt tot een bepaalde marktkennis. Deze marktkennis kan leiden tot een verandering in mindset in de richting van dienstverlening. De service provider moet zich hierbij richten op het leveren van diensten over een langere termijn in plaats van winst maken op korte termijn.

Les 8: Dienstpakketten
De marktkennis verkregen van de consumenten kan worden gebruikt voor het ontwikkelen van universele service blueprint die kan worden ingezet voor het ontwikkelen van andere gebouwen. Verschillende dienstpakketten zouden kunnen worden gecreeerd uit deze blueprints die aansluiten bij een bepaald type gebruiker. Deze pakketten kunnen tevens leiden tot het aanbieden van kantoorconcepten die aansluiten bij de wensen van consumenten over een langere periode.

Conditionele lessen
Les 9: Verticale en horizontale integratie
Service suppliers moeten verticaal en/of horizontaal integreren in de toeleveringsketen om in staat te zijn om PSSs te kunnen leveren.

Les 10: Online gebouwpaspoorten
Service suppliers zouden hun materialen in online gebouwpaspoorten kunnen stoppen om inzicht te geven in geleverde producten aan externe partijen. Deze producten kunnen hiermee eenvoudiger worden verkocht aan het einde van een contractperiode. Tevens zou er een intern rendement gebruikt kunnen worden om kosten te dekken gerelateerd aan het tweede leven geven aan een product. Dit maakt het financieel interessanter om gebruikte producten te verhandelen.

Les 11: Special Purpose Vehicles
Service suppliers kunnen SPVs gebruiken om risico's gerelateerd aan faillissementen af te denken. Tevens kunnen deze entiteiten gebruikt worden om geleverde producten te financieren.

De uitkomsten van het onderzoek gerelateerd aan het eerste onderzoeksdoel zijn gepresenteerd in Table II.
De 11 empirische lessen zijn samengebracht tot een 'interactie-model', welke relateert aan het tweede onderzoeksdoel Dit model is weergegeven in Figuur VI.

EXPERT PANEL

Om de interne en externe validiteit van de onderzoek te meten is een expert panel gehouden. Deze sessie had de vorm van een focus groep (Bryman, 2012, p. 504), waarbij een groepsdiscussie is gehouden rondom een aantal stellingen die relateerden aan de gebruikte business tactics. De gebruikte stellingen relateerden aan (1) aspecten die aan het licht kwamen tijdens de case studies, maar waarbij het niet eenvoudig was om tot duidelijke conclusies te komen of (2) aspecten waarvan de uitkomsten uit de literatuurstudie niet overeenkwamen met aspecten uit het empirische deel van het onderzoek.

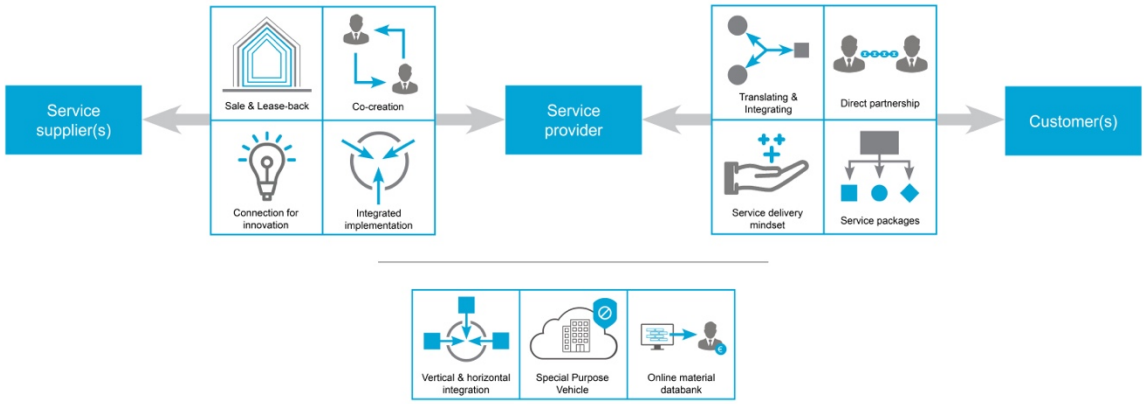

Figure VI: Interaction model (own ill.)

Om er zeker van te zijn dat de uitkomsten van het onderzoek zowel intern áls extern werden gevalideerd, zijn experts geselecteerd die betrokken waren bij het onderzoek en experts die dat niet waren. Om er ook zeker van te zijn dat er validatie werd verricht vanuit verschillende perspectieven in de sector, zijn er experts geselecteerd die de rol van 'consument', 'service provider' en 'service supplier' hebben in hun dagelijkse werk. Het expert panel valideerde zo goed als alle uitkomsten van het onderzoek en tijdens de gehouden discussie kwamen er zelfs aspecten aan bod die verder bouwden op de onderzoeksresultaten. Echter, enkele panelleden hadden hun vraagtekens bij de manier waarop bepaalde leveranciers geclusterd worden en welk type service-contracten er gebruikt zouden worden voor een bepaalde PSS. Deze contrasterende visies kunnen worden herleid naar de rol en positie van deze experts in de vastgoedsector en leveringsketen.

CONCLUSIE

Product-Service-Systemen zijn longitudinale relationele processen die de introductie van een Circulaire Economie kunnen ondersteunen. Hierbij zijn producten en diensten op mogelijk verschillende schaalniveaus met elkaar geïntegreerd, waarbij het geleverde product ondergeschikt is aan de geleverde dienst. De aangeboden dienst heeft als doel om te voorzien in de behoeften van de eindgebruiker over een bepaalde periode.
Het geïntegreerde aanbod van diensten kan worden bewerkstelligd door samenwerking tussen de service suppliers zelf en tussen de servcie supplier en de service provider. Tevens verhoogt de wederzijdse afhankelijk tussen partijen de nood om samenwerking.
Omdat de service provider de centrale partij is binnen een geserviced ontwikkelingsproject, is het zijn taak om de samenwerking tusseen verschillende dienst leverende partijen te bevorderen. Daarbij moet de service provider beginnen met het selecteren van de juiste partijen en deze clusteren rekening houdend met gelijke doelstellingen en het aankomende takenpakket
Omdat de service provider het geserviced gebouw gaat exploiteren, wordt het mogelijk om informatie gerelateerd aan gebruikersvoorkeuren samen te voegen tot een service blueprint. Uit deze blueprint kunnen bepaalde gestandaardiseerde dienstpakketten worden verkregen die flexibele kantoorconcepten aan kunnen bieden met flexibele voorwaarden.
De grootste toegevoegde waarde van deze kantoorconcepten is de ontzorging van diens gebruikers.
Omdat partijen betrokken raken tijdens de gehele levensduur van een gebouw, wordt het eenvoudiger om vooraf na te denken hoe producten hergebruikt kunnen worden. Dit leidt tot het eenvoudiger terugbrengen van materialen in een gesloten materialenkringloop. De servicecontracten kunnen tevens op een dergelijke manier worden afgesloten dat materialen daadwerkelijk teruggenomen moeten worden door diens leveranciers.
Als dit gebeurt, kan de introductie van een meer Circulaire Economie bewerkstelligt worden.

DISCUSSIE

Discussie over theorie

De huidige theorieën gaven veel achtergrondinformatie over de manier waarop PSSs konden worden geïmplementeerd op een redelijk abstract niveau en welke gevolgen dit zou hebben op de berokken partijen. De kennis gecreëerd met dit onderzoek is wat meer diepgravend en bevind zich vooral op een 'operationeel niveau', dit is gedaan door vooral te focussen op de rol van de service provider binnen geservicete vastgoedontwikkelingsprojecten.

Discussion over praktijk

Er waren grote verschillen in het karakter van de drie onderzochte case studies, dit kwam doordat de aard van de geïmplementeerde PSSs en de context van de case studies erg anders was. Dit heeft er echter wel toe geleidt dat de uitkomsten van het empirische gedeelte van het onderzoek de vier business tactics goed bedekt, ondanks dat de meeste aandacht van het onderzoek gelegen heeft op de business tactics Contracten en Netwerk.
Hierbij heeft de case studie over de Triodos Bank de meeste kennis gecreëerd over de contractuele aspecten van een PSSs en de ondersteunende rol van de service provider. De case studie over de Basisweg leverde kennis op over de ma-

nier waarop verschillende service suppliers kunnen samenwerken om een geïntegreerde PSS kunnen leven en welke Marketing waarde de implementatie van een PSS met zich meebrengt. De case studie over The Boutique Office functioneerde als een voorbeeld hoe ontwikkelaars zichzelf kunnen transformeren in service providers.

De case study over de Triodos Bank liet zien dat simpele obligatoire voorzieningen genoeg kunnen zijn om de circulariteit van producten te waarborgen. De toegevoegde waarde van complexe PSSs kan daarbij in twijfel getrokken worden. Echter, service suppliers zullen terugnamegaranties niet accepteren als er voor hun niks 'extra's' in zit. PSSs leveren deze extra's omdat ze de kans bieden om het businessmodel van service suppliers uit te breiden. PSSs zijn dus nodig om ook terugneemgaranties van materialen af te dwingen.

De toepasbaarheid van het gebruik van SPVs kan in twijfel worden getrokken aangezien er weinig empirisch bewijs is dat deze entiteiten geaccepteerd worden door financiers. Verschillende studies vermelden dat financiers erg hoge rentepercentages rekenen rondom deze SPV's vanwege het hoge risiconiveau.

Naast de projectontwikkelaar wordt het ook mogelijk geacht dat aannemers of asset managers de rol van de service provider kunnen innemen. Ecther, het afstudeerbedrijf is tot dusver het enige bedrijf (voor zover de onderzoeker weet) dat heeft aangetoond zichzelf in een service provider te kunnen transformeren.

LIMITATIES

Dit onderzoek is beperkt door het aantal beschikbare projecten in de huidige vastgoedsector die geschikt zijn om te gebruiken als case studies voor dit onderzoek. Dit heeft geleidt tot een situatie waarbij de ontwikkelaar van alle drie de case studies dezelfde partij is. Ten tweede, de drie case studies bevonden zich allemaal in de ontwikkelingsfase op het moment dat er case studie onderzoek werd verricht. Daarom relateren de uitkomsten van dit onderzoek in mindere mate aan de rol van de service provider en de andere partijen gedurende de exploitatie fase. Ten derde, de focus van dit onderzoek lag wellicht iets te veel op de interactie tussen de service provider en de service provider, daarom slaan de uitkomsten in mindere mate op de benodigde interactie tussen de consument en de service provider. Ten vierde, het is nog steeds onzeker of de bestudeerde PSSs daadwerkelijk worden geïmplementeerd in de case studies gerelateerd aan de projecten 'Triodos Bank' en 'Basisweg'.

Validiteit and betrouwbaarheid

Construct validiteit *(construct validity)* is vastgelegd door het gebruik van de business tactics, zoals omschreven door Reim et al. (2015), voor het operationaliseren van dit onderzoek. Deze business tactics zijn afgeleid van de systematische literatuurstudie gehouden door de auteurs naar de implementatie van PSSs in diverse sectoren. Interne validiteit *(internal validity)* is gecreëerd door het gebruik van de 'building theories'-methode, zoals omschreven door Eisenhardt (1989) en Vrijhoef (2011). Externe validiteit *(external validity)* is geprobeerd te behalen door het interviewen van mensen werkzaam bij verschillende partijen en het gebruik van een expert panel. Tevens zijn er verschillende onderzoeksprotocollen opgesteld en tot uitvoering gebracht om de betrouwbaarheid van het onderzoek te verhogen.

AANBEVELINGEN

Service suppliers worden aanbevolen om hun eigen toegevoegde waarde binnen de toeleveringsketen te heroverwegen. Deze partijen kunnen een sterkere positie binnen een project verkrijgen indien ze geïntegreerde service concepten in plaats van fysieke producten gaan leveren. Hiermee bouwen ze tevens hun business model uit en tonen ze aan verantwoordelijkheid te durven nemen over hun eigen producten.
De onderzoeker adviseert dat **service providers** hun centrale positie in een ontwikkelingsproces gebruiken om (1) service suppliers uit te dagen met innovatieve concepten te komen, waarbij ze producten gaan leveren als diensten. Dit door (2) het implementeren van kleine pilotprojecten in hun vastgoedontwikkelingen en (3) de kennis die hiermee verkregen wordt om verdere innovatie en implementatie van deze PSSs in andere projecten verder te brengen.

Consumenten worden aangeraden om na te denken over de toegevoegde waarde van het vastgoed wat ze gebruiken. Hierbij zouden ze moeten reflecteren op de manier waarop vastgoed de bedrijfsprocessen ondersteund en wat ze hiervoor bereidt zijn om te betalen. Het servicen van gebouwen zou kunnen bijdragen om alleen in te moeten kopen wat bedrijven echt nodig hebben aan vastgoed.

Om het implementeren van PSSs zoveel mogelijk gebouwonderdelen zouden **wetgevende partijen** hun standpunt ten opzichte van gedeeld eigenaarschap moeten heroverwegen. Dit zou het mogelijk moeten maken om bepaalde onderdelen juridisch ´los te koppelen´.

Toekomstig onderzoek zou zich kunnen richten op:
(1) de invloed van geservice producten op de exploitatie-fase van een vastgoedproject. Zo'n onderzoek zou inzicht kunnen geven in de rol van de service provider tijdens exploitatie en de toegevoegde waarde van geserviced vastgoed voor de consument.
(2) De rol van data om de exploitatie van een gebouw te optimaliseren. Hiermee zouden behoeften van gebruikers eenvoudiger in te zien zijn en kan een gebouw efficiënter geëxploiteerd kunnen worden.
(3) Het gebruik van SPVs om producten te financieren in een pool
(4) Online gebouwpaspoorten en indicatoren voor 'circulariteit'.

Table II: Getabuleerde onderzoeksuitkomsten

	Service supplier	Service provider	Customer
Contracten	- Verlengde verantwoordelijkheden - Verticale integratie - Horizontale integrate - Continue (levenslooplange) waarde levering - Verantwoordelijk voor geintegreerde dienstverlening - Verlaging van transactiekosten - Risico verhoging - Risico verlaging door: - Gebruik van interne winst - Creatie van SPVs - Open contracteringsvorm - Delen van data - Sloopoptie - Nieuwe bedrijfskansen - Van prijs-gerelateerde naar prestatie mindset - Contract als asset i.p.v. fysiek product	- Integratie van vraag en aanbod - Dienstverlening naar consumenten - Vertalen van vraag naar prestaties - Inkopen van services van leveranciers - Samenwerking met diverse partijen - Ondersteun innovatie bij leveranciers - Creeeren van vertrouwen - Investering in casco van gebouw - Verdiensting van de inbouw	- Gebaseerd op prestatie-indicatoren (KPI's) - Gebruik van Service Level Agreements - Periodieke betalingen aan service provider - Dientspaketten - Gebasseerd op kantoorruimte / werkplaatsen - Flexibele contractperiodes - Flexibele contractspecificaties
Netwerken	- Gezamenlijke verantwoordelijkheid voor levering van services - Internaliseren van 'omliggende' bedrijven - Gebruik van consortia / joint ventures - Gebruik van SPV om: - Eigenaarschap in order te brengen - Risico te verlagen - Producten te financieren - Transactiekosten te verlagen - Bottom-up commitment te creeeren	- Managen van het ontwikkelingsproces - Managen van stakeholders - Integreren van geleverde services - Vertrouwen creeeren / richten op co-creatie - Bepalen van clusters - Bepalen van inter-organisatorische structuur - Bepalen van gebruikte contracten - Selecteren van geschikte service suppliers - Focussen op co-creatie - Managen van de exploitatie - Integreren van taken ontwikkelaar en asset manager -	- Zoeken naar partners die dezelfde doelen nastreven
Marketing	- Sterkere / dichtere realtie met consument en service provider - Communiceren van toegevoegde waarde door transparatie - Transparantie in geleverde prestatie - Nieuwe vorm van waarde-creatie riching consument - Levensduurkosten verlaging bij 'simpele' PSS - Toegevoegde waarde door integratie bij complexe PSS	Kant van leveranciers: - Vraag op abstracter niveau - Gegarandeerde prestatie - Investeringsverlaging - Toekomstige verbeteringen in producten - Nieuwe valueringsbenadering gebaseerd op TCO Kant van consumenten: - Overname taken van consumtent - Analyseren van marktvraag - Analyseren van voorkeur consumenten - Gebruiks-georienteerde aanpak - Leveren van flexible concepten - Flexibele contracttermijnen - Relatie opbouwen met consument - Concurrentievoordeel vanwege betere prijs/kwaliteit ratio	- Bepalen van gevraagde services - Veranderen van vraag - Vraag op een abstracter niveau - Ontzorging door all-in services - Fees gebaseerd op levensduurkosten - Reductie van taken - Gegarandeerde prestateies - Gebruiks-georienteerde aanpak - Verhoogde prestatie van services - Duurzame opeeratie van organisatie - Concurrerent aanbod - Waardelevering gebaseerd op behoeften - Waardecreatie lastig te vergelijken met huidige aanpak - Verbeterde kwaliteit gebouw door beter onderhoud
(Product en service) Ontwerp	- Gebruik van modulaire / standard componenten - Ontwep voor demontage - Vroege betrokkenheid van leverende parijen	- Platform voor geintegreerd ontwerp - Veranderede wensen consument - Vroeg betrekken van alle partijen - Ontwikkelen van service blueprint - Lean ontwikkelingsproces	- Service ontwerp op basis van wensen - Blueprint voor 'universele service-wensen' - Service paketten in blueprint

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REAL ESTATE DEVELOPERS AS
CIRCULAR SERVICE PROVIDERS

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Introduction

According to the United Nations (2017), within the future decades the entire world population will grow significantly, the demand for already constrained natural resources will herewith increase. The United Nations (2017) hereby states that: "If we (i.e. earthlings) don't act to change our consumption and production patterns, we will cause irreversible damage to our environment". The construction and real estate sector contributes largely to these unsustainable practices, since these sectors are responsible for one third of the total global energy use, using 40% to 50% of all the raw materials every year and producing 40% of solid waste streams (Antink et al., 2014). The introduction of the principles of the Circular Economy in the real estate sector could therefore be a proper instrument to stop the depletion of the world's natural resources and unsustainable raw materials consumption. One of the aims of implementing the Circular Economy is to "replace the 'end of life' concept of the linear economy [...] and aim for the elimination of waste through the superior design of materials, products systems, and, within this, business models" (Ellen MacArthur Foundation, 2013b, p. 7). This concept stands out from many other sustainable concepts, because of the addition of an economic model.

The implementation of so-called Product-Service-Systems (PSSs) in real estate development projects could be a way to shift the current real estate sector towards a more Circular Economy (Michelini, Moraes, Cunha, Costa, & Ometto, 2017). With the implementation of this concept will the responsibilities over products and related services arranged differently compared to current practices. Hereby the responsibility of materials remains with the suppliers of that product (Stahel, 2006), which also includes the end-of-life processing of the supplied materials. As the suppliers remain responsible for their products, it is in their interest to optimize the design so that the quality and value of the raw materials remain with their original value. Moreover, products will be designed in such a way, that they will provide the highest user value. This implies that the implementation of Product-Service-Systems in real estate development projects could not only stimulate the shift of the real estate sector towards a Circular Economy but could also trigger parties to implement a user-cantered approach within real estate development projects (Ellen MacArthur Foundation, 2013b; Prins et al., 2015; Rau & Oberhuber, 2016).

The Circular Economy is a 'hot topic' and the concept of Product-Service-Systems has been discussed in literature since the end of the 1980's. There is, however, little knowledge in theory and practice about the implementation of Product-Service-Systems in real estate development projects. This knowledge gap relates to the functioning of Product-Service-Systems in real estate development projects and the ways actors in the project organization should interact with each other, in order to implement such systems.

This research aims to assist real estate developers to incorporate Product-Service-Systems in real estate development projects. Clarifying the functioning of Product-Service-Systems (PSSs) in real estate development projects from their perspective, by providing models which they can use to interact with supply and demand parties during the development process. The perspective of the real estate developer has been chosen, because this actor steers the development projects and aligns the demand side with the supply side of real estate development projects (Miles et al., 2007). The real estate developer is herewith assisted to shift towards the role of the circular 'service provider' (Kazemi, 2016; Van den Brink, 2016).

Readers' guide

Part 1 of this report forms the introduction of this research and presents the main concepts. This part starts with Chapter 1, in which the research proposal is presented. This chapter is followed by Chapter 2, in which the main concepts involved in this research are introduced. These concepts hereafter are related to each other by the conceptual framework of this research.

The theoretical basis of this research is presented in Part 2: Theories. In this part, which consists of Chapter 4, the literature study of this research is presented. This literature study has been conducted in order to get an overview of the existing theories and existing knowledge related to this topic, the outcome of the second part of this research could therefore be seen as the theoretical foundation of this research.

The empirical analyses of this research is presented in Part 3 of this report: Practices. This part consists of one chapter (i.e. Chapter 5), wherein the three conducted case studies are presented, discussed and analysed separately. The outcomes of these in-case analyses are then compared to one another in the cross-case analyses. The empirical findings form the output of this chapter.

The theoretical and empirical findings come together in Part 4 of this report, which forms the synthesis of this research. The findings of this research are presented in Chapter 6. In this chapter, the empirical findings are confronted with the existing theories, the outcomes of this confrontation lead to the formation of a proposition. An expert panel was held to externally and internally validate these findings, the outcomes of this expert panel are presented in Chapter 7. The main outcomes of this research are discussed in Chapter 8. The research, sub-questions and main research question are also answered in Chapter 8, which herewith forms the conclusion of this research. Recommendations that are made based upon the outcomes of this research are presented in Chapter 9.

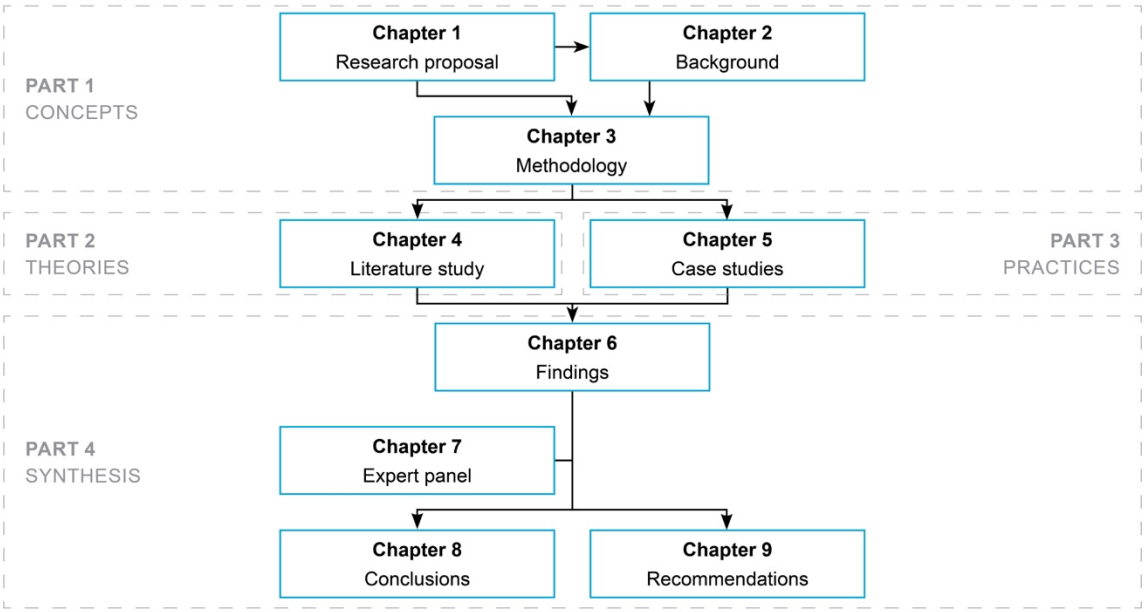

Figure 1: Research structure (own ill) (based upon Heurkens, 2012, p.39; Huijbregts, 2017, p.41)

PART 1
CONCEPTS

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1. Research proposal

The research proposal of this thesis is presented in this chapter. This is done by presenting the main research topic in the first paragraph. Its relevance for society, science, the real estate sector and the graduation company in the second paragraph. This chapter continues with the presentation of the main problem statement in the third paragraph. This results in the main research objective that is presented in the fourth paragraph. Several research sub-questions are defined that lead together to the main research question, which are presented respectively in the fifth and sixth paragraph. This main research question endeavours to obtain the main research objective and aims to provide a possible solution for the main research problem.

1.1. RESEARCH TOPIC

1.1.1. Servitization

Servitization is the process of adding services to products. Already in 1988 Vandermwerwe and Rada (1988) mention this concept, hereby mentioning that: "Modern corporations are offering fuller market packages or 'bundles' of customer-focused combinations of goods, services, support, self-service, and knowledge. But services are beginning to dominate" (Vandermerwe & Rada, 1988, p. 314). Servitization fits according to Mont (2002) in the wider trends of the shift towards a 'Service Economy'. This kind of economy is defined as a "[...] service-oriented model of manufacturing growth has key competitive factors such as the capability for continuous innovation, improved design and quality and customised goods, rather than the production of large volumes of standardised products" (Mont, 2002, p. 238).

Products as services

The concept of "products as services" was introduced by Walter Stahel in 1989. He advocated a service society, whereby the value of utilization was at the heart of economy. This advocates a performance driven orientation, where the user pays for utilisation of a product. The objective of this functional economy is to "create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible" (Mont, 2002, p. 238). Stahel (2008) summarized the main ideas of selling of 'products as services' as follows:

- The object of sale is the performance and not the product itself, the customer satisfaction is the end-result.
- Liability of the quality of the overall performance remains at the seller (the service provider or service supplier, red.)
- Payment is done when the performance is delivered and is based on the quality of the delivered service (no fun no money), and not at the moment when products are transferred.
- Service has to be provided in situ, instead of produced centrally.
- The property rights and related liability remains at the service provider and are not transferred to the buyer.
- Customer service is used as marketing strategy, instead of using publicity and sponsoring.
- Value is delivered over the long-term utilization period instead of short-term exchange value at the point of sale".

1.1.2. Product-Service-Systems

If a service is connected to a certain product, a Product-Service-Systems (PSSs) could be created, these PSSs are hereby an integrated combination of products and service that deliver value in use (Baines, Lightfoot, Benedettini, & Kay, 2009). Hereby, Product-Service-Systems can be defined as "a marketable set of products and services capable of jointly fulfilling a user's need" (Goedkoop et al., 1999). With the implementation of these Product-Service-System that physical product is connected to a non-physical service. It is necessary that the system is designed in such a way that it provides clients / users with a particular result or function. Aurich, Fuchs, and Wagenknecht (2006) mention that "[...] the manufacturing service enterprise (i.e. the service supplier) no longer distinguishes between products and services, but rather provides its customers with highly individualized solutions. Alieh Kazemi combined this and defined PSSs as:

> *"Products-service-systems are longitudinal relational processes, based on the principles of Circular Economy, during which products and performances are integrated, whereby the product is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's evolving needs over time" (Kazemi, 2016, p.68).*

Within this definition the five characteristics of a PSS are recognized (De Grauw (2015), these are:

- A performance is an agreed action of performing that results in an utility, goal, function, or commitment.
- A product is not a goal in itself, but subordinate to the performance.
- The service is mainly a non-physical action or operation whereby the performance is maintained, extended or optimized over time.
- The service cannot be produced or consumed in itself and is subordinate to the performance.
- The system is an integrated mix of performances, and the subordinate services and components needed.
- The system includes the communication required between client and provider.

Real estate as a service

Servitization could be introduced within the real estate sector with the implementation of Product-Service-Systems. A servitized real estate sector should offer products that allow supplying parties to offer a performance or a service towards the costumer. Since the customer will pay for this product, the service provided with it should yield a certain degree of utility (i.e. a performance) for the user. Hereby De Grauw (2015) defines performances as:

> *"A performance is an agreed upon action of performing that results in an output, utility, goal, function, or commitment whereby the product is not a goal in itself, but enabling the performance. Secondly, the service is mainly a non-physical action or operation whereby the performance is optimized over time".*

Van den Brink (2016) combined this definition with the definition of buildings given by Prins (1992). Hereby the definition of a servitized buildings could hereby become:

> *"A collection of products that together form an entity that can be described as a building. A building is as such a collection of interrelated products at different scale levels" (Van den Brink, 2016, p. 12).*

A collection of products forms the building, which delivers performance and subsequent service to the user(s) of this building. Hereby, products become services and, because a building is a collection of interrelated products, a building becomes a service.

1.2. RESEARCH RELEVANCE

1.2.1. Societal relevance

The Dutch government recognized the importance of the implementation of the Circular Economy and launched a new government-wide program in September 2016. This program focusses on the development of a Circular Economy for the entire Dutch economy. Main goal of this program is the transformation of the current Dutch economy into a circular one before the year of 2050 (Ministerie I&M en EZ, 2016). Also, the recently formed government underpins the importance of the Circular Economy and intends to spread *best practices* among actors and to *diagnose* main obstacles to implement circular business models (Rijksoverheid, 2017). As mentioned in the introduction, the construction and real estate sector can be accounted for a huge part of the depletion of the natural resources and unsustainable raw materials consumption (Antink et al., 2014). Therefore, the implementation of PSSs in real estate development projects could contribute to obtaining the mentioned goals of the Dutch government in relation to Circular Economy.

However, in The Netherlands, public parties have mostly a facilitating role in real estate development projects (Heurkens, 2012; J. Van der Waal, personal communication, May 11, 2017). Therefore, the private parties in the real estate sector should take the initiative and incorporate circular business models in order to transform the Dutch real estate sector towards a Circular Economy.

1.2.2. Scientific relevance

Many graduates such as Rampersad (2016), Van den Brink (2016), Kazemi (2016), Loppies (2015) and others – mostly Dutch – scholars have conducted research about the implementation of the Circular Economy in the real estate sector. However, not enough knowledge is available, since their research did not focus on the juridical, organizational and financial implications of the implementation of the Circular Economy on an organizational level and the needed shift in responsibilities.

Secondly, according to Reim et al. (2015), Romero and Rossi (2017), Tukker (2015) and Michelini et al. (2017) the implementation of Product-Service-Systems (PSSs) could lead to the implementation of Circular Economy in the real estate sector. As the introduction of these PSSs arranges responsibilities over products and provided performances differently. However, according to Reim et al. (2015), a research gap exist how to successfully implement PSS business models, because the PSS literature has not discussed PSS-business models extensively. This indicates that more scientific knowledge is needed how to implement these PSS business models in the real estate sector on an operational level.

Thirdly, the introduction of PSSs within the CE creates changing tasks and responsibilities of actors in the real estate development process, therefore the way actors collaborate and divide responsibilities will change as well (Van Staveren, 2016). The central organization within circular real estate development projects is according to Ellen MacArthur Foundation (2013a) and Van den Brink (2016) the service provider. This actor would manage the overall performance of a servitized building by aligning the demands of the users of the building with the services offered. This party is therefore placed in between the supplying parties, clients and the other stakeholders in the project organization (Ellen MacArthur Foundation, 2013a). Although Kazemi (2016) and Van den Brink (2016) conducted a research about the role of the service provider, the question "what the (exact) role of the service provider would be remains unanswered' (Van den Brink, 2016, p. 130).

1.2.3. Sectoral relevance

The willingness to implement PSS business models might be present under private parties in the real estate sector. Current examples of PSSs in the Dutch real estate sector are:

- *Lighting as a Service,* a business concept developed by Philips that opts for the servitization of lighting (M. Schillemans, personal communication, June 20, 2017).
- *The M-use elevator,* an elevator-concept developed by Mitsubishi whereby service components are added to elevators in order to create a Product-Service-System (R. Koedam, personal communication, October 3, 2017).
- *Energy as a Service,* hereby users are unburdened by INNAX by the servitization of the 'energy installation' (P. Blaauw, personal communication, June 30, 2017).

Also two examples of servitized and circular real estate development projects are present, this is project *'The Valley'* in Hoofddorp[2] (J. Feuth, personal communication, September 22, 2017) and *'The Dutch Mountains'* in Eindhoven[3] (A. Van de Moosdijk, personal communication, July 05, 2017).

However, these market parties have difficulties with the implementation of PSS business models and the creation of servitized real estate development projects since:

- There is an ongoing discussion around issues concerning responsibilities, liabilities and ownership (Kazemi, 2016; Kok, Wurpel, & Ten Wolde, 2013; Van den Brink, 2016).
- Market parties do not know how to cooperate with each other. Moreover, they cannot find the right development processes in order to implement these PSSs. It is difficult for these parties to find proper incentives and contractual arrangements to implement circular (i.e. PSS) business models (J. Bergman; personal communication, August 24, 2017; M. Bierman, personal communication, October 05, 2017; N. Eekhout, personal communication, September 11, 2017; M. Veerman, personal communication, July 05, 2017).

1.2.4. Relevance for the graduation company

At the same time in which this research is executed, the graduation company is developing and implementing a new business model. This business model aims for a changing real estate market in which the offering of services stands central.

> *This new strategy focusses on the corporate cool tenant in the lease market, inspiring workspaces with flexible lease terms. These new buildings be user-cantered, inspirational and with a flexible-occupancy and flexible lease model. All based upon the vision of 'designing from the inside out': "First comes life, then spaces, then buildings" (OVG Real Estate, 2017c, p.21-22).*

Although the new strategy of the graduation company starts to offer services towards the tenants of their buildings, the way these services are being delivered is not based upon the use of Product-Service-Systems. Therefore, the chance is missed to actually create a service-based supply chain within the real estate development projects of the graduation company. In such a service-based supply chain are PSSs procured from suppliers, integrated with each other by the service provider and delivered towards tenants as an integrated 'real estate as a service'-concept (Kazemi, 2016; Van den Brink, 2016). The graduation company cannot implement these PSSs because, according to C. Berning (personal communication, September 20, 2017).

- The graduation company does not have the proper knowledge how to implement Product-Service-Systems in their real estate development projects:
- The whole supply chain should implement service-based business models before these could be implemented properly. Currently there are not many suppliers that provide 'circular services'.

[2] https://www.circularvalley.com/

[3] https://e52.nl/dutch-mountains-wordt-grootste-houten-gebouw-ter-wereld/

1.3. RESEARCH PROBLEM

With the implementation of Product-Service-Systems, the roles and positions of involved organizations in a real estate development project will change, because these organizations receive new tasks and responsibilities. Therefore, this implies the implementation of PSSs need "[...] a systematic approach and will need new forms of cooperation among multiple actors operating in different parts of the supply chain [...]" (Kazemi, 2016; Prins et al., 2015, p. 455).
However, since there is currently not enough knowledge available in theory and practice about the implementation of Product-Service-Systems on an operational level in real estate development projects, these actors do not know how this cooperation and interaction could look like.

Real estate developers traditionally have a central position within the project organization of real estate development projects, as they 'steer' these projects in their interaction with the supply and demand side of the real estate supply chain (Miles et al., 2007). Because of the current central position within real estate development projects, the real estate developer could take the place of the central organization within circular real estate development projects and become service provider (Rood, 2015; Van den Brink, 2016).

Because of the organizational overlap between the service provider in circular real estate development projects and the current real estate developer. It is believed that real estate developers could have a driving force in order to push the implementation of Product-Service-Systems in real estate development projects (Van den Brink, 2016). However, as mentioned before, there is still not much known in science and practice about Product-Service-Systems in real estate development projects. This leads to a situation where actors do not know to implement them and how to interact with each other in order to implement these PSSs.

Thus, there is a lack of knowledge in science and practice about:

a. *How* Product-Service-Systems function on an operational level in real estate development projects.
b. *How* real estate developers could perform the role of the service provider within real estate development projects and what their position would be.

The next problem statement is defined based upon the discussion presented above:

Real estate developers do not know how to interact with service suppliers and customers to implement Product-Service-Systems in order to realise circular real estate development projects, since there is not enough knowledge available in science and practice about (1) the functioning of Product-Service-Systems on an operational level; and about (2) the position and the role of the service provider within circular real estate development projects.

1.4. RESEARCH OBJECTIVE

In order to overcome the mentioned problems in the former paragraph, it would first be necessary to conceptualize the functioning of Product-Service-Systems in real estate development projects. This knowledge should provide insight in the functioning of PSSs on an operational level for the different organizations involved in circular real estate development projects. The roles of the involved organizations in servitized real estate development could be derived from this information.
If the roles of the different organizations in servitized real estate development projects are known, it could become clear what the role and position of the service provider is and how this actor could perform this role. Based on this, working models could be developed that could be used by real estate developers to perform the role of the service provider and interact with other organizations involved in servitized real estate development projects. These working models should in the end help service providers to implement PSSs in real estate development projects.

The next research objective is formulated:

(1) Conceptualize the functioning of circular Product-Service-Systems on an operational level and (2) develop conceptual working models that could be applied by real estate developers to perform the role of the service provider within circular real estate development projects.

1.5. RESEARCH SUB-QUESTIONS

As mentioned in the former paragraph it is necessary to first know (1) what the functioning is of PSSs on an operational level and (2) to develop working models that could be applied by real estate developers to interact with service suppliers and customers.

Five research sub-questions are formulated in order to reach these objectives. Hereby, the first two research sub-question relate to obtaining the first objective of this research and the latter three research sub-questions are designed to endeavour the second objective of this research. The questions related to the second research objective are divided based upon the different interactions with organizations in the supply chain of servitized real estate development projects. Hereby the third research question relates to the interaction between the service provider and service supplier, the fourth to the interaction between the service provider and the customer and the fifth research sub-question relates to the way the service provider could connect these two sides with each other.

Research sub-question 1

The first research sub-question relates to the operationalization of Product-Service-Systems. The aim of this research question is therefore the choose and / or develop a model that could be used to operationalize the implementation of Product-Service-Systems in real estate development projects.

Table 1: Research sub-question 1

Objective:	Choose and / or develop a model that could be used to operationalize the implementation of Product-Service-Systems in real estate development projects
Question:	**How could the implementation of Product-Service-Systems be operationalized?**

Research sub-question 2

The outcomes of the second research sub-question aim to operationalize the functioning of PSSs in real estate development project. The outcomes of this research sub-question relate to obtaining the first research objective as presented in the former section of this chapter.

Table 2: Research sub-question 2

Objective:	Conceptualize Product-Service-Systems in real estate development projects
Question:	**What are Product-Service-Systems?**

Research sub-question 3

The last three research sub-questions relate to the role of the service provider within servitized real estate development projects and the needed interaction in order to implement Product-Service-Systems. The aim of the third research sub-question is to develop a conceptual working model that could be applied by a real estate developer to interact with service suppliers in order to implement Product-Service-Systems.

Table 3: Research sub-question 3

Objective:	Develop conceptual working model(s) that could be used by real estate developers to interact with service suppliers in order to implement Product-Service-Systems.
Question:	**How could a service provider interact with service suppliers?**

Research sub-question 4

The answer of the fourth research question aims to develop a conceptual working model that could be applied by real estate developers to interact with customers in order to implement Product-Service-Systems.

Table 4: Research sub-question 4

Objective:	Develop conceptual working model(s) that could be used by real estate developers to interact with customers in order to implement Product-Service-Systems.
Question:	**How could a service provider interact with customers?**

Research sub-question 5

As mentioned before, the outcomes of the fifth research question combines the two sides of the supply chain and aim to develop conceptual working models that could be applied by real estate developers to implement Product-Service-Systems

Table 5: Research sub-question 5

Objective:	Develop a conceptual working model that could be used by real estate developer to interact with service suppliers and customers in order to implement Product-Service-Systems.
Question:	**How could a service provider connect the demand and supply side of circular real estate development projects?**

1.6. RESEARCH QUESTION

The research sub-questions as presented in the former section are combined with each other in order to form the main research question of this research. Hereby the main research question becomes:

How could a circular service provider interact with service suppliers and customers in order to implement Product-Service-Systems in real estate development projects?

Actor:	Circular service providers
Object:	Circular real estate development projects
Subject:	Product-Service-Systems in the Circular Economy

2. Background

Management in the built environment and the management of a project implies acting towards a certain goal. In order to reach these goals, managers use certain instruments. This means that "Management is getting thing done… with people", and management can be seen as being in command of – a part of – an organization so that processes – internal and external – are tuned in and end up well (Bruil & Heurkens, 2012, p. 26). According to Daamen (2010) actors in (urban) development practice are in constant search for effective and efficient 'strategies' needed to produce successful outcomes of projects (Heurkens, 2012). This instrumental view on management implies "the total process of planning, decision-making and administering of all aspects of an action or system from its inception to its termination" (Bruil & Heurkens, 2012, p. 26). Therefore, it is important to analyse the whole spectrum of management activities related to development processes.

In this chapter, the conceptual framework that is used in this research will be presented. This is done by introducing several management principles in the first section. This section is followed by the introducing and operationalization of the Conceptual Steering Model of De Leeuw (2002) in the second section. This leads to the generation of the conceptual framework, which is presented in the third section of this chapter.

2.1. MANAGEMENT PRINCIPLES

2.1.1. Project and process management

In the built environment, management is often about management of projects and management of processes. Project management herein can be defined as "the structuring, organization, coordination, monitoring and evaluation of all activities that are necessary for the establishment of a project (Bruil & Heurkens, 2012, p.33). Next to this, a central element is that project management is the division of the project into phases, therefore project management becomes 'management through phasing' (Bruil & Heurkens, 2012). Process management, in the meanwhile, can be defined as "complexity management within networks of people" (Wamelink, 2009, p.411, in Bruil & Heurkens, 2012, p.35). Hereby, a process organization consists of inter-organizational networks whereby the different organization, parties and actors have equal relationships with each other.
The main difference between projects and processes is that projects are seen as closed systems and processes as open ones. Process-oriented approaches are therefore suitable for analysing the environment and gain insight in the context (Bruil & Heurkens, 2012). Since real estate development projects are seen as fundamentally open, a process-oriented method will be used in this research.

2.1.2. Systems steering

A systems approach considers reality as a system, "in which the whole is more than the sum of the parts" (Bruil & Heurkens, 2012, p. 65). Hereby a system can be defined as "[...] a collection of objects [...] being associated to each other in such a way that no element or groups of elements are isolated from the whole" (De Leeuw, 2002, p.96, in Bruil & Heurkens, 2012, p.65).

As said before, management is, besides many other things, about steering. Systems steering can be seen as applying influence with the aim to reach certain objectives or goals. Hereby a distinction should be made between (1) the system which is steered (i.e. the Controlled System) and (2) the system which steers (i.e. the Controlling Unit) (Bruil & Heurkens, 2012), see figure 2. It is logical that the Controlling Unit steers the Controlled System, hereby the Controlling Unit applies goal-oriented measures in order to steer the Controlling System towards predetermined objectives or goals. On the other hand, the Controlling System also

sends information to the Controlling Unit, in the form of feedback (De Leeuw, 2002). In the next section, this systems steering model will be implemented in its context.

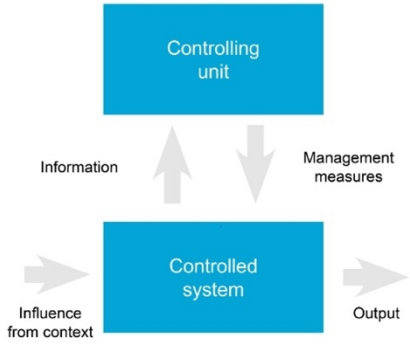

Figure 2: The CU/CS configuration (after De Leeuw, 2002, and Bruil & Heurkens, 2012)

2.2. CONCEPTUAL STEERING MODEL

In the built environment, contextual influences and relationship are of big importance. This is mainly because the time period from initiative to completion covers a long time span, therefore the influence of the context or environment is a big risk factor.

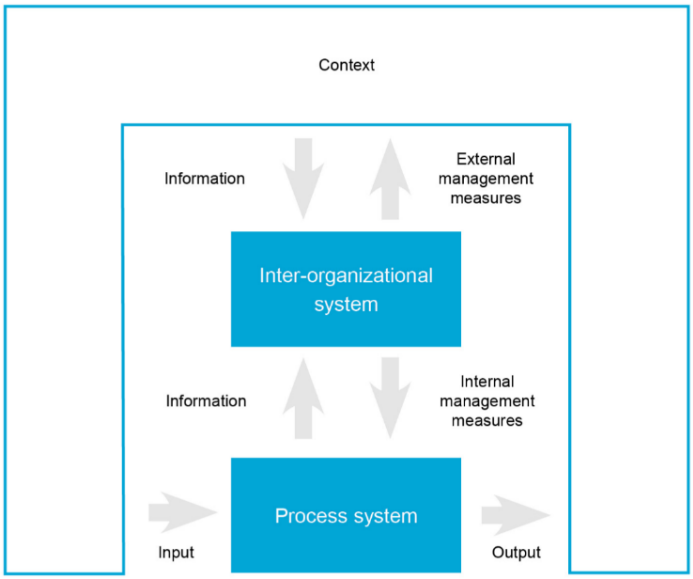

Figure 3: Conceptual steering model (after De Leeuw, 2002, in Heurkens, 2012)

The conceptual steering model of De Leeuw (2002), which is used in the dissertation of Heurkens (2012), is presented in figure 3. The concepts in this model are already linked to real estate development processes. Hereby the CU is referred to as the inter-organizational system and the CS the process system. The conceptual steering model is not a representation of reality but provides a conceptual model that explains all sorts of mechanism occurring in project.

2.2.1. Context

The context refers to the different levels of surrounding of which a certain empirical object is part of. This context might be subject of change. The context shapes conditions in which a circular real estate development project takes place (Heurkens, 2012) and is sometimes also referred to as the project environment, according to Bruil & Heurkens (2012) "the project environment – or context – is the total sum of external influences within which a project is formulated, assessed and completed".

2.2.2. Inter-organizational system

The inter-organizational system represents different aggregation levels of organizational structures, formal and informal relationships and roles between different actors (Heurkens, 2012). In case of this research project the inter-organizational system refers to formal and informal relationships of the project organization of a real estate development project. The inter-organizational structure herein can be defined as "[...] the sum of the ways an organisation divides its labour into distinct tasks and then coordinates them" (Bruil & Heurkens, 2012, p. 57).

In many sectors, such as the real estate sector, a division can be made between (1) demanding parties and (2) supplying parties, connected by a (3) (demand or supply) system integrator (Segerstedt & Olofsson, 2010; Vrijhoef & De Ridder, 2005). See also Figure 4, on which the demanding parties are represented left and the supplying parties on the right of the figure.

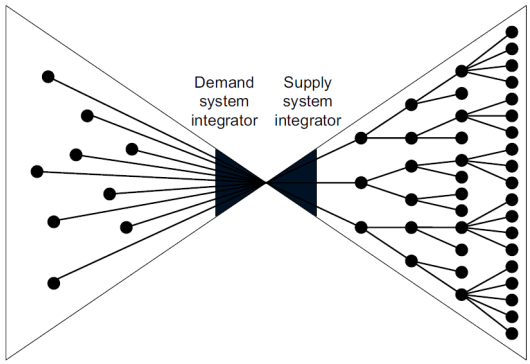

Figure 4: The central role of the demand and supply system integrator (Vrijhoef & De Ridder, 2005)

Demanding parties

According to Vrijhoef and De Ridder (2005) demanding parties in a traditional real estate development are most often represented by the client. With the introduction of PSS in the real estate sector, clients will become customers since the demands of a customer will shift from product ownership to service delivery and performance (De Grauw, 2015; Kazemi, 2016). For practical purposes, the customer will – in this research – be seen as the end-user of the building, which is most often 'the main client' of the real estate developer. The customer is hereby not the actual person, but the organization responsible for the real estate within a firm that uses the servitized real estate. Hereby the customer is the organization that actually 'consumes' the delivered services by the service provider / service supplier.

Supplying parties

The supplying parties are most often responsible for delivering the built facility to the client side of the supply side. Most projects are often one-off and therefore coalitions between supplying parties are currently most often teared down after project delivery (Vrijhoef, 2011; Winch, 2010).

According to Van den Brink (2016), supplying parties in the real estate sector do not often partner together for more projects, since there is no strong focal firm on the supply side. In the CE, this central organization is present and is called the service provider. This party is placed in between the supplying parties, clients and the other stakeholders in the project organization (Ellen MacArthur Foundation, 2013a). In his research, Van den Brink (2016) makes distinction between two different kind of service providers, based on a study by Baines and Lightfoot (2013):

1. **Pure service providers;** they focus on delivering services without having any physical, underlying product. This are for example consultancy firms.
2. **Manufacturing service providers; this** are combinations of manufacturers and pure service providers. This kind of company offers services based on underlying products.

The system integrator (i.e. the service provider)

The second kind of service providers (manufacturing service providers) have a lot in common with the aforementioned definition of buildings and related performance and services. It has to be taken into notice that the abovementioned service providers are different kind of service providers. The service providers of Baines and Lightfoot (2013) are in the perspective of the Circular Economy service suppliers, since they only supply products and do not provide, in the perspective of the real estate sector, the whole building. Therefore a distinction should be made between service suppliers and service providers.

1. **Service suppliers:** are the traditional suppliers of products, but in the CE they provide these products in the form of Product-Service-Systems. This are the abovementioned manufacturing service providers.
2. **Service providers:** are the organizational 'spiders in the web' aligning demands of the clients with services provided by the suppliers. This are the abovementioned pure service providers.

The Ellen MacArthur Foundation (2013a) also proposed the idea of a service provider as a central organization, but this service provider is not defined clearly and is presented as a fixed organization with unclear relationships and operations. Van den Brink (2016) tried to clarify the role of the service provider and explains that the role of this party would be to eliminate existing barriers between the supplying parties in the real estate sector. Hereby the service provider is the link between the supplying parties and the demanding parties, being the customer(s). Van den Brink (2016) describes the responsibilities of the service provider as:

> *"The supply side needs to offer a performance that is supported by a service that optimizes said performance. The performance is based upon a delivered product (i.e. the building) The building is in part a collection of products that are interrelated at different scale levels. These products are delivered by the service provider, usually in combination with (different) supplying parties, but the service providers manages the overall performance". (Van den Brink, 2016, p. 95)*

The service provider in the CE becomes responsible for:

- The transaction between the service provider and the customer(s)
- The transaction between the service provider and the supplying parties

A conceptual representation of the inter-organizational system as used in this research is presented in Figure 5

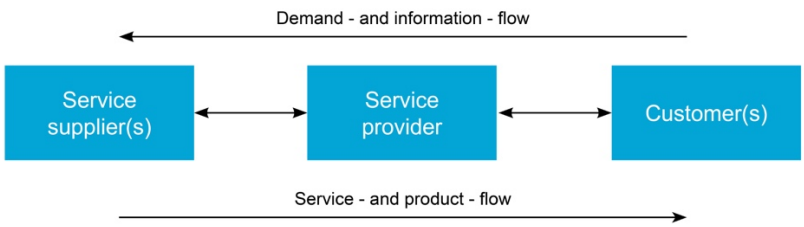

Figure 5: Demand and service flow (based upon Segerstedt & Olofsson, 2010; Vrijhoef & De Ridder , 2005)

Definition of actors:

Service supplier(s): The traditional suppliers of products, but in the CE they provide these products in the form of Product-Service-Systems. Also: Organization that performs a service with an underlying physical product (adopted from Van den Brink, 2016)

Service provider: The organizational 'spiders in the web' aligning demands of the clients with services provided by the suppliers. Organization that integrates services as delivered by the service suppliers and delivers them towards the customer. This research takes the perspective that he current real estate developer would transform itself towards the role of the service provider.

Customer: Actor / organization that makes use of the delivered services (most often the end-user of a building). The customer is the department responsible for the real estate within a firm that uses the servitized real estate.

2.2.3. Process system

The process system is managed by the project organization of the inter-organizational system. The process system relates to the whole development process in order to deliver and / or manage the real estate development project (Heurkens, 2012). The process system in real estate development projects are sometimes referred to as black boxes since it is very difficult to grasp all the influences, processes and strategies used that influence the process system. Black boxes are considered as port of systems whereby only relations between the black box and its context are relevant (Heurkens, 2012). In this research relates the process system to the process of implementing PSSs in real estate development project, which is simultaneously the unit of analysis within the empirical part of this research.

2.2.4. Internal & external management measures

The three components (context, inter-organizational system and process system), as described above are linked to each other. These relationship reflect the dynamics that are present in- and around certain project. Heurkens (2012) mentions hereby that a changing context could influence the processing system which is considered as input for the process. Internal management measures are according to De Leeuw (2002) aimed at influencing the structure or objectives of the project, and external management measures are used to influence the structure or objectives of the project surroundings. This means that internal management measures are used by actors to realize an effect on the output of the real estate project itself. Next to this, the inter-organizational system itself is influenced by information or signals that are coming from project surroundings. On the other hand, the inter-organizational system itself could also influence the project surrounding using external management measures. In such a case, the external environment is steered in order to achieve project objectives (Heurkens, 2012).

In this research the internal management measures relate to the way the involved actors steer the implementation of PSSs in real estate development projects. Four sets 'PSS business tactics' were recognized as useful in the literature review of Reim et al. (2015), which are (1) Contracts, (2) Network, (3) Marketing and

(4) (Product and service) Design[4]. These tactics can be defined as "company's residual choices at an operational level after deciding which business model to apply" (Reim et al., 2015, p. 66). These tactics link decisions on a strategic-level with decision on an operational-level and are used by companies to create, deliver and capture value on an operational level. Therefore, these could be seen as the internal management measures taken by the involved organizations. These business tactics are:

1. **Contracts:** Define "[...] the responsibilities of the involved parties during a specific contractual period. A PSS contract is designed to address all aspects related to providing the service and to state the rights and liabilities of involved parties clearly" (Reim et al., 2015, p. 67).
2. **Network:** Refers to how actors "[...] use their network relationships with external partners to ensure PSS business models are implemented successfully" (Reim et al., 2015, p. 70).
3. **Marketing:** Describe how actors: "[...] interact, communicate and use customer and market insights to implement their PSS business model" (Reim et al., 2015, p. 68).
4. **(Product and service) Design:** Relate to how actors "[...] design product and services to meet the diverse needs of customers and successfully implement PSS business models" (Reim et al., 2015, p. 71)

Table 6 provides an overview of the tactics to implement PSS business models as described by (Reim et al., 2015). Herein the business tactics are further specified into key aspects to implement these tactics.

Table 6: Business tactics and related key aspects (Reim et al., 2015)

Tactics	Key aspects
Contracts	Responsibility and terms of agreement
	Formalization and complexity
	Risk level
Network	Type of partners
	Type of relationships
	Sharing and coordinating activities
Marketing	Communication of value
	Extent of customer (customer, red.) interaction
	Customer (customer, red.) and market insights
(Product and service) Design	Functionality
	Customization
	Improved resource utilization
	Extent of innovation

2.2.5. Output

As seen in figure 3, the output of the process system flows back into the 'context', in case of real estate development projects the output is mostly a constructed building. In case of a servitized building, products will be delivered according to the service it delivers. Hereby the service provided with it should yield a certain degree of utility (i.e. a performance) for the user. Therefore, the output of the related process should be measured according to the performance it delivers. Selviaridis and Wynstra (2015, p. 3507) define 'output' as the "[...] direct results of the service activity or production process itself, whereas 'outcomes' are

[4] Reim et al. (2015) defined in their systematic literature review five business tactics to operationalize Product-Service-Systems. However, the choice is made to use only four of them in this research and omit the concept of 'Sustainbility'. See section 3.5

defined as the value derived by the customer from a given service or product". Hereby output is linked to effectiveness and outcome to efficiency:

- **Effectiveness:** Degree to which objectives are met, this is the degree to which circular servitization actually takes place.
- **Efficiency:** Extent to which servitization takes place against a minimum use of time and costs, hereby the degree to which the used organizational structures fits circular service provision is valued

2.3. CONCEPTUAL FRAMEWORK

In order to conduct this research, it is necessary to relate the concepts as introduced before to each other and put these in a conceptual framework. According to Miles and Huberman (1994, p. 18) a conceptual model "explains, either graphically or in narrative form, the main things to be studies and the presumed relationships among them". The conceptual framework of this research is presented in figure 6.

In this model the element 'inter-organizational system', 'process system' and 'internal management measures' are highlighted in blue because these elements act are the focus point of the case study research. These are the main blocks needed to conceptualize the research. Within these conceptual building blocks, several green boxes are highlighted. These boxes further operationalize this research, as explained in the former section.

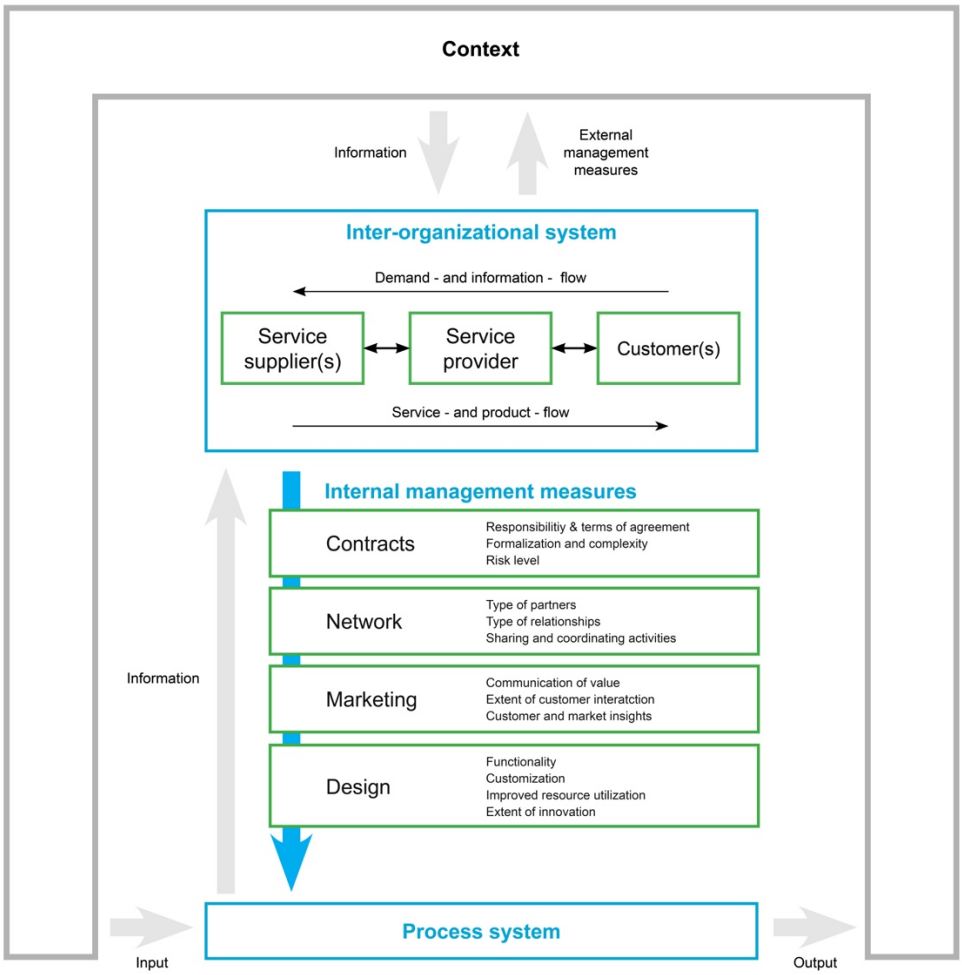

Figure 6: Conceptual framework (own ill.) (based upon De Leeuw, 2002; Heurkens, 2012)

3. Methodology

This research proposal is presented in Chapter 1 and more background information about the main concepts has been provided in the former chapter. This chapter aims to present and underpin the chosen research methodologies for this research project and to provide insight in the used structure of this research. The first paragraph of this chapter therefore describes the methodological framework used in this research. The used methodologies of this research are further explained in the second paragraph of this chapter, whereby the four research steps are discussed separately. In order to keep this chapter – and report – concise several references are made in this chapter towards multiple appendices.

3.1. METHODOLOGICAL STRUCTURE

The main objective of this research to conceptualize the functioning of PSSs and develop working models that could be used by real estate developers. Since this relates to the development of new theories, a qualitative research strategy has been chosen to use in this research (Bryman, 2012). The theoretical shift of actors towards a servitized real estate sector has an explorative character since not much is known about this subject in science and practice. An explorative research is "[...] undertaken with the objective [...] to explore an area where little is known about. [...] Explorative researches are also conducted to develop [...] tools and procedures" (Kumar, 2014, p. 11). Therefore, this type of research is appropriate since this graduation research relates to developing new instruments and means. A methodological framework is designed to provide insight in the methodological structure of this research. These dimensions include the conceptual analytical model, research methods and research techniques. This structure is developed based upon Huijbregts (2017) and Heurkens (2012).

Table 7: Methodological framework, based upon Heurkens (2012, p.112) and Huijbregts (2017, p.51)

Concepts	**Analytical model based on systems approach**				
Aim	Understand inter-organizational systems and process systems, & management systems				
Question	Which models can be used to conceptualize and operationalize the implementation of PSSs in the real estate sector?				
Methods	**Case studies**		**Theory building**		
Aim	Data collection, analysis and comparison		Empirical lessons		
Question	In what way do interact involved actors in current servitized real estate development projects?		What empirical lessons can be drawn from the learned from the current interaction of involved actors in servitized real estate development projects?		
Technique	**Literature & doc. review**	**Participant observation**	**Interviews***	**Expert-panel(s)**	**Displaying tables & figures**
Aim	Documented information	Practical understanding	Practical experiences	Practical validation	Comprehensive overviews
Question	Which literature sources provide information and insight into PSSs in real estate?	What does a PSS look like in a real estate development project in practice?	What are the experiences and views of actors of circular real estate development projects?	What are the perspectives of experts on the preliminary findings of this research?	How to present retrieved data from the case studies to draw conclusions?

*Interviews include explorative interviews and semi-structured interviews

There is a certain hierarchy recognizable between the used methods and techniques within the methodological framework. On top of the hierarchy stands the analytical model which is based on a systems approach. The two main research methods are hereafter case studies and theory building. These methods are supported by five techniques, which are concisely presented in table 7, see also Heurkens (2012) and Huijbregts (2017).

The main question of this research is answered using a three-step research structure.

- The first step relates to the development of **Concepts**. Hereby the main research gap is explored, and the research problem, research objective and research question formulated. Next to this, in this part general knowledge about the topic is gained.
- The second step relates to **Theories**. Goal of this step is to get an overview of the existing theories and existing knowledge related to the research topic. This step forms the theoretical foundation of this research.
- The third step relates to **Practices**. Goal of this step is to create a better understanding of the application of PSSs in current servitized real estate development projects. Hereby empirical data is derived data from the conducted case studies.
- The last step refer to **Synthesis**. The outcomes of the second and third step are combined and confronted with each other in order to build theories.

The used research techniques are described in Appendix C: Research techniques.

3.2. RESEARCH METHODOLOGIES

3.2.1. Part 1: Concepts

The first step in the research process is with the use of an **explorative literature review** to gain insight in the topic are, to explore possible research gaps and to select an appropriate operational model for this research.

When an overall impression of the research gap and research topic was gained, **explorative interviews** were conducted with experts gain insight in the perspective of practitioners in the real estate sector. The aim of these explorative interviews is to gain deeper insight in the current practices and status of the implementation of PSSs is in the field. By doing this, (1) the research becomes focussed, (2) an initial definition of the research question is made and (3) an a priori specification of constructs was shaped (Eisenhardt, 1989). It should be noted that the first part of this research had an iterative character (Edmondson & McManus, 2007).

Table 8: Objective, question and methodology of Part 1

Objective:	a. Getting an impression of the topic area and explore possible research gaps b. Gain insight in the perspectives of practitioners c. Select an operational model
Question:	What is already known about the implementation of Product-Service-Systems in real estate development projects? Which models can be used to conceptualize and operationalize the implementation of Product-Service-Systems in real estate development projects?
Technique:	a. Explorative literature review b. Explorative interviews (unstructured interviews)

3.2.2. Part 2: Theories

In order to get a full overview of the existing theories and existing knowledge a **literature review** is used, the aim of this method is to provide an account of the literature that is comprehensive. Since little academic literature is available about the implementation of Product-Service-Systems in the real estate sector, a meta-ethnography method is used whereby master theses of former MBE-students were the main source (Bryman, 2012). Based on the used sources in these theses, a more in-depth literature review was made.

Table 9: Objective, question and methodology of Part 2

Objective:	Gain insight in the existing theories and existing knowledge
Question:	What is known in existing theories about the implementation of Product-Service-Systems in real estate development projects?
Technique:	Literature review

3.2.3. Part 3: Practices

In order to create a better understanding of the application of PSSs in the current real estate sector and gain insight in the current interaction between involved actors in servitized real estate development project, **case studies** were conducted. Case studies are used to 'investigate a contemporary phenomenon within its real-life context' (Yin, 2014).

Table 10: Objective, question and methodology of Part 3

Objective:	Gain insight in the current interaction between involved actors in servitized real estate development projects.
Question:	In what way do actors involved in current servitized real estate development projects currently interact?
Technique:	Case studies; in-case analyses; cross-case analyses

A more detailed description of the used research techniques can be found in:

- *Appendix C: Research techniques;*
- *Appendix D: Case study protocol.*

3.2.4. Part 4: Synthesis

The outcomes of the case studies provide input for the synthesis of this research project wherein theories are build. This process of **theory building** is based upon the theory building approach of Eisenhardt (1989). This theory building approach leads to the generation of a proposition, which has the form of empirical lessons for real estate developers. The main steps in this theory building process are the in-case analyses, a cross-case analysis and a confrontation of existing theories with practice. The main findings are internally and externally validated with the use of an **Expert panel**.

Table 11: Objective, question and methodology of Part 4

Objective:	Draw empirical lessons for real estate developers in order to support them to implement Product-Service-Systems in real estate development projects
Question:	**What empirical lessons can be drawn from the learned from the current interaction of involved actors in servitized real estate development projects?**
Techniques:	Theory building (in-case analyses, cross-case analyses); Expert panel

A more detailed description of the used research techniques can be found in:

- ***Appendix C: Research techniques;***
- ***Appendix E: Expert panel protocol***

3.3. CONCLUSION

Table 12: Objective, question and methodology of Part 1

Objective:	a. Getting an impression of the topic area and explore possible research gaps b. Gain insight in the perspectives of practitioners c. Select an operational model
Question:	**What is already known about the implementation of Product-Service-Systems in real estate development projects?** **Which models can be used to conceptualize and operationalize the implementation of Product-Service-Systems in real estate development projects?**
Technique:	a. Explorative literature review b. Explorative interviews (unstructured interviews)

Although several authors and graduates focused upon the implementation of circular business models in the real estate sector, these researchers do not focus upon the implementation of PSSs specifically. Therefore, a scientific knowledge gap exists about the implementation of PSSs in the real estate sector on an operational level.

In order to create this scientific knowledge and conduct this research, a conceptualization and operationalization of used concepts in this research is needed. The Conceptual Steering model of De Leeuw (2002) is used to conceptualize this research. The conceptual steering model is not a representation of reality but provides a conceptual model that explains all sorts of mechanism occurring in project. The main elements in this model are (1) The inter-organizational system, (2) the process system and (3) the context in which these systems are applied.

The process system is the system on which the focus of this research lies. The business tactics as described and defined by Reim et al. (2015) are used to operationalize this process system. These tactics can be defined as "company's residual choices at an operational level after deciding which business model to apply" (Reim et al., 2015, p. 66). These tactics link decisions on a strategic-level with decision on an operational-level and are used by companies to create, deliver and capture value on an operational level.

PART 2
THEORIES

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4. Literature study

A literature study has been conducted in order to get an overview of the existing theories and existing knowledge related to the research topic. This literature study is presented in this chapter, which is structured using the business tactics as defined by Reim et al. (2015). The outcomes of the literature study are – if applicable - further classified per stakeholder. This makes it possible to tabulate the findings of the literature study, as done in Table 15. This chapter ends with a conclusion of the second step of this research, which related to 'Theories'. This conclusion is made based upon the determined objectives, questions and methodologies as mentioned in Paragraph 3.2.2.

4.1. CONTRACTS

As mentioned before, according to Reim et al. (2015, p. 73) the contract tactic "[...] addresses how the advanced relationship between a supplier, provider and customer is incorporated into a form agreement that balances mutual interests". In case of a PSS contract, these contracts are based on the delivered service of the product. A contract relating to PSSs is designed to address all aspects related to providing a specific service and to state the rights and liabilities of involved parties clearly. Key aspects herein are the delivered performance of the service, incentives and risk allocation (Reim et al., 2015; Selviaridis & Wynstra, 2015).

Selviaridis and Wynstra (2015) mention that in order to design these contracts successfully; measurable outcomes, appropriate incentive structures as well as an appropriate mix of contractual and relational governance mechanisms is needed. When this is all defined correctly, it leads to "increased efficiency, improved spending accountability, innovation, budget flexibility, value for money and inclusion of social and environmental objectives into specified outcomes". According to Reim et al. (2015) three categories of business models and related contracts could be used by companies to deliver PSSs. These are (1) Product-oriented services, (2) Use-oriented services and (3) Result-oriented services.

1. **Product-oriented service contracts***:* A supplier commits to deliver a service related to a product, in addition to the sale of this product (Reim et al., 2015, p. 65). The property rights of the products are transferred to the customer and the supplier is responsible for providing the agreed-upon services (Azarenko et al.,2009 in Reim et al.,2015). This extra service could be for example a maintenance contract or a takeback-agreement (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38; Tukker, 2004).
2. **Use-oriented service contracts:** A product is made available by the provider under a rental or leasing agreement, hereby the supplier does not sell the physical product (Reim et al., 2015, p. 66). The product itself is still central in this business model, while it is not sold to the customer. The ownership of the product is not transferred and risks and responsibilities over the product remain with the supplier (Reim et al., 2015). Example of this could be a lease, rent. Pooling or pay-per-service (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38; Tukker, 2004).
3. **Result-oriented service contracts:** In this model, the supplier agrees to provide the customer with a certain result or outcome rather than a specific product or service (Reim et al., 2015). Hereby the supplier gets paid for the result and is responsible for delivering this result, without a specific product is necessarily involved. The customer pays the supplier for providing the agreed-upon result and the property rights stay with the supplier (Reim et al., 2015). The result could be quite abstract, such as 'light', 'comfort' or 'mobility' (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38; Tukker, 2004). Example of these kinds of business models in the real estate sector is Turntoo (Rau & Oberhuber, 2016; Rooijers, 2017).

As can be seen in the discussed business models, the supplier will become increasingly responsible and owner of a product. The customer will use the product without being the owner of it. This changes the relation between supplier, customer and product. A certain spectrum is visible between product ownership and pure 'products as services' (Loppies, 2015, p. 49; Stouthuysen, 2014, p. 38).

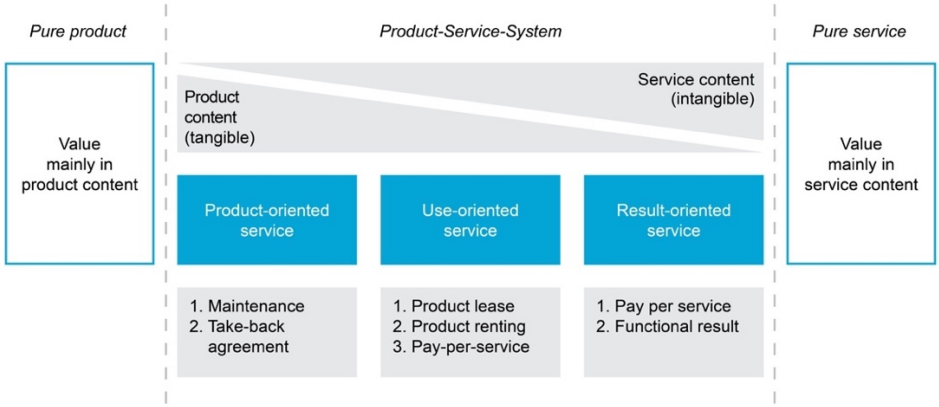

Figure 7: Main and subcategories of PSS business models (adapted from Tukker, 2004)

4.1.1. Service suppliers

Currently, the responsibilities of suppliers and contractors in a real estate development project terminate at the moment of product delivery, with a limited addition of guarantees. According to Kazemi (2016) this leads to business to business relationships and lowest cost tendering whereby the only goal is to make a building that fit current needs. This leads to the existence of a split incentive between the business models of the current supplying parties with a short term vision, based on selling their products; and the business models of users with a long term-vision, based on demand for services that fit their organization's needs (Kazemi, 2016).

One of the biggest differences in the implementation of PSSs in the real estate sector, compared to a current real estate development project, is that supplying parties remain responsible for the delivered products. Hereby their responsibilities are extended towards the in-use phase and even the end-of-life phase of a product (Mont, 2002; Reim et al., 2015; Selviaridis & Wynstra, 2015). De Ridder and Vrijhoef (2007) mention hereby that suppliers should extend their strategies beyond project delivery and change their model into 'continuous value delivery', also known as 'life cycle value delivery'. Hereby the industry delivers value in the form of services. In order to achieve this, suppliers must therefore shift from a delivery system in a price-based environment towards a higher level of performance-based competition (Parmar, Kashiwagi, & Egbu, 2004)

Vertical integration

Suppliers receive new roles that are normally most often executed by the customer when PSSs are implemented in real estate development projects. This requires from the service supplier to take care on – for example - maintenance activities (Reim et al., 2015; Selviaridis & Wynstra, 2015). This means that suppliers will vertically integrate within the supply chain of the real estate sector (Kazemi, 2016; Roos & Agarwal, 2015). Hereby the responsibilities of involved parties are changing and the business boundaries are blurring. Which creates opportunities for organizations to "radically transform their businesses" (Robinson & Chan, 2014, p. 908). The concept of vertical integration is described by Baines, Lightfoot, and Smart (2011, p. 948) as "the extent to which a firm owns and takes responsibility for its upstream suppliers and its downstream customers". Backward vertical integration hereby implies taking over activities of sub-suppliers and forward vertical integration concerns taking over activities that would normally be carried out by customers (Baines et al., 2011). Hereby the supplier extends and diversifies its delivered services (Mont, 2002; Roos & Agarwal, 2015).

Other incentive structures

In a PSS-contract, the price is based on the actual delivered performance during the in-use phase of a project. In practice, the service suppliers are paid periodically based on the overall performance of the delivered services. This means that service supplier become responsible and liable for the quality and the overall performance of the delivered products and relating services (Kazemi, 2016; Mont, 2002; Stahel, 2008; Van den Brink, 2016). Hereby the amount of risk as well as the potential revenue streams for the supplier would increase (Selviaridis & Wynstra, 2015). The extended responsibilities create incentives for supplying parties to work more efficiently and reduce their transaction costs (Selviaridis & Wynstra, 2015, p. 3506). Hereby the suppliers will be incentived to think the other way around and start thinking about value delivery towards customers instead of revenue creation for themselves.

In theory, the customer would be able to change his demands while using products offered as services. This puts some extra risk on the shoulders of the suppliers to keep the delivered services up-to-date when the demands of the customer change. Hereby the responsibility for the costs associated with changing the delivered products lies at the supplier. Therefore the suppliers must be sure the delivered products are designed in such a way that they are able to adapt appropriately (Kazemi, 2016; Van den Brink, 2016).

4.1.2. Service provider

In the current real estate sector, the real estate developer (now: service provider) takes the biggest risk in a project, because this actor invests his own (or loaned) equity (Peiser & Frej, 2004, p. 3). This business model will – according to Loppies (2015) - probably no longer function anymore in a servitized Circular Economy because the service provider (former real estate developer) does not have to purchase any physical goods anymore to develop a building. This stems from the theory that suppliers will remain ownership over their delivered materials (Ellen MacArthur Foundation, 2013a; Loppies, 2015).

According to Van den Brink (2016) the service provider gets a coordinating role within the supply chain because this organization will become responsible for managing the transaction between the service provider and the customer(s), and the transaction between the service provider and the supplying parties. The service provider would hereby be the organization that Vrijhoef and De Ridder (2005) call the 'demand and supply system integrator' the service provider facilitates "[...] supply chain coordination and collaboration to realise end customer outcomes by aligning incentives among supply chain actors" (Selviaridis & Wynstra, 2015, p. 3506).

According to Kazemi (2016, p. 127) the service provider is in practice responsible for translating the customer functional demand into innovative solutions, hereby aligning the different services provided by the service provider in a physical and performance-service perspective. In other words, this means that the service provider concludes a service-based contract with the customer to delivered 'real estate as a service'. And, secondly, a service-based contract with the service supplier(s) wherein the demands of the customer are translated in the performance requirements of individual Product-Service-Systems.

4.1.3. Customers

In order to receive the appropriate service, the contract-agreement between the customer and the service provider should define the correct performance indicators, terms and conditions. Next to this, the end-user is responsible to pay a periodic payment to the service provider (Kazemi, 2016).

4.2. NETWORKS

The implementation of a PSS into the real estate industry would need system optimization, new production process, new ownership relations, networks and chains. Hereby, the complexity of the aforementioned processes would increase while the need of different parties working together will increase (Prins et al., 2015; Selviaridis & Wynstra, 2015; Van den Brink, 2016). Reim et al. (2015, p. 73) mention that "[...] a single company cannot indecently create, deliver and capture PSS value" This means that the establishment of relationships by suppliers with external partners is essential in the implementation of PSSs business models.

4.2.1. Service suppliers

If the real estate sector shifts towards a Circular Economy whereby Product-Service-Systems are put in place, some pressure will be put on the collaboration between supplying parties to collaborate for a longer period (Van den Brink, 2016). This has several reasons:

- The traditional approach based on costs and revenues for the individual organization has to transform into an integrated relationship with multiple organizations around one goal (Kazemi, 2016; Van den Brink, 2016).
- Organizations are together responsible for the overall performance of their delivered Product-Service-System and become therefore mutually dependent on each other (Van Staveren, 2016).
- Parties could internalise neighbouring activities or other business. This creates operational and competitive advantages because of higher levels of productivity and efficiency by delivering better client value (Vrijhoef & De Ridder, 2005).
- Supplier could shift towards more integrated production and business formats, this by project-independent collaborations with other parties in the supply chain. This creates operational and competitive advantages because of higher levels of productivity and efficiency by delivering better client value over a longer period of time (Vrijhoef & De Ridder, 2005).

Therefore, suppliers are in a way forced to establish mutual relations with other suppliers and form consortia or joint ventures (Vrijhoef, 2011). Moreover, according to Vrijhoef and De Ridder (2005), supplying parties should shift towards more integrated production and business formats while implementing PSSs.

However, clients currently do not often have long-term relationships, this hinders long-term collaboration and the integration of supply chains in the current real estate sector. If clients have the power to shift their procurement strategies towards a situation whereby long-term relations are preferred, increased system integration would have a chance to develop itself, because the trust needed to develop this pain-and-gain sharing relationship cannot be achieved in single projects (Vrijhoef & De Ridder, 2005). Therefore the introduction of Product-Service-Systems could be seen as a change for supplier to establish these long-term relations and herewith higher levels of efficiency and productivity.

4.2.2. Service provider

According to Vrijhoef and De Ridder (2005) more integrated and longer-term supply chain arrangements are heralded to me more efficient and effective, which leads to higher levels of client value and profitability. Eventually the overall performance of the supply chain would be enhanced. Since the complexity in the real estate sector is relatively high, such a collaborate system approach is difficult to establish. Many parties are involved in both the demand and the supply side in construction, hereby many interest and views should be taken into consideration (Wamelink & van Bennekom, 2010). According to Antink et al. (2014) and Winch (2010), also the huge amount of stakeholders involved and the temporal character of the project organization in a real estate development project makes it difficult to configure and coordinate the supply chain.

In current real estate development projects, the real estate developer acts most often as a centralized supply chain coordinator because the developer is responsible for managing all aspects of a project (Miles et al., 2007). Next to this, the developer not only has to cope with different interest, but also the huge amount of stakeholders involved in a real estate development project (Antink et al., 2014). Vrijhoef & De Ridder (2005) mention that in order to achieve this, a centralized supply chain control should be established. This to synchronise different supply chain activities and align demand and supply using a 'collaborative system approach' (Vrijhoef & De Ridder, 2005). In the shift of the real estate sector towards a Circular Economy, it is in this research presumed that this centralised supply chain control will be executed by the service provider, see also Box 1.

Box 1: Underpinning of the changing role of the real estate developer in a circular real estate development project

Real estate developers as service providers

In his thesis, Van den Brink (2016) concludes that the question: 'How does this organization [the service provider, red.] relate to the current supply side stakeholder in the construction process?' remains unanswered. However, in the interviews held by Van den Brink it was said that developers and contractors see themselves as the new service provider since they are already the coordinating and assembling party within the real estate sector.

Next to this, in the different business models developed by Van den Brink (2016) it is assumed that the roles of the main-contractor and developer will disappear when a consortium is formed to realize circular real estate development projects. Currently, these parties play a central role within the real estate development process and it is highly probable that these parties do not want to forfeit their positions in the real estate sector.

As said before, the real estate developer is 'the spider in the web' between the involved actors and plays the role of client for the supplying parties (Nozeman, Fokkema, Laglas, & van Dullemen, 2008). Because of their current position in the real estate sector, they have a large impact on changes within the real-estate chain. It can be hypothesized that they will change their role into a service provider since this party will also act as a central 'spider in the web' and be responsible for the transaction between the service provider and the client / user(s) as well as the transaction between the service provider and the supplying parties. Hereby the service provider is responsible for the overall performance of the delivered services, which is comparable with the current tasks and responsibilities of a real estate developer.

In order to boost the implementation of these innovative business models, a collaborative approach between customers and suppliers is according to Reim et al. (2015) often mentioned. According to Caldwell and Settle (2011) pain-sharing and gain-sharing mechanism should be built in to contracts in order to encourage service suppliers and customers to collaborate. Herewith more innovative and integrated solutions will be established, which are in the end beneficial for both parties.

Opposite to the arrangement of legal matters in the current real estate industry, the relationship between parties should start with building a relationship, then talking about organizational issues and finally arranging the legal aspects. This creates common understanding of all demands and possible solutions, before the project is organized and fixed in a contract (De Ridder & Vrijhoef, 2007). According to De Ridder and Vrijhoef (2007) this should lead in the end to equal partnering based on mutual cooperation. Joint interests are hereby guaranteed and transaction costs should be diminished. Hereby trust building and frequent interaction with the customer is necessary (Reim et al., 2015; Selviaridis & Wynstra, 2015).

4.3. MARKETING

As mentioned before, according to Reim et al. (2015, p. 73) the marketing tactic "[...] communicates the PSS offer's value to customers, while also capturing customers 'needs and requirements". Marketing in a servitized real estate sector should be seen differently than in the current real estate sector, because in a PSS business world, there is an "[...] anticipation of market demands and trends with integrated concept design", hereby "[...] market and client information is lead into the supply chain" (Vrijhoef, 2011, p. 239). Robinson & Chan (2014) mention hereby that providing integrated solution that combine products and services could address a customer's unique requirements over the life-cycle of the project.

4.3.1. Service suppliers

As mentioned before; the delivered value by PSS is not based solely on value delivery with products, but on value delivery based on services. Hereby customers only define what services they want and supplying parties try to fit in this demand by delivering services. Hereby, the biggest challenge for supplying parties is basically reversing the supply chain. This means that the supply chain should be capable of delivering buildings proactively in the way customer goods are being delivered. These must be totally pre-designed and pre-developed, but still be flexibility to cope with changes in the demand of the customers (De Ridder & Vrijhoef, 2007). Currently these approaches mostly focus on concepts relating to modular production networks. Standardization of components within the supply chain are herein the basis of speed and flexibility, which thrives collective competitive advantage to competitors (De Ridder & Vrijhoef, 2007; Vrijhoef & De Ridder, 2005). According to Mont (2002) the entire system will hereby become more adequate in responding to changing market demand and it is herewith more likely that innovation is stimulated

Reim et al. (2015) mention that it is necessary to communicate the added value that will be delivered with PSS clearly, because customers take a solution that is totally different compared to current approaches. Also, the interaction with the customers changes. This means that a closer relationship with the customer is needed to build trust and common understanding (Reim et al., 2015).

4.3.2. Service provider

According to Van den Brink (2016) the service providers delivers a services towards the customer in the form of a constructed building. Hereby the service provider should make sure that the delivered services meet a certain performance level over a determined period of time by prescribing a total quality approach and specify proper compliance or the supply chain (Van den Brink, 2016; Vrijhoef, 2011, p. 238). De Ridder and Vrijhoef (2007) explain that hereby the demands of the customer remain on a higher aggregation level as well since the demands are based upon outcomes and / or results instead of technical requirements. By doing this, the service provider creates value which lies in the fact that usable space will be provided over time with associated services towards the customer. Mont (2002) also mentions that new network need to arise that investigate market changes and customer preferences. Hereby networks could share information that is relevant for the entire product chains or the industry sector to deliver value added services to customers. Another competitive advantage of providers will be increased by improved relationship building with customers because of "[...] increased contact and flow of information about customer's preferences" (Mont, 2002, p. 240), hereby supplying parties gain more insight in customer's preferences and could use this information in order to develop new service models.

At last, because of this new way of value delivery, the implementation of new service-based business models imply changes on the strategic, functional, financial and physical value of real estate. These values are hard to determine, and relate to their 'willingness to pay' (Azcárate-Aguerre et al., 2017; Den Heijer, 2013). Therefore the actual service fees for servitized products are hard to determine. And, secondly, the integrated design solutions with a changing balance effect the strategic decision-making of owners / users in relation to their real estate (Den Heijer, 2013).

4.3.3. Customers

Instead of being a client a procuring different products and establishing concrete specifications for products, this actor will becomes a customer with service demands and requirements. Hereby it is necessary to know "What value against what costs is delivered, but leave open the way how this is achieved" (De Ridder & Vrijhoef, 2007, p. 884). Hereby, according to (Mont, 2002):

> *"[...] The customer receives greater diversity of choices in the market, maintenance and repair services, various payment schemes and the prospect of different schemes of product use that suit them best in terms of ownership responsibilities. [...] And customers may be revealed from the responsibility for a product that stays under ownership of a producer for its entire life span" (Mont, 2002, p. 240)*

According to the servitization literature, the customer can easily change his demands and therewith changing its building. Next to this, decision making is easier and makes the building better suited to its demands compared to current practices (De Ridder & Vrijhoef, 2007). This creates value-added services for customers. However, according to Loppies (2015), the service supplier should have a certain freedom in the way he delivers services. If the performance requirements are too much detailed, the ability and/or possibility of service suppliers to deliver services it too much narrowed. This hampers the attractiveness for supplier to join a project because a supplier wants to deliver its standardized subsystems. Therefore, customers should establish frameworks for 'procurement space' (De Ridder & Vrijhoef, 2007; Loppies, 2015).

As said before, if result-oriented and use-oriented services will be applied, the customer does not necessarily receive ownership of a certain product that delivers him the service, but just leases the user rights. According to Kazemi (2016) the customer receives therefore actually value for money instead of products for money. The added value for the customer herein lays that the customer just pays for the delivered services and not for transactional costs made throughout the supply chain. According to Reim et al. (2015) there are three different business models possible when delivering services, hereby value can be categorized into value creation, value delivery and value capturing, see Table 13.

Table 13: Comparison of PSS business model (Reim et al., 2015, p.66)

	Product-oriented	Use-oriented	Result-oriented
Value creation	Provider takes responsibility for the contracted services	Provider is responsible for the usability of the product or service	Provider is responsible for delivering results
Value delivery	Provider sells and services the product sale and service (e.g., maintenance or recycling)	Provider assures the usability of the physical product along with service	Provider actually delivers result
Value capturing	Customer pays for physical product and for the performed services	Customer can make continuous payments over time (e.g. teasing)	Customer payments are based on outcome units, they pay for the result

4.4. (PRODUCT AND SERVICE) DESIGN

4.4.1. Service supplier

The supplier should – according to Van den Brink (2016) - always deliver services according to the demands of the customer during the whole project lifecycle. This means that when circumstances and/or conditions change, or the customer has new demands, the service supplier must change its delivered services towards the customer (Van den Brink, 2016). This leads to a situation whereby the supplier is incentivized to develop products that are totally pre-designed and pre-developed, but still be flexibility to cope with changes in the demand of the customers (De Ridder & Vrijhoef, 2007). In practice, this means that designers and suppliers could use three concepts to provide flexibility for customers in a Circular Economy. These concepts are described by Loppies (2015) as:

1. **Build with modular or standardized components:** Products that are easily be demountable and usable for other purposes fit in the most efficient technical material loop (Loppies, 2015; Rampersad, 2016).
2. **Design for future disassembly***:* While designing a building, the designer should focus on the development of components, materials, building techniques and connections that should focus on easy demounting of materials (Loppies, 2015). Hereby a building could be split up according to the six shearing layers of Brand (1994).
3. **Lean development:** Create maximum value for customers by diminishing affairs that do not create value for these customers (Loppies, 2015).

4.4.2. Service provider

As mentioned before, the service suppliers are mutually dependent on each other to deliver enhanced services. Therefore, the service provider "[...] should make a platform for joint decision making between the team and the suppliers, since the suppliers have the best knowledge regarding the components (and related services, red.)" (Kazemi, 2016, p. 127). In practice this means that the service provider should integrate the services delivered by the different service suppliers into an integrated building with the use of a proper design and development phase.

4.5. SUSTAINABILITY

Reim et al. (2015) defined in total five business tactics to implement PSSs on an operational level. The fifth business tactic is 'sustainability'. According to (Reim et al., 2015, p. 72) "deploying sustainability tactics can ensure PSS business models are implemented successfully and can signal a pro-active approach that will ensure sustainability driven changes meet the dual goals of economic and environmental benefits". The key aspects of sustainability are: (1) improved resource utilization and (2) extent of innovation. As will be seen at the end of this paragraph this business tactic is not taken into consideration since this tactic does not relate to 'residual choices made on an operation level'.

Already at the start of this century, Roy (2000) mentioned that product-service service could stimulate eco-designs while designing and marketing them. Back then, the expectation was established that these new forms of product-service combinations together with 'new creative solutions' could reduce environmental impacts by a factor of four or more, while remaining economically viable and acceptable to users (Roy, 2000, p. 297).

Also, according to the literature review of Selviaridis and Wynstra (2015, p. 3506) the introduction of service-based contracts while offering PSSs could "[...] provide the basis for incorporating environment and societal outcomes into supply chain operation, as environmental and energy studies demonstrate" (Selviaridis & Wynstra, 2015, p. 3506). This implies that there is in general a growing demand for increased

supply chain performance that goes beyond traditional service aspects and include sustainability, safety and innovation. According to Tukker (2015), implementing PSSs could also support the introduction of Circular Economy, hereby he states that: "Product-Service Systems (PSSs) have been heralded as one of the most effective instruments for moving society towards a resource-efficient, circular economy and creating a much needed 'resource revolution'" (Tukker, 2015, p. 76). According to Aurich et al. (2006) especially user- and product-oriented services frequently contribute to reduced environmental loads in terms of more conscious product usage as well as increased resource productivity.

In literature, several reasons are presented that lead to the improved resource utilization by the implementation of PSSs are suggested:

- **Dematerialization;** by reducing the material flows in production and consumption with the same level of performance (Mont, 2002, p. 237).
- **Efficiency improvements;** by a more intensive use or a prolonged life of capital good (Tukker, 2004).
- **Life-cycle cost optimization;** during the design phase (Tukker, 2004).
- **Efficient technology;** make a higher economy of scale possible (Tukker, 2004).
- **Closing material loops;** when being part of the underlying contract (Mont, 2002, p. 239).
- **Reducing consumption;** by using products in alternative ways (Mont, 2002, p. 239).
- **Incentive providers:** reduce resource usage by making them responsible for the environmental costs related to their handling (Mont, 2002, p. 239).

4.5.1. Discussion on business tactic 'Sustainability'

As mentioned in the former chapter is this research about the implementation of Product-Service-Systems in the real estate sector with the underlying aim to implement the Circular Economy in this sector. The list presented above indicates that the implementation of PSSs could lead to higher sustainability levels. Moreover, according to Reigado, Fernandes, Saavedra, Ometto, and Costa (2017, p. 41) "[…] the implementation of PSSs methodologies is a promising pathway to support the shift to a Circular Economy (CE)".

The scope of sustainability

Sustainability is traditionally based on concepts like eco-effectiveness and eco-efficiency. Hereby things are doing less worse, this concept aims at the reduction in resource while increasing economic and social well-being (Ghisellini, Cialani, & Ulgiati, 2016). This means diminishing the impact and reducing toxic emissions. This strategy still harms the environment and only postpones the total depletion of resources. So, it does not eliminate the root causes for unsustainable practices. Therefore sustainability is sometimes referred to as: doing things less bad, instead of doing things good.

Thus, sustainability refers to the optimization of, whereas - according to the Ellen MacArthur Foundation (2013a, p. 7) - the Circular Economy aims to "replace the 'end-of-life' concept of the linear economy with restoration, a shift towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models". Thus, the CE goes further than sustainability since enables growth by a supportive relationship with ecological, social (and economic) systems (Aminoff, Valkokari, & Kettunen, 2016). It is therefore believed by the researcher that

Ends instead of means

As mentioned in Chapter 1 are the business tactics used to operationalize this research since they apply to operational choices made by organizations. These tactics function as internal management measures by the involved organizations and function as means in order to come to sustainability and/or Circular Economy. Sustainability is therefore – in the perspective of the researcher – an end-state instead of a mean in order to reach sustainability. Moreover, the four other business tactics are – in the perception of the researcher already sufficient to operationalize the implementation of said PSSs.

The researcher has based on these three reasons decided to leave out the business tactic of sustainability. Sustainability relates in this research to Circular Economy, which is operationalized by a proper implementation of the other four business tactics. The aspects that would in first instance be part of the sustainability business tactic (i.e. (1) improved resource utilization and (2) extent of innovation) are added to the business tactic of Design. This to explicitly ensure the 'the closing of loops' will be ensured (and herewith the CE) when PSSs are implemented. These aspects are added to the concept of Design since they apply to the physical characteristics of PSS, whereas the tactics Network, Contract and Marketing are more organizational aspects.

4.6. CONCLUSION

Table 14: Objective, question and methodology of Part 2

Objective:	Gain insight in the existing theories and existing knowledge
Question:	**What is known in existing theories about the implementation of Product-Service-Systems in real estate development projects?**
Technique:	Literature review

Many operational changes are mentioned in Table 15 that should lead to the incorporation of PSSs on an operational level according, based on the studied literature. Although a range of literature resources have been studied from different fields, there is - in the perspective of the author – not much empirical evidence available that supports the theory that PSSs will lead to the introduction of circular economic business principles. A reason for this is provided by Tukker (2015, p. 88), he states that "The most important contribution of the post-2006 literature is probably the strong attention to what PSS development means for a company's structure, culture, capabilities and management". Hereby most literature focused on changing the business models of companies and not on the implementation of circular economic business principles specifically.

Table 15: Literature table

Business tactic	Main sources	Service suppliers	Service provider	Customers
Contracts	(De Ridder & Vrijhoef, 2007) (Kazemi, 2016) (Mont, 2002) (Selviaridis & Wynstra, 2015) (Van den Brink, 2016)	- Extended responsibilities - Vertical integration - Continuous (i.e. lifecycle) value delivery - Responsible for integrated service delivery - Reduction of transaction costs - Risk increase - New business opportunities - From price-based to performance-based - Changing demands during exploitation	- Demand and supply integration - Deliver services to customer - Translate demands into performances - Purchase services from suppliers - Collaborative approach - Trust building - No investments during development needed	- Determine performance requirements - Periodic payments to service provider
Networks	(Antink et al., 2014) (Azcárate-Aguerre et al., 2017) (Miles et al., 2007) (Reim et al., 2015) (Van den Brink, 2016) (Vrijhoef & De Ridder, 2005) (Vrijhoef, 2011)	- Collaborative responsibility for service delivery - Internalization of neighbouring activities - Forming of consortia / joint ventures - Project-independent collaborations	- Long-term supply chain arrangements - Manage the real estate development process - Stakeholder management - Integration of delivered services - Trust building	n/a: The studied existing theories did not focus upon the role of the Customer in a PSS-delivery network.
Marketing	(De Ridder & Vrijhoef, 2007) (Miles et al., 2007) (Mont, 2002) (Reim et al., 2015) (Selviaridis & Wynstra, 2015)	- Closer relationship with customer / provider - Communication of added value	- Take over tasks from customer - Analyse market demands - Analyse customer preferences - New valuation approaches - Total quality approach - Relationship building with customers	- Determination of demanded services - Changing of demands - Procurement space - Value for money
(Product and service) Design	(De Ridder & Vrijhoef, 2007) (Loppies, 2015) (Mont, 2002) (Reim et al., 2015)	- Usage of modular or standardized components - Design for future disassembly - User-cantered supply chain - Flexible demands	- Platform for joint decision-making	n/a: The concept of Design focused on the physical product characteristics related to the offering of PSSs in real estate development projects.

PART 3
PRACTICES

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5. Case studies

Case studies are used in this research to create empirical knowledge. Since this research involves a qualitative research design, an information-oriented selection procedure has been found most appropriate to sample appropriate case studies (Yin, 2014). Hereby the expected information content formed the basis of case selection (Flyvbjerg, 2006). The objective of conducting case studies is to collect relevant empirical data. In order to ensure the proper date would have been gained, a criterion sampling approach was used. With this method case studies were selected that meet certain criteria (Bryman, 2012, p. 419).

Selection procedure

The used selection criteria were: (1) a case study is a project of OVG Real Estate, (2) the real estate development project should be in the development, realisation or operational phase, (3) within the real estate development project, some elements of a Product-Service-System should be applied, (4) this product should be part of the three 'core' layers of a building defined by Brand (1994), (5) the supplier or provider of the leased product remains responsible for the delivered product during the operational phase of the project and (6) the chosen case studies should cover together the four business tactics. Based on this selection criteria three case studies were selected, being (1) Triodos Bank, (2) Basisweg and (3) The Boutique Office.

Data collection

These three cases studies are – as mentioned above – projects of OVG Real Estate, the researcher conducted a graduation internship during the research process. This internship allows the research to directly access multiple sources for conducting case studies. The next sources of evidence, as described by Yin (2014), will therefore be used while conducting case study research: (1) Participant observation, (2) Semi-structured interviews and (3) Documentation. The unit of analyses of these case studies is the real estate development process of servitized real estate development projects.

The complete case study protocol is included in Appendix E: Case study protocol

Cross-sectional case study design

In order to create actual empirical data from these case studies, a cross-sectional case study design has been applied after the case studies were described (Bryman, 2012; Yin, 2014). This cross-sectional case study design fits in the process of theory building as described by Eisenhardt (1989). The used analyses techniques for this cross-sectional case study design are the in-case analyses and the cross-case analysis (Eisenhardt, 1989), See also Appendix C: Research techniques.

The in-case analyses has been made first, the aim of this analysis is gaining data from the case studies. Hereby the specific features of the case study in relation to the implementation of PSSs on an operational level are analysed (Eisenhardt, 1989). These analyses are presented in the first paragraph of this chapter, whereby the different case studies are discussed separately. Each in-case analysis starts with a discussion about the main obstacles / barriers that should be overcome in the specific case study. The actual in-case analyses is made hereafter, whereby the four business tactics of Reim et al. (2015) are used to structure the analyses. The in-case analysis of each case study ends with a reflection on the goals obtained by the involved actors in the case studies and a table with the outcomes of the in-case analysis (see Table 16, Table 17 and Table 18).

A cross-case analysis was made after the in-case analyses. The cross-case analyses aims at identifying similarities and differences between the case studies, hereby a pattern matching technique is used (Eisenhardt, 1989; Yin, 2014).

Readers' guide

The three selected case studies are discussed separately in this chapter. Each case study description starts with an overall introduction of the project, which provides background information about the project context and the introduction of a service component in the building. This is followed by the presentation of the in-case analysis of each case study and a reflection upon the determined objectives of the case study. The cross-case analysis is incorporated in the fourth paragraph of this chapter. The analysis is categorized using the business tactics and the different stakeholders. The outcomes of this cross-case analyses (which also function as the empirical analyses) are tabulated and presented in Table 19.

5.1. TRIODOS BANK – FAÇADE AS A SERVICE

Figure 8: Artist Impression exterior of the new office of Triodos Bank (source: OVG Real Estate)

5.1.1. Introduction

Triodos Bank is a financial institution that provides finance for companies, institutions and projects that create added value for society, environment and/or culture (Triodos Bank, n.d.). At the start of the project, in November 2010, the offices of Triodos Bank are dispersed in Zeist, a mid-scale city in the province of Utrecht. Since Triodos is growing, the bank decided to build a new office and merge 2 out of 3 locations together in this new building, which will be around 12.500m^2 (Draaijer & Partners, 2012).

JOIN Ontwikkeling (a joint venture between OVG Real Estate and Triodos Bank) will develop this building on domain 'De Reehorst' in Zeist. The building is designed based upon very sustainable / Cradle to Cradle building principles. The design hereby aims for the connection with nature and a small ecological footprint on De Reehorst by closing loops in several ways.

During the design and development phase, which lasted from 2012 to 2016, new visions in society about sustainability arose, which lead to the incorporation of circular ambitions at the end of the design phase. These ambitions consisted of three main 'building blocks': (1) Usage of sustainable building materials, (2) Closing of loops and (3) Ownership remains with the supplier. Already a lot of examples are present in the real estate sector about the implementation of circular business models within the fit-out and furniture of buildings. Therefore, the decision was made to try circular business models on bigger and more elementary parts of the building to stimulate innovation. Which resulted in a decision to try circular business models on the façade of the building (C. Berning, Personal communication, September 20, 2017).

The first idea was to organizationally arrange this with the use of a sale-and-leaseback structure, whereby the ownership of the façade would be placed within an SPV. The SPV would be owned by a joint venture consisting of Triodos Bank and the façade supplier, this would create a result-oriented service model. However, it turned out that it is not possible to split the façade from the rest of the building from a juridical perspective (AKD, 2017)

Therefore another strategy had to be found how to reach the before defined objectives and aims. The original aims of the 'circular façade'-project were to place the responsibility of maintaining, repairing, monitoring and take-back of the façade with the original façade. In the end, it turned out that these goals could also be obtained with the use of so-called obligatory provisions *(obligatoire voorzieningen)*. This is basically an extra contract between Triodos Bank and the façade supplier, arranging the maintenance, operation and take-back of the façade, this structure is presented in Figure 9.

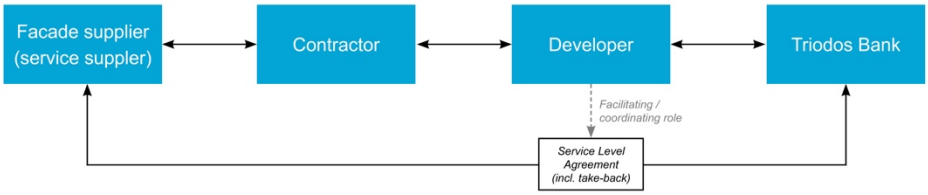

Figure 9: Inter-organizational system circular facade Triodos Bank (own ill.)

More information about this case study can be found in Appendix F: Case study reports

5.1.2. In-case analysis

Obstacles

The Program of Requirements (PoR) for this project was already established in 2012. Back then, the concept of Circular Economy was not a relevant topic within the real estate sector. Although this PoR based on very sustainable practices focusing on 'closing of loops' related to many subjects in the redevelopment of the estate, it was very difficult to incorporate circular business models in the project, because:

- The design was already made
- Contracts were already fixed between JOIN and the contractor
- The contractor had already purchasing agreements with material and product suppliers

This created little possibilities to implement circular business models in the project and limited the amount of interventions that could be taken to come to a more optimal structure for all involved parties in terms of agreements and product design.

A solution thought to be find in using a sale-and-leaseback structure at the date of project delivery. Hereby the ownership of the façade would be split from the rest of the building. However, superficies cannot be placed on the façade of the building because a superficies will split a building up in two 'work' that should be independently exploitable. However, a building without a façade is not possible. This obstructed the use of a result- & use-oriented service contract model.

Service supplier

Literature suggest that in order to implement PSSs in practice, in some occasions the service supplier should remain ownership of their delivered product (Reim et al., 2015). However, as could be seen in case of the Triodos project, this would lead to an unfavorable decision for the service supplier since it is difficult for this party to keep products on its balance sheet. And, secondly, if the service supplier would remain ownership of it delivered product, then the service supplier would only handle in its own interest. Focusing on optimizing the residual value of the product instead of value delivery towards the customer. One of the main point of the circular façade project is that the service supplier within the project would receive more responsibilities and tasks compared to a more traditional approach. This increases the risk of this actor. This increased amount of risk formed one of the main obstacles for the service supplier in this project and therewith for the complete case.

At last, the service supplier of the project mentioned that one of the most important objectives to participate in this case was to learn from for future project. Hereby targeting on the development of a new business model for its company. The service supplier would hereby only participate in the project if the outcome would lead to enough long-term knowledge creation which could be used to implement in its own business. If this wouldn't be the case, then the service supplier would not be willing to participate in the project. Therefore, another obstacle was to find a solution that would create enough business potential for the service supplier so that this actor would be willing to participate.

Service provider

In the Triodos project, the service provider (i.e. real estate developer) had the obligation to incorporate circular business models into the Triodos project. Besides the already mentioned late introduction of these business models, the service provider was hindered in this by the amount of supplier that are working 'circular'. This limited the possibilities for the type of products on which circular business model could be implemented. And, the service provider bounded up with the supplier chosen by the contractor. So, a traditional real estate development process and mindset had to be reconfigured into a circular one.

This traditional mindset is herewith an obstacle in the implementation of circular business models in this case study on its own. Although the project is compared to other project very sustainable on itself, the way contracts are designed and the development process is run through still leads to short term thinking in terms of quality delivery and adversarial relations. This hampered the service provider in its attempt to redesign several parts of the projects so they will fit in a circular business model.

Customer

The customer is in this project also the client of the project, investing in its own new office. If the ownership would have been split from the rest of its building or another organization would become totally responsible for the façade, this would imply that the customer would not be 'in control' anymore of the façade of its new high-quality investment. Therefore the customer demanded to keep a certain kind of control over the façade.

Contracts

The found contractual solution to overcome most barriers is found in the use of a – rather simple – product-oriented service contract. Hereby an 'obligatory provision' between the client and the service supplier is added to the existing contractual agreements. These provisions relate to maintenance, repair, monitoring and circular take-back of the materials by the service supplier. The service supplier found the most heavy responsibility in the take-back of the façade with the obligation to give the products in the façade a second life. The risk related to these responsibilities are diminished by using the internal yield generated by a more efficient and effective exploitation of the façade to pre-finance the second life of the façade ánd pre-finance a new façade after the first contractual period.

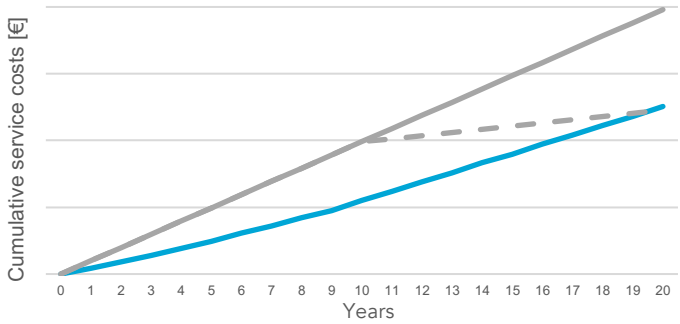

Figure 10: Cumulative service costs facade Triodos Bank (JOIN, 2017).

This internal yield will be generated in a separate entity that will be owned by the service supplier and the customer. In figure 10, the blue line indicates the cumulative costs for maintenance when applying service-based contracting, the grey line indicates the cumulative costs for according to the MJOP *(meerjaren onderhoudsplanning, multiple year maintenance plan)*, and the dotted grey line indicated the cumulative maintenance costs according to an MJOP-contract over 10 years, whereby after 10 years only maintenance in terms of cleaning is executed.

> *"Als […] de leverancier (red.) niet het goedkoopste maar het beste glas gebruikt en niet de goedkoopste maar de beste schoonmaakmiddelen gebruikt en de juiste frequentie hanteert, dan kost dit nu wat meer. Maar, over 20 jaar kunnen we dan wel wat met die materialen" (M. Bierman, personal communication, October 05, 2017)*

Also, the contract concerning the obligatory provision will become quite open and flexible, hereby the aim is to not put too much in detail which obligations parties have since this is still quite uncertain. By doing this, the interests of both parties will be assured and future decisions concerning the façade could be made more easily and based upon common interests.

> *Wat we nu bij Triodos doen is niet zeggen: 'Jij moet garantie geven en dit, dit en dit doen'. Maar zegen: 'Hoe gaan we samen zo ideaal mogelijk om met een levensduur van een gevel van zo'n 10, 20 jaar met een bepaald ambitieniveau?" N. Eekhout (personal communication, September 13, 2017)*

One of the general obstacles in the implementation of PSSs in the real estate sector is that not a lot of parties are working 'circular' and have still a mindset relating to more linear approaches. In order to change this and encourage supplying parties to work circular, the service provider (i.e. real estate developers) in this case tried to find a structure whereby circularity is connected with the possible addition of new business models for suppliers. Hereby not only transferring responsibilities forward in the supply chain, but proactively stimulating the creation of new business models for the supplying parties based on shared responsibilities and common gains. Only then will be supplying parties accept these new kinds of business models.

Network

As mentioned in the case study description, at the start of the project much attention was paid to the creation of a common understanding of the main interests and visions of the involved parties in the project. This create some trust between the involved parties since the outcome of this strategy was that these parties obtained the same mindset and strived for the same goals. In this case: ensuring circularity and generate knowledge for future PSS projects. This assured also that the involved parties had the same bottom-up commitment to eventually participate in the project, if this wouldn't have been the case it could have been questioned if the parties would have been willing to work with each other.

> *"Als je wat nieuws wil proberen en wil innoveren heb je lef en vertrouwen nodig in de partijen waarmee je het samen doet. Je weet één ding zeker: over een paar jaar ziet alles er anders uit. Als je aan tafel zit met partijen die je recht in de ogen kan kijken en kan zeggen: 'Wij streven hetzelfde doel na en proberen het samen succesvol te maken', dan is het goed" M. Bierman (Personal communication, October 05, 2017)*

As mentioned before, one of the most important things in this case is the increasing amount of risks and responsibilities for the service supplier. The meetings at the start of the project have led towards a more easy acceptance of this by the service supplier.

> *"Leveranciers [...] hebben moeite met prestatiecontracten waarin je omschrijft hoe ze moeten omgaan met het terugnemen van [...] een product (red.), omdat ze het gevoel hebben dat de bal heel erg bij hen ligt end at het minder een gezamenlijke effort is" C. Berning (Personal communication, September 20, 2017).*

Moreover, the intention that contracts will be designed in such a way that in future will be decided how to improve, adjust or replace the façade in cooperation with the involved stakeholders also contributed to the willingness of the supplier to accept his new role. At last, the goal of the involved organizations was to generate knowledge to use for future servitized real estate development projects for internal or external parties. Therefore the service suppliers explicitly mentioned that he wants to work as much open-source as possible. Hereby the service supplier wants to share as much information open-source as possible. Hereby providing insight in the working method towards external parties, but also to increase the chances to sell the façade to an external party after the contract has determined.

Marketing

Because both the service supplier as the customer will be involved in making decisions about the façade, both companies could tougher determine which maintenance and cleaning is needed at which moment. This leads in theory to less maintenance and operation costs since maintenance works are now based upon what is actually needed to be done and not what is determined in contracts in order to keep guarantees over provided materials.
Secondly, the amount of costs could be reduced by the integration of monitoring, cleaning and small maintenance of the façade towards one party. Currently these tasks are divided between different companies.

> *"Dit gaat niet alleen om geld te verdienen voor Triodos. Het gaat om een intrinsieke motivatie van jezelf om de wereld te veranderen. Anders waren we er echt al eerder mee opgehouden" N. Eekhout (personal communication, September 13, 2017).*

Another marketing value for the customer ánd the service supplier is that it will become easier to upgrade the overall performance of the façade or implement new innovative techniques, because customer and supplier are still in contact with each other and the internal yield could be used to finance the needed investments to do this.

(Product and service) Design

When it became apparent that the supplier would remain responsible for the façade during the in-use phase of the project, this actor immediately proposed to (1) use better quality of glazing and to (2) make the design more flexible and modular. The latter was not possible anymore because the development phase was in its final stages.

5.1.3. Reflection

With the use of the extra obligatory provision, the predetermined goals to add a circular business model onto the façade of the new Triodos building would be established while the predetermined obstacles and criteria would be overcome / met.

However, the used strategy is actually quite ineffective. If the incorporation of circular business models would have been a topic earlier in the development of the project, the design of the building and especially the façade would probably would have been more modular and flexible. Although the obstacle that superficies cannot be placed on facades would still have been in place, the potential flexibility in service provision would have been higher and more time could have been spent in finding a solution how to create added value for the involved parties.

At last, is should also be taken into account what is actually the added value of a circular business model. In this project, circular material take-back has already been incorporated in the Triodos project by including closing of loops on the complete Reehorst domain already in the Program of Requirements in the initiative phase of the project (Draaijer & Partners, 2012). Triodos will be the end-user and owner of the building and is an organization of which can be expected that it will handle the disposition of its real estate with care. Therefore, would the chance that building products and materials are brought back into a closed material loop by the client already be substantial.

Therefore, the addition of the circular business model on the façade of the project seems to have - in the perspective of the researcher – the most added value in terms of knowledge creation for involved parties to learn from for future projects whereby PSSs will be incorporated and not on incorporating circularity specifically. Which could be valuable in itself as well. However, a lot more lessons could have been learned from this project if JOIN would have focussed from the start on the incorporation of circular business models on other parts of the building as well. This could have increased the implementation of circular economic business models a lot and could have led to more knowledge creation.

Table 16: Findings in-case analyses Case 1: Triodos Bank

	Service supplier	Service provider	Customer
Barriers	- Transfer of ownership needed because of balance sheet accounting - Ownership of façade can't be split from rest of the building - Only willing to participate when model is replicable - Increasing amount of risk and responsibilities	- Existing contractual arrangements - Not enough parties to work circular with - Traditional mindset in the real estate sector	- Building owner should be façade owner - Less control over façade when not owner
Contracts	- Obligatory provision to extend responsibilities - Internal yield to pre-finance future expenses - Organizational stretch - New business opportunity	- Open form of contracting, allowing future decision making. - Incentive found by creating future business opportunity for supplier - Reward behaviour that increases material value and service delivery	- Take part in SPV / shared entity
Networks	- Open-source working - Creation of trust	- Facilitating role in a 'simple' B2C situation - Focus on relationship building and the creation of a common understanding	- Partnership that aims at finding proper ways to innovate and implement new business models
Marketing	- Façade performance monitoring - Efficient maintenance and cleaning - Shared decision making - Possibility to implement innovations / increase performance	n/a: The service provider in this case had only a facilitating role. The added value of the façade as a service project was communicated directly between supplier and customer	- Strive towards organizational goals i.r.t. sustainability - Shared decision making - Increase performance level in the future - Decrease TCO - Predictive and stable service fees
(Product and service) Design	- Improved product quality - Attempt to make the design more flexible	Lessons: - Incorporate PSS / CE as early as possible - Leading in development process, so leading in PSS / CE initiatives	n/a: No operational aspects were found relating to the 'Design' concept in this case that applied to the customer

5.2. BASISWEG – COMFORT & ENERGY AS A SERVICE

Figure 11: Artist Impression exterior of project Basisweg after renovation (source: OVG Real Estate)

5.2.1. Introduction

The building of the Basisweg project has originally been built in 1974 and is designed by Oyevaar, Stolle & Van Gool architecten and was one of the first buildings in the Amsterdam Sloterdijk area. The design of the building is characterized by the repetition of office-units that together form a circle. This design creates big free floor fields that was – and is still – really innovative in the office market. A real estate developer (i.e. the graduation company) bought the building in order to redevelop it.

During an early stage of the design phase, the idea arose between the real estate developer and an energy company to servitise the complete climate installation. These two parties had already experience with the servitization of a heat/cold generation system *(WKO-systeem)* and wanted to innovate further. Hereby the sustainable 'energy generation assets' (solar panels, heat/cold-generation system) will be servitized using a result-oriented service contract and the 'release system' (climate ceilings, piping etc.) will become servitized with the use of a product-oriented service contract. Hereby the service provided towards the real estate developer / service provider relates not to the acclimatization of the office spaces, but to the availability of the HVAC installation.

More information about this case study can be found in Appendix F: Case study reports.

5.2.2. In-case analysis

Obstacles

The existing structure forms some challenges to implement these PSS business models because:

- The existing building has a unique and quite specific design, which limits the possibilities in the type of HVAC system to be applied
- The existing building is quite large, the implementation of these innovative business models is therefore quite risky.

Service supplier

The involved supplying party in this project has already experience with the servitization of climate installations. Examples of this are the servitization of heat/cold generation (WKO) system and servitization of solar panels. However, in this project several different 'sub-systems' are combined into one project. Therefore one of the obstacles for the service supplier is to integrate a huge task package consisting of many sub-projects and expertises into one service delivery. As discussed in Section 4.2, the service supplier will become severally liable for the delivered service and the related performance of this HVAC system. The risk profile for this project for this actor is rather high because this model is rather new, the project is quite huge and this actor will be liable for its handling.

Service provider

OVG intends to sell the building after completion, this means that the supplying parties make agreements with OVG about the servitization of the HVAC system, whereby probably the ownership of this installation is split from the rest of the building. This implies that the parties have to be sure that the made agreements would also be valid after a possible sale of the building and that a potential purchaser of the building will accept that a new kind of ownership model is applicable for the HVAC system. Secondly, if the supplying parties become responsible for the HVAC system during exploitation of the building their interest in the project will change and will presumably increase. Therefore OVG has to make sure that the way the building will be developed covers the interests of the involved parties and find a proper strategy to 'steer' the different actors during the development process.

Customer

During the interview held with the first main tenant of the building it became clear that the objectives relating to circularity of this organization are rather different than those of the service provider and the service suppliers. While the latter two parties aim to introduce new type of business models while working circular, the aim of the customer just focusses on taking their Corporate Social Responsibility and handling used materials in a more conscious manner. This creates a different perception of the Circular Economy between the involved parties.

Contracts

In order to servitize the HVAC system and deliver 'Comfort & Energy as a Service', the tasks and responsibilities relating to the design, realization, maintenance, monitoring, exploitation and circular take-back of the system are transferred towards the service supplier. The underlying contract is hereby based upon the fixed fee per square meter per year and based upon the availability of the system. Hereby the service supplier becomes severally liable *(hoofdelijk aansprakelijk)* for the entire HVAC system and its performance. This reduces the risk level for the service provider, but increases the risk level for the service supplier. In order to split the ownership of the installation from the rest of the building, superficies *(opstalrechten)* will be used. Hereby the HVAC installations will be seen as a separate work and the building would still be seen as an individual functioning system.

Network

As mentioned before, the service supplier is the main contractual party and becomes responsible for the delivery of the HVAC system as a service. Because the risk profile is quite high and the task package is extensive, the service supplier actually consists of several parties that formed a joint venture. The individual parties in this joint venture add up to each other, hereby they can:

- Handle the wide range of tasks
- Use their own expertise
- Share risk and profit
- Deliver an integrated product
- Finance the delivered products

In order to let these joint ventures function well, the involved organizations should add up to each other and do not have much 'organizational overlap'. This is, in this case accomplished by the combination of an installation advisor and an energy company, with the probable addition of an installation installer. The selection of these companies could be rather difficult. In order to create an appropriate synergy, the companies that have to collaborate with each other should have the same mindset, while on the other hand it is in the interest of the service provider to select organizations which also fit in their vision. Therefore the use of long-term partnerships that could be used in several projects is advocated.

Table 17: Division of tasks and responsibilities within an CEaaS-SPV (According to Feuth, personal communication, September 22, 2017; Glashorst et al., 2017, p.21)

Advisor	Installer / sub-contractor	Energy company
Providing advice for design	Realisation	Concept development
Supervision during realisation	Maintenance	Energy provision
Alterations (inregeling)	Disassembly	Exploitation / monitoring
Monitoring		Financing*

**In case the SPV / Energy company remains owner of parts of the installation*

The joint venture should on the one hand be responsible for the delivered materials and related services, but on the other hand not the owner of the products since this causes problems with balance sheet accounting and might provide the wrong incentive structures. Therefore an SPV is used in this case that would be the owner of the products. Hereby the products will be financed by an external financier / bank, whereby the SPV will act as a fund.

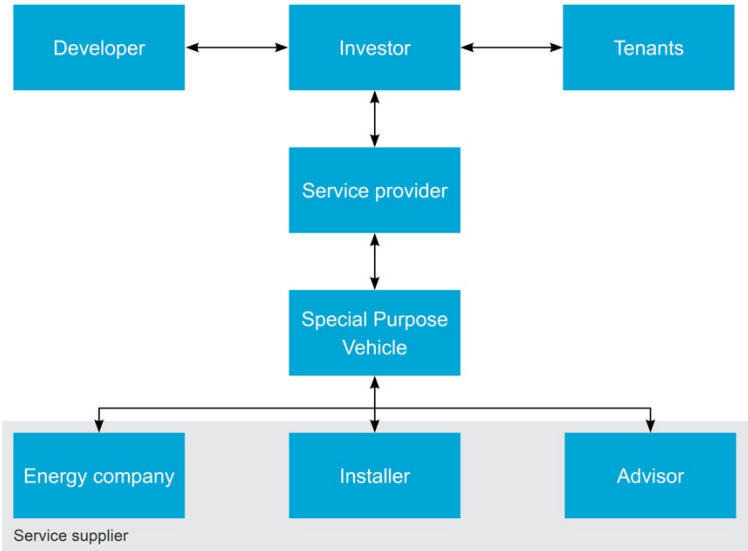

Figure 12: Inter-organizational system Comfort & Energy as a Service Basisweg (According to Feuth, personal communication, September 20, 2017; Glashorst et al., 2017, p.21)

This approach also covers the risk in case a party goes bankrupt. Since the system is split from the rest of the building and the value delivery towards the building owner is based upon the performance of the delivered service, the asset of this project is the contract and not the product that make the service delivery possible. The SPV will therefore handle the consequences of one of the parties in the joint venture stepping out of going bankrupt, since the underlying contract and task package could be bought separately

Another point of the use of this SPV is that risk and profit should be made within this collaboration structure. In a more traditional approach, different parties calculate their own risk and profit, which leads to huge transaction costs in projects. If this risk and profit is kept in first instance within the SPV, then the amount of transaction costs will decrease, and the joint venture will become more compatible compared to other approaches in the real estate sector.

At last, during the development process, there was a lot of interaction between the supplying parties and the service provider. Hereby both parties worked with 'open books' in order to create trust and common understanding of each other's perspectives and interests. This created a more integrated approach and the involved parties believed this method would stimulate this innovative test-project.

Marketing

The most marketing value is created for the service provider, because this party:

- Does not need to invest in (most parts) of the HVAC system
- Receives a guaranteed performance
- Is secured of stable and predictive service fees

The discussed structure could provide more services besides the 'standard' delivery of the HVAC system as a service. For example, the data derived from the HVAC system could be used in the future to optimize the exploitation of the building. In order to provide insight in the delivered performance, the service supplier could report to the service provider about the own performance of the installations. This creates trust from both sides and could eventually lead to a further optimization of the exploitation of the system and the building.

The motivation of the energy company to step into this project is that according to J. Feuth (personal communication, September 22, 2017) "[...] energy will become very cheap. On top of that, it's already a commodity. [...] We know we are the Kodak and should therefore innovate". Therefore, the energy company is searching for new partnerships and new business models.

> *"Essentie voor dit gebeuren […] is dat wij denken dat energie heel goedkoop gaat worden en his is nu al een commodity. Wij weten dat wij de Kodak zijn en zijn daarom op zoek naar nieuwe modellen" J. Feuth (personal communication, September 22, 2017).*

As can be seen in Table 18, the implementation of PSS does not affect the customer on operational basis compared to a more traditional approach, because the customer in this case study is a sub-tenant of the building owner and already received 'guaranteed performance' (i.e. office floors of a certain quality) for 'predictive and stable service fees (i.e. a fixed rent).

(Product and Service) Design

Already in the preliminary design phase of the project, the idea came to mind of the service provider to incorporate PSS business models for the HVAC installation. This provided the actors the possibility to incorporate an 'ideal' contract structure for the HVAC installation. And, since the advisors for the HVAC installations were already involved early, the quality of the design of these installations increased.Moreover, the aim towards the more technical design of the project is to design the HVAC installations flexible and demountable to allow future upgrades and take-back.

The early involvement of the supplying parties affected the design process. Since these parties were involved earlier, the role of the architect was more to integrate the different design solutions into a coherent and integrated building. Hereby a balance was sought between optimizing the design of for example the HVAC system while the overall architectural performance of the building should be kept in mind as well. Hereby the role of the real estate developer (i.e. service provider) was to coordinate this in a proper way as well.

> *"Vroeger bepaalde de projectontwikkelaar hoe bijvoorbeeld de E-installaties eruit moesten zien in ontwerp en budget. Van daaruit ging je bezuinigen op allerlei onderdelen om de investering te drukken. In het ideale model heb je de service supplier (red.) die bepaalt hoe het budget over de gehele life-cycle eruitziet op basis van de installaties die hij zelf heeft ontworpen. Dit levert een discussie over TCO op en daarmee ontstaat een heel ander spel" J. Feuth (personal communication, September 22, 2017)*

The probability for take-back of materials will further be increased by the creation of a living material passport by the service provider. In order to establish this, the service provider demands from parties to do everything in BIM to create insight in the used material and create a building passport. Goals of these building passports is to create a material databank, which could be used to provide insight for other parties in the used materials in a building. Hereby, a platform should connect the information owned by different actors to form a network and a marketplace. An example of such a platform is the recently launched online platform Madaster (Rooijers, 2017).

Box 2: What is Madaster?

What is Madaster?

Madaster is an online platform from which material passports of buildings can be downloaded.

The underlying goal of Madaster is to eliminate waste of materials by giving them an identity. This by coupling of material identity to location in a material passport. This material passport provides insight in the materials used in a building, the amount, the quality and the possible financial and circular value of it. Madaster is an independent platform that is freely accessible 'for everyone'. Hereby, Madaster tries to provide an ecosystem of initiatives and innovation "that facilitates the transition to a Circular Economy"

5.2.3. Reflection

At the moment of writing, no clear arrangements and agreements are made between the service supplier(s) and the service provider because the involved parties are in the process of figuring out which strategy would work best to servitise these HVAC systems. This is for the involved parties rather difficult since the amount of uncertainties and criteria on which can be steered upon is quite big. Therefore it is still not known whether this approach would eventually be applied in the project or the step towards the introduction of PSSs on the climate installations is still too big. Therefore it is difficult to indicate whether all the mentioned obstacles and barriers are overcome. However, the described structure would already overcome the more general barriers relating to the servitization of the HVAC system and not the more project-specific ones. For example:

- The Network-approach diminishes the high risk for the involved parties and service provider
- The huge amount of tasks and responsibilities is handled by division of them
- The interest of the service suppliers in terms of design are handled by a new design approach
- The products are placed within an SPV, whereby the ownership is handled well.

The interests of the customer are a bit kept out of sight in this analyses and in this case study in general, because the most added value in terms of Marketing is created between the service supplier(s) and the service provider. The interests in terms of circularity mostly refer to resource handling, this is also a major part of this case study, but the focus mostly lies on the creation of a new business model and inter-organizational structure. On the other hand, the interests of the customer lie without the scope of this research and therewith the scope of this case study.

Table 18: Findings in-case analyses Case 2: Basisweg

	Service supplier	Service provider	Customer
Obstacles	- Huge task package - Voluminous project - High risk profile - Contract including different sub-project and expertises	- Existing building structure - OVG will sell the building after renovation - Interest of service suppliers increase	- Different perception of circularity
Contracts	- Responsible for life-cycle (from design to take-back) of the HVAC system - 'DB(F)MO'-contract with provider - Severally liable for duties - Superficies used to split ownership - Underlying asset is the contract, not the product	- SLA with service suppliers. - Result-oriented service contract - Contract based upon availability, fixed fee per square meter per year	n/a: The interest relating to Circular Economy relates to the addition of value towards materials or prevent the extraction of material value during the lifecycle of it. The focus does hereby not lie on the implementation of PSSs. And, the influence of the customer on the overall development process is rather small. Therefore is the influence of the customer on an operational level nihil.
Networks	- SPV as service supplier - Joint responsibilities within the SPV - Partnering to develop innovative business models - Actors / parties should add up to each other in an SPV - Decrease transaction costs by partnering - SPV as an ESCO / fund - Risk and profit sharing in SPV - Risk reduction related to bankruptcy by forming of SPVs - Clear inter-SPV agreements arranging organizational, juridical and financial aspects	- Co-creation; cooperation to find a proper solution	
Marketing	- Monitoring of own performance - Reports to service provider - Increased performance by partnering with actors with the same (CE / service) mindset	- Investment reduction - Task reduction - Guaranteed performance - Predictive and stable fees (pay per use) - Data from suppliers to increase overall building performance	
(Product and service) Design	- Early involvement in design phase to increase performance - Flexible and demountable system to allow upgrades and take-back	- Early involvement of advisors and suppliers in relation to the HVAC - Living material passport	

5.3. THE BOUTIQUE OFFICE – DEVELOPER AS SERVICE PROVIDER

Figure 13: Artist Impression exterior of The Boutique Office (source: OVG Real Estate)

5.3.1. Introduction

The Boutique Office is an existing former post centre in the Amsterdam Zuidas area, the building was built in 1992 and bought by a real estate developer (i.e. the graduation company) in order to redevelop it. During the development period, which lasted from 2015 until 2017, some strategic and organizational changes were pursued within OVG because of the implementation of a new business strategy. Since the development of this new strategy happened nearly parallel to the development of The Boutique Office, already a lot of ingredients of this new strategy were implemented in the development of The Boutique. Therefore, the Boutique Office can be seen as the 'launching project' for the real estate developer's strategy. Within this new strategy no casco office square meters will be leased out, but actually office space and working places.. This connects to the users demands, which actually look for places to work instead of square meters to rent.

More information about this case study can be found in Appendix F: Case study reports.

5.3.2. In-case analysis

Obstacles

The main idea behind the case of The Boutique Office is that the real estate developer takes its responsibility over the developed building and start to exploit the building which this actor has (re)developed himself. Hereby the developer phases the obstacle that if he wants to exploit the building and simultaneously still wants to develop other buildings, he will end up in a bad equity position. Because the equity which is needed for the (re)development of other projects will be stuck in the building which he exploits at that moment.

One of the underlying aims is to provide more services towards the users of the building during the exploitation phase. A possibility to do this is by using external organizations to deliver services through the service provider towards the customer (i.e. end-user). Hereby the responsibility to deliver a kind of service towards a customer is back-to-back transferred towards an external service supplier. This creates the risk that the service provider could not fulfil his duties to deliver agreed upon services towards the customer because of a possible underperformance of a service supplier.

Contracts

The service provider concluded a kind of sale-and-leaseback transaction with an international investor in order to release equity and scale up the business model. Equity will be released by the sale of the building and the lease of the building will be financed by subleasing the building towards sub-tenants.

The sale-and-leaseback of the building is based upon a triple net lease agreement. By doing this, the most essential parts that 'form' a building are transferred towards the investor and the most essential parts for the building exploitation (fit-out etc.) remain under the responsibility of the service provider. This created opportunities for the service provider to take as much responsibility and freedom in exploitation, while this actor would still be able to not remain ownership of the building.

> *"Wij zitten tussen belegger en gebruiker in en komen daarmee in een regierol terecht waarbij we gebruik kunnen maken van operations door het implementeren van smart technologieën en het beheer en onderhoud slimmer uit kunnen voeren" T. Ummels (personal communication, October 02, 2017)*

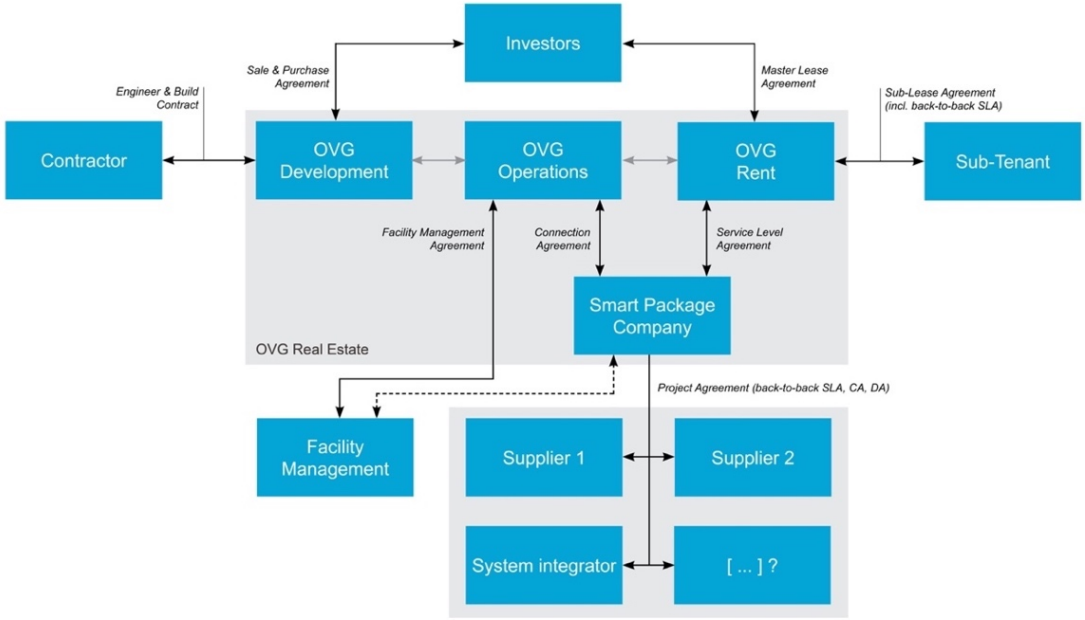

Figure 14: Inter-organizational system service provision The Boutique Office (own ill.)

On the other hand, this situation gives the investor less control over its asset while the investor is still responsible under Dutch law to provide tenants and sub-tenants 'rent comfort' *(huurcomfort)*. The investor cannot control this if a developer is responsible for the fit-out and exploitation. Therefore, a balance should always be sought in the division of responsibilities and the demarcation in a triple-net lease. According to T. Ummels (personal communication, October 02, 2017) this balance is found in The Boutique Office by

placing the most critical parts for 'rent comfort' at the investors side and the critical parts for operation and the new strategy at the side of OVG.

> *"Ze (de investeerders, red.) hebben een basic auto gekregen met te openen ramen en alles erop en eraan. De smart regensensors hebben en dergelijke zijn van OVG. Het pookje bij het stuur zit er ook nog voor het geval de smart regensensor het niet meer doet" T. Ummels (personal communication, October 02, 2017)*

Networks

In terms of service provision, the service provider connects the demands of the customers into specific demands and requirements towards service suppliers. Hereby the service provider arranges and manages the contracts, whereby he positions himself in the middle of the development process. In this constellation, it becomes possible for the service provider to procure products as services where possible. Hereby the service provider could choose himself with kind of services to purchase and in which contractual structure.

However, as could be seen in the case of The Boutique Office, the critical services in the building operation are kept in-house by the service supplier. This indicates that although contractually arrangements could be made quite strictly, this does not mean that a service provider could trust that these tasks and responsibilities are executed according to his exact preferences. Therefore, the service provider should find a proper balance between outsourcing of service provision and keeping services in-house, hereby ensuring the quality of them.

Marketing

By becoming responsible for the development ánd exploitation of the building, the tasks of the service provider increase. Hereby integrating the role of the current real estate developer and the current asset manager. As a result, a more integrated service provision approach towards customers could be delivered.

> *"Wij zetten ons voor 10 jaar in zodat we een beleggend product creëren voor een investeerder en aan de andere kant bieden waar de gebruiker naar zoekt. Zij willen namelijk een mixed flexibel programma waardoor de investering aan de kant van de belegger niet meer op te lossen zijn" T. Ummels (personal communication, October 02, 2017)*

Hereby the service provider is able to also provide a more integrated concept on a building level while offering services relating to hospitality, community building, cleaning, catering etcetera. In fact, hereby the service provider takes over many tasks that were normally executed an asset manager or corporate real estate manager of a company that rents the space. Hereby the way building are perceived by the customers will be different compared to traditional approaches whereby tenants are bound by long-term contracts and have to operate several parts of the building themselves.
This new way of service delivery is also beneficial for the service provider himself for the Boutique Office itself and possible future projects. The data gathered by the Smart Package Company is kept in-house, therefore this data can be used to increase building performance and the way the building is operated more effective and efficient for the Boutique Office and other future office projects as well.

(Product and service) Design

One current trend within the real estate sector is that traditional offices become less in favour of the workers of a variety of companies while co-working spaces are becomes more popular (Sargent, 2017). The market insights of the service provider are hereby used to develop this new integrated business model, whereby the concept of the building and the process to develop it are aligned with each other. It could also be mentioned that this insight is used by the service provider to predevelop certain product groups since the

service provider made a blueprint for these new kind of office buildings within their new strategy. So, in this case it are not the service suppliers that predevelop products, but the service provider predeveloping a complete product blueprint relating to a complete building.
With this product blueprint, the service provider integrates the design, development and exploitation of the complete building with each other. Hereby the service provider places himself in the lead of value creation towards the customer, resulting in a scalable user-centered product. Since the service provider made a blueprint for the product and process to develop a building, a more lean development process could become the outcome of it. Because of the standardization of the development process and product, many barriers that normally hamper the speed of the development process are taken away. However, it could also be questioned what the actually value is of this scalable product since real estate project are always influenced by the complicated context of place, time and related stakeholders (Wamelink & van Bennekom, 2010).

5.3.3. Reflection

The strategy used by the service provider to overcome the three mentioned obstacles is simply finding a balance between outsourcing of aspects that do not relate to the core business of service provision while having a strong steering approach on the aspects that actually deliver value to the main business of service provision. For example, the building itself is 'outsourced' by the sale of the core and shell while the fit-out is kept 'in-house' since this determines a lot the quality of the building and therewith the performance level of the delivered services.

Within the fit-out of the building itself, a distinction could also be seen in essential services and the more general services of a building. Hereby the Smart Package, which forms a strategically important element of the New Strategy is kept in-house and developed together with several subsidiaries of the service provider to keep the quality of it high. On the other hand, several other more general services relating to for example Facility Management are outsourced towards external parties.

The service provider sees himself in the middle of the development and exploitation process, filling the gap between development and exploitation. Although the service provider can provide a lot added value towards customers by the integration of these phases, the amount of risk for this actor will increase as well, because the service provider has a Master lease with the investor for 10 years with the investor, whereby the service provider would split this in a sub-lease. Hereby the vacancy risk is at the side of the service provider. In a more traditional approach the vacancy risk lies at the investor, which can handles this since these parties tend to be financial robust companies with huge 'back support'. Although the service provider is a financial robust company as well, the amount of equity and trusts at the side of the service provider does significantly change compared to the most investors.

Table 19: Findings in-case analyses Case 3: The Boutique Office

	Service supplier	Service provider	Customer
Obstacles		- Equity position - New product offer towards investors - Control over 'strategic services'	
Contracts	- Transfer of risk to supplier by DBMO- and E&B-contracts	- Sale-and-leaseback structure to take responsibility over the building - Core & shell sold to investor (triple-net) - SP responsible for inner-layers - Take over tasks from 'asset managers' - Back-to-back SLA's from customers to suppliers	- Service packages - Based on office space / workplaces - Flexible duration - Flexible conditions
Networks	n/a: The focal point of this case study lies on the creation of a new business model by a real estate developer in order to be able to become a service provider. Therefore takes this case study mostly the perspective of the service provider	- Finding the proper organizational structures for service provisioning - Strategic services could be provided by 'in-house suppliers'	n/a: The case study did not focus on the actual interaction between service provider / customer that much
Marketing		- Task increase - Integrated service provision towards customers - Take over tasks from customers (fit-out, Facility Management) - Market research about customer demands and preferences - Pre-developed building concept and development process	- Unburdening by all-in services - Task reduction - Guaranteed performance - User-cantered approach - Increased performance of services - Competitive offer (higher quality, lower fees) - High-quality building maintenance and operation
(Product and service) Design		- Increased efficiency by connecting development & in-use phase - Integrated (building and fit-out) service delivery enhances performance	- Service design based on customer preferences - Product blueprint aiming at 'general' customer' demands - Service package offering in product blueprint

5.4. CROSS-CASE ANALYSIS

The cross-case analysis that is made in the context of the used cross-sectional case study design method is presented in this chapter. The aim of this cross-case analysis is to identify similarities and differences between the outcomes of the in-case analyses. The cross-case analysis is made with the use of a pattern matching technique (Eisenhardt, 1989).

5.4.1. Contracts

Service supplier

Within the analysed case studies, a general tendency of more responsibilities for the service supplier was recognizable. Hereby the size of the contract increased, while the complexity of the contracts was able to decrease. This relates to the fact that contracts used in the case studies were based upon performance and service delivery, instead of detailed technical requirement with a heavy guarantee regime. Only in two of the three cases a specific type of service contract could be recognized. In these two case the type of contract used was based upon the shearing layer (Brand, 1994) the product is part of. These case studies indicate that:

- Product-Service-Systems are preferably contracted using a result- or use-oriented service contract.
- Unless they are part of the structure or the skin of the building, then a product-oriented service contract is preferred.

This division is based upon argument that in order to sell a building (i.e. towards an investor), the building should be 'complete'. Although it is difficult to exactly determine what a 'complete' building means, the starting point in this research is that at least the complete structure of the building and the skin form a complete building (i.e. core & shell, see case study 3: The Boutique Office).

In the different case studies could be seen that the amount of responsibilities and liabilities related to the acceptance of a service-based contract, were quite high and therewith the risk level for the supplying parties increased as well. In both the Triodos case as well as in the Basisweg case a solution to handle the financial risk was to use a shared entity between the service supplier and the building owner and respectively a shared fund between the supplying parties. Both structures had the underlying goal to use the safety net that could be used if big financial investments had to be made in the future or have a security if one of the contractual parties leaves or goes bankrupt. The use of these financial 'back-ups' was also mentioned as an important instrument to increase the second life of a product or cascading of it, because the service suppliers are also responsible for the take-back of the materials in both cases and the uncertainty relating to costs involved with this is quite high. The pre-financing of the costs and the use of a living material passport could diminish this risk.

Service provider

Since the nature of the case studies differed remarkably from each other and therewith the role of the service provider was different in each case study it is difficult to compare the way the service providers addressed the aspects related to contracts.

- In the Triodos case the service provider had a facilitating role just connecting the service supplier and the customer
- In the Basisweg case the service provider and the service supplier collaboratively develop the PSS business model and other arrangements.
- In the case of The Boutique Office the service provider puts himself in the middle of the development and the exploitation. Hereby 'purchasing' services from suppliers and selling them towards the customers.

In the case of The Boutique and the Basisweg, both service- and use-oriented services were topic of PSS-delivery, hereby the service provider uses a 'back-to-back' SLA between himself and the customer and himself and the service supplier. Hereby the responsibility of service delivery towards the customer are

directly transferred towards the service supplier. The implementation of PSS in these projects were for the involved service suppliers and the service provider quite new and it was at the start of both project unknown how to actually arrange this. Therefore the service provider and the service supplier(s) collaboratively decided and discussed with each other how to handle these new forms of contracting and relating aspects. The outcome of this is that currently these contracts are aimed to be quite open and flexible in the future, allowing both the service supplier and service provider to decide in the future how to handle certain responsibilities. This decreased the future risk for both parties and avoided the contracts to become 'killer contracts' *(wurgcontracten)*. And, secondly, the partnership approach of the service provider created in both cases the potential to create new business opportunities for the involved service suppliers.

As mentioned before, the case of the Boutique Office is quite different than the other two cases since this focuses on the new role of the service provider and relating aspects. Although this case did not provide many insight in the used contracts to deliver products as services, it did provide insight in the contractual structure that made it possible to extend the responsibility of a real estate developer to the exploitation phase of a project. Main idea in this case was that by the sale of the core and shell of the building to an investor, equity of the real estate developer will be released. With the conclusion of a Master Lease Agreement, the real estate developer becomes the main tenant of the building and can hereby act as a service provider, while taking over tasks from the current asset manager.

Customer

The most contractual differences in the executed case studies could be seen between the service provider and the service supplier. An explanation for this could be the focal point relating to case studies while conducting the case studies lie on the contractual relation between the service provider and the service supplier. A slightly different approach was recognizable within the case of Triodos Bank, in this case the customer explicitly focussed on the creation of trust and risk reduction for the service supplier. This can be explained by the fact that the customer is in that case is also the end-owner of the building. Therefore the customer executed the role of the service provider in other cases.

5.4.2. Networks

Service supplier

As mentioned before, the amount of tasks of the service supplier generally increase when PSSs are implemented in a real estate development project. In order to handle these extra responsibilities, two different approaches in the case studies were recognized:

1. An organizational stretch, adding new business departments to the company (Triodos, Boutique).
2. Collaborations with other companies to collaboratively deliver an integrated service (Basisweg).

This difference stems from the fact that in case of the Basisweg an integrated product/use-oriented service is being delivered (i.e. the HVAC installation is a system composed by different actors in the supply chain) and within the Triodos case a single product-oriented service (i.e. the façade is traditionally already an integrated product-system). Similar in the Basisweg and the Triodos case was the focus on co-creation between the service supplier and other parties. Because these kinds of business models are new and therefore trust and common understanding had to be created. In the Triodos case and especially in the Basisweg case, the ideas exist to place the products in an SPV. This idea stems from the argument that (1) suppliers do not want to have these products on their balance sheet accounts and (2) suppliers receive a lot more responsibilities which they find difficult to handle on their own.

A solution for this is to put these products in an SPV, which can be owned by the involved actors in the service delivery. Also, in a situation whereby a Product-Service-System will be delivered in a joint venture / SPV of different organizations, the tasks and responsibilities related to service provision can be shared between the involved organizations. The integration of the specialities of the involved parties would hereby

in theory lead to a more integrated and higher quality service delivery. The shared responsibilities and liabilities in the SPV will have some advantages:

- The related risks could be shared between the involved parties of the SPV
- Bottom-up commitment of involved parties within the partnership will be generated because of 'pain and gain' sharing'
- These SPVs makes the partnership more compatible and cheaper since extra risk margins are not needed anymore.

Service provider

In the perspective of the three conducted case studies it becomes apparent that in order to implement PSSs the service provider should to act as a more traditional real estate developer during the development phase, but also stimulate try to stimulate innovation in its basic form. The 'real estate development' role of the service provider relates to the selection of appropriate partners to work with together with the right inter-organizational structure to do this. Hereby the service provider should think about which strategy and which contracting method is most applicable for which shearing layers and related product that would be servitized. On the other hand, since the service provider has a steering and initiative taking role within the real estate development project his task would also be to challenge the service suppliers to come with innovative solutions to foresee in the demand for services in the building to be developed. Since these innovative solutions are in the end also beneficial for the service provider himself, the focus should hereby lie on co-creation between the service provider and the service supplier(s) within the entire real estate development project.

Customer

Close partnership and trust building between the customer and supplier were seen as important from both perspectives in case of the Triodos Bank. An explanation for this can be found in the fact that the customer and the supplier have a direct contract, without the service provider between them. The type of partnering and relationship building in the other cases were not be seen as very difficult compared to more traditional approaches.

5.4.3. Marketing

Service supplier

The servitization of an actual product was analysed in the cases of the Basisweg and Triodos Bank, in both cases the integration of tasks and responsibilities led to task increase of the service supplier. This task increase led to a more integrated value delivery and control mechanism. Since the service supplier is responsible for the performance of the products he delivers, he is incentived to handle in the interest of the customer and/or service provider. In the conducted case studies this created (in theory): (1) A monitoring system of the performance of the delivered products, hereby more transparency was created, (2) A shared decision making process during the exploitation how to maintain, operate, adjust etc. a product, (3) Increased efficiency in product operation and maintenance and (4) the opportunity to implement innovations or increase the performance level of the product. Secondly, the service suppliers are able to predict the costs related to the delivery of their products and thereby asking for stable and predictive service from the service provider. And because contracts that are normally divided in different phases are now brought back to one integrated contract over the life-cycle of the project.

Service provider

As can be seen in the cases of the Basisweg and The Boutique Office, the demands of the service provider could remain on a higher aggregation level. This implies that the service provider is more steering upon the value delivery of a certain product instead of the technical performance of it during the development phase.

The value created by servitized products is based upon the outsourcing principle of PSSs. This implies that service provider receive a (1) guaranteed performance, (2) pay a predictable and stable service fee and (3) investments in result- and use-oriented servitized products are not needed anymore. The value creation towards the customer is based upon an integrated – and maybe higher quality – service delivery. Hereby tasks that are normally executed by the customer are taken over. Hereby a deep knowledge of market and customer preferences is needed. As could be seen in the Boutique Office and the relating new strategy of the service provider this finds its practice in the creation of a product blueprint.

A remarkable difference between the Basisweg case and the case of the Boutique Office is that in the first case the amount of tasks of the service provider is reduced, while the amount of tasks increase in the latter case. An explanation for this is that if products are servitized the amounts of task decrease since more tasks will be executed by the service supplier. But in order to supply services towards a customer, the tasks of a service provider would increase since this actor has to combine the different services into a coherent building (as a service) towards the customer. Thus, the focus of the tasks will shift from the development and the steering of the development of a building towards the operations phase of a building.

Customers

During the interviews, the interviewed customers of the case studies provided different insights and interested in the servitization of products. The servitization of products supports the introduction of Circular Economy and therewith the wider organizational goals of Triodos Bank. In addition to this, the circular façade is beneficial for Triodos because of a lower TCO for the façade and the possibility to increase the performance of the façade or to implement innovative solutions in the future more easily. On the other hand, the customer of the Basisweg case will not be the building owner the added value of servitization for the customer can be questioned. Their interest lies more in the introduction of circular principles rather than other organizational interests. This indicates that 'products as services' might create the most added business value for building owners rather than sub-tenants.

5.4.4. (Product and service) Design

Service supplier

As could be seen in the Triodos and Basisweg project, supplying parties want to be involved as early as possible in the design process to enhance the efficiency and effectiveness of their service delivery. The early involvement in the project lead to a more integrated design, which eventually could lead to a more effective and efficient service delivery by the service supplier. Secondly, if the suppliers are more early involved in the design phase, their influence on the design is bigger. Hereby they could choose for more flexible and demountable systems, which provide possibility for flexible service delivery and it enhances the possibility of future take-back of products. As could be seen in both the Basisweg and Triodos case study, the service supplier will be incentived to increase the overall quality of the delivered products. This does not only lead to a better service delivery during the exploitation phase, but would also increase the residual value of the product which lead to an easier cascading of the project after its life-cycle.

Service provider

As could be seen in the case of the Boutique Office, the service provider developed and exploits the building, hereby integrating the design phase and the exploitation phase. Since this party will be responsible for the development and exploitation until the end of its lifecycle, it can be assumed that the service provider will do its best to design this building in such a way that it still has value in the future. In this perspective would the service provider design the building as flexible as possible, allowing future changes and upgrades to the building and herewith its servitized products. This is in line with the discussed design strategies for circular buildings. The service provider should select the supplying parties early in the development process to establish this. Hereby cooperatively develop the building with the service suppliers and architect towards an integrated building.

Customer

No differences on an operational level were found when implementing PSSs that directly related to the customers compared to more traditional approaches.

Table 20a: Findings cross-case analyses

Business tactic	Actor	Triodos Bank	Basisweg	The Boutique Office
Contracts	***Service supplier***	- Obligatory provision to extend responsibilities - Internal yield to pre-finance future expenses - Organizational stretch (maintenance dep.) - New business opportunities	- Responsible for life-cycle of the HVAC system - 'DB(F)MO'-contract with provider - Severally liable for service delivery and failures - Superficies used to split ownership - Underlying asset is the contract, not the product	- Transfer of risk to supplier by DBMO- and E&B-contracts
	Service provider	- Open form of contracting, allowing future decision making. - Incentive by the creation of future business opportunity for supplier - Reward behaviour that increases material value and service delivery	- SLA with service suppliers. - Result-oriented service contract - Contract based upon availability, fixed fee per square meter per year	- Sale-and-leaseback structure - Core & shell sold to investor (triple-net) - SP responsible for inner-layers - Take over tasks from 'asset managers' - Back-to-back SLA's from customers to suppliers
	Customer	- Take part in SPV / shared entity	- n/a: not much empirical findings related to contracts used by Customer when implementing PSSs	
Networks	***Service supplier***	- Open-source working - Creation of trust	- SPV as service supplier - Joint responsibilities within the SPV - Partnering to develop innovative business models - Actors / parties should add up to each other in an SPV - Decrease transaction costs by partnering - SPV as an ESCO / fund - Risk and profit sharing in SPV - Risk reduction related to bankruptcy by forming of SPVs	n/a: This case study was mostly about the way developers could transform themselves into service providers
	Service provider	- Facilitating role in a 'simple' B2C situation - Focus on relationship building and the creation of a common understanding	- Co-creation; cooperation to find a proper solution	- Finding the proper organizational structures for service provisioning - Strategic services could be provided by 'in-house suppliers'
	Customer	- Partnership that aims at finding proper ways to innovate and implement new business models	n/a: The interests related to CE of the customer of these case studies did not relate to the implementation of PSSs.	

Table 20b: Findings cross-case analyses

Business tactic	Actor	Triodos Bank	Basisweg	The Boutique Office
Marketing	***Service supplier***	- Façade performance monitoring - Efficient maintenance and cleaning - Shared decision making - Possibility to implement innovations / increase performance - Decreased transaction costs	- Monitoring of own performance - Reports to service provider - Increased performance by partnering with actors with the same (CE / service) mindset	n/a: This case study was mostly about the way developers could transform themselves into service providers
	Service provider	n/a: In this case the role of the service provider was supportive. The added value of the façade as a service project was communicated directly between supplier and customer	- Investment reduction - Task reduction - Guaranteed performance - Predictive and stable fees (pay per use) - Data from suppliers to increase overall building performance	- Task increase - Integrated service provision towards customers - Take over tasks from customers (fit-out, Facility Management) - Market research on customer demands and preferences - Pre-developed building concept
	Customer	- Strive towards organizational goals i.r.t. sustainability - Shared decision making - Increase performance level in the future - Decrease TCO - Predictive and stable service fees	- Sustainable organizational footprint	- Receives space to work, instead of casco office floors - Flexibility in services and lease periods - Demands on a higher aggregation level - Unburdening by all-in services - Task reduction - Demands on a higher aggregation level - Guaranteed performance - User-centered approach - Competitive offer (higher quality, lower fees)
(Product and service) Design	***Service supplier***	- Improved product quality - Attempt to make the design more flexible	- Early involvement in design phase to increase performance - Flexible and demountable system for upgrades and take-back	n/a: This case study was mostly about the way developers could transform themselves into service providers
	Service provider	- Incorporate PSS / CE as early as possible - Leading in development process, so leading in PSS / CE initiatives	- Early involvement of advisors and suppliers - Living material passport	- Increased efficiency by connecting development & in-use - Integrated (building and fit-out) service delivery enhances performance
	Customer	- n/a: The concept of Design mostly relates to the actors 'Service Supplier and 'Service provider', since these parties are most involved in the design / development phase of a real estate project.		

PART 4
SYNTHESIS

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6. Findings

This chapter form the closing part of the theory-building process by confronting theories with practice and the development of a proposition (Eisenhardt, 1989). The confrontation of theory with practice is presented in the first section of this chapter. The proposition which forms the end-result of this research is presented in the second section. This proposition consists of (1) empirical lessons for the service supplier and (2) conditional lessons that should shape the context in which PSSs could be implemented. The final are added in the third section of this chapter. These final research results are divided in three parts. The first one being an 'Interaction Model' that could be used by real estate developers in order to interact with service suppliers and customers. The second part is an 'Inter-organizational structure' for the development and operation of a servitized building. This 'inter-organizational structure' could be seen as the inter-organizational structure after the Interaction model has been applied. The third part of the research findings is a tabulated overview of the research results.

6.1. CONFRONTING THEORY WITH PRACTICE

Confronting theory with practice means that the outcomes of the literature study are examined in the perspective of the empirical findings derived from the case studies and it subsequent analyses. The main conflicting differences and supportive similarities between the existing theories and practices are herewith recognized and tried to be explained (Eisenhardt, 1989; Vrijhoef, 2011). The outcomes of the cross-case analysis are further tabulated in order to make a comparative analyses between the empirical findings and the existing theories from literature possible. This step is presented in the first section of this chapter, As such, the main aspects that were found in theory are discussed per business tactic, per main stakeholder per main 'topic' found in literature. A comparison table is added to every paragraph of this section, see Table 22, 23, 24 and 25. A summary of the conducted analyses and an overview of the main similarities and differences found between the existing theories and empirical findings is presented in these Tables. Some symbols are used to make these comparisons graphically clear. A legend explaining the meaning of these symbols is presented in Table 21.

Table 21: Explanation of used symbols in Section 6.1

Theory	Empirical findings
✓ Aspect was found in the empirical findings	= Corresponding to existing theories
× Aspect was not found in the empirical findings	+ New aspect compared to the existing theories
	≠ Aspect showed differences compared to the existing theories

6.1.1. Contracts

Service suppliers

From product delivery to service delivery

It is mentioned in the literature study that with the implementation of PSSs in real estate development projects, supplying parties remain responsible for: the performance of delivered products, the condition of it and the end-of-life phase of a serviced product (Mont, 2002; Reim, Parida, & Örtqvist, 2015; Selviaridis & Wynstra, 2015). Hereby suppliers could adopt their business model, which could imply a shift from a delivery system in a price-based environment towards a higher level of performance-based competition (Parmar, Austin, & Mill, 2004). This tendency was also visible in the outcomes of the case studies.

Vertical integration & creation of new business models

The introduction of PSSs in the real estate sector would also imply a vertical integration of the service supplier within the supply chain. Hereby suppliers receive new roles that are normally most often executed by the customer (Kazemi, 2016; Reim et al., 2015; Roos & Agarwal, 2015; Selviaridis & Wynstra, 2015). This vertical integration could also be witnessed in two of the three case studies. In the Triodos Bank case, the service supplier mentioned that the implementation of PSSs created an opportunity to add a maintenance department to the company (N. Eekhout, personal communication, September 13, 2017). The vertical integration was also visible in the Basisweg case. The service supplier could herewith renew its old business model which was expected not to be sustainable anymore due to changing market circumstances (J. Feuth, personal communication, September 22, 2017).

The case studies also proved that service suppliers could take over tasks from the customer ánd the sub-suppliers as well. For example, the customer in the case of Triodos Bank was normally responsible for cleaning the building and would outsource it towards another supplier. The implementation of PSSs in the building implies that the service supplier could take over tasks from the customer as well as from other suppliers. This means that service supplier could also horizontally integrate within the supply chain.

Reduction of transaction costs

The extended responsibilities create incentives for supplying parties to work more efficiently and reduce their transaction costs. Hereby the suppliers will be incentived to think the other way around and reconsider value delivery towards customers instead of revenue creation for themselves (Selviaridis & Wynstra, 2015, p. 3506). This phenomenon was also shown in the case of Triodos Bank and the Basisweg. In the first case the service supplier would decrease the TCO for the customer by integrating activities related to maintenance, repairs and cleaning and using higher quality materials. In the latter case study several suppliers will work together in a joint venture to deliver one integrated service. Hereby risk and profit is made within the joint venture which would create a 'cheaper' service delivery compared to more traditional and fragmented product delivery approaches.

Increased risk

As mentioned in the literature study could the amount of risk as well as the potential revenue streams for the supplier increase they offer their products in the form of PSSs (Selviaridis & Wynstra, 2015).The increasing amount of risk could be seen as one of the most important barriers in the implementation of PSS as seen in the conducted case studies. Generally spoken, the service providers found it difficult to accept these new business models as they are not used to commit themselves for a long period to a certain project. This can be seen as one of the reasons why the general introduction of the PSSs in the real estate sector goes slowly. The main risks for the service supplier were mostly about (1) possible unforeseen future costs related to maintenance, repairs and take-back of the products and materials, and (2) about the potential bankruptcy of one of the involved organizations. In the outcomes of the case studies, four approaches were recognizable that aimed at decreasing the financial risk for the service suppliers. Hereby the first approach could be seen as a prerequisite before the latter three other could be applied.

- **Open form of contracting:** Service-based contracts aim at service (and product) delivery for several years. This creates uncertainty for supplying parties as the future context of projects is hard to predict. This risk could be reduced by designing PSS business contract in an open and flexible way. This would make it possible for the involved parties to postpone important decisions about future events. Thus, the future decisions could be made more easily and based upon common interests.
- **Usage of an internal yield:** Within the case of the Triodos Bank a financial back-up for the service supplier was created by savings which were created by the implementation of PSSs. Hereby financial calculations were made based upon the traditional maintenance of the product. These were compared with a service-scenario. If the TCO of the service-scenario was lower than the traditional

scenario. The agreement was herewith made that the customer pays for the 'traditional approach', the yield created with this was used as financial back-up for the service supplier.

- **Creation of an SPV:** Service suppliers that collaboratively deliver a PSS could use an SPV to secure themselves and the customer / service provider for eventual negative effects. These could be caused by the bankruptcy of one of the supplying parties, service provider or customer.
- **Data sharing:** The service supplier within the case study of Triodos Bank and the service provider of the Basisweg case supported the idea of sharing data related to materials and products online while creating building passports. This makes it possible to provide insight for other parties about used materials in a building. Hereby, a platform should connect the information owned by different actors to form a network and a marketplace. An example of such a platform is the recently launched online platform Madaster (Rooijers, 2017).

Changing demands during exploitation

According to Van den Brink (2016) and Kazemi (2016) the customer would be able to change his demands when PSSs are applied in a real estate development project. This phenomenon was not visible in the findings derived from the case studies. This could be explained in two ways:

- The transition from the offering of products towards the offering of services is already found difficult and risky by the service suppliers.
- Limitation of the study, the case studies only covered the development phase related to the implementation of PSSs. Changes during the exploitation phase were therefore out of the scope of this research.

Preference for use- or result-oriented services

The assumption was made that service suppliers would prefer to use product-oriented service contracts as the implementation of serviced business models in the case studies was rather new for the involved actors. On the other hand, the empirical findings showed that the service suppliers prefer to use more result- or use-oriented service contracts. This is because, service suppliers see that the use of the product-oriented type of contracts does not provide many advantages for themselves. The other two business models create more freedom and business opportunities for service supplier. This means that they can decide themselves how to handle the increased task package.

Service provider

Spider in the web

According to Van den Brink (2016) the service provider gets a coordinating role within the supply chain, because the service provider is responsible for managing the transaction between the service provider and the customer(s), and the transaction between the service provider and the supplying parties. The empirical findings indicate a similar phenomenon. As could be seen in all three case studies, tasks of the service provider could be to:

- Translate the demands of the customer into performance requirements for the service suppliers. Hereby the Service Level Agreement for the complete building is divided into specific performance requirements (Service Levels) that should be delivered by the service suppliers.
- Deliver services to the customers during the exploitation phase of the building.
- Procure products in the form of services from the service suppliers during the exploitation period.
- Support suppliers in the needed organizational change needed to become a service supplier.

Usage of superficies

During the research process, turned out that using result- or use-oriented service contracts is not possible on all layers of a building due to juridical obstacles. When result- or use-oriented service contracts are applied, the ownership of the underlying product remains with the service supplier. This implies that the ownership of that specific product is split from the rest of the building, which could be done with the use of superficies *(opstalrecht)*. In order to do this should (1) the product on which the superficies should be able to be defined as a 'self-contained work' *(zelfstandig werk)*. And, Secondly the building on which the superficies is places should remain 'independently exploitable' *(zelfstandig exploiteerbaar)* (AKD, 2017; D. de Jong & D. Van Noort, personal communication, September 29, 2017). If 'essenial building components' that define a building are split from the rest of the building. It can be assumed that a notary would not let pass this act. It is difficult to generalize the building components on which superficies can be placed and which not (i.e. what essential building components are and which not), as since there is currently not much experience with this juridical instrument on a building scale (D. de Jong & D. Van Noort, personal communication, September 29, 2017). In order to make the division between building components more clear, the method of 'Shearing layers' as defined by Brand (1994) is being used. The assumption is made that the Structure and Skin of a building are 'essential building components' and the Services, Space Plan and Stuff, which form the 'inner layers' are not. This implies that it is only possible to use superficies on the shearing layers Services, Space Plan and Stuff and not on the other two building layers. Thus, result- or use-oriented service contracts could be used on the fit-out of the building (i.e. Services, Space Plan and Stuff). And, secondly, product-oriented service contracts should be used to service the casco of the building (i.e. Structure and Skin).

Sale and lease-back

In the theories, it is mentioned that in the current real estate sector, the real estate developer (now: service provider) takes the biggest risk in a project, because this actor invests his own (or loaned) equity (Peiser & Frej, 2004, p. 3). According to the existing theories this business model would not be valid anymore. The service provider (former real estate developer) does not have to purchase any physical goods anymore to develop a building (Ellen MacArthur Foundation, 2013; Loppies, 2015). This claim is – in the perspective of the empirical findings – only partially true. The outcomes derived from the case study about The Boutique Office indicate that result- or use-oriented service contract could not be used in every product because the building has to remain 'independently exploitable' and in some way be sold towards an investor (D. de Jong & D. Van Noort, Personal communication, September 29, 2017; AKD, 2017). Thus, the real estate developer would still need to invest equity in the building relating to the structure of it and the skin in order to create an 'independently exploitable' building.

Exploitation

In the existing theories only, few information was found about the role of the service provider during the exploitation period of a serviced building as most of the available literature focuses upon the development period of these type of buildings. Although this research has the same focus, the findings derived from the case studies mention that during the exploitation phase, the service provider would execute the task of the current asset manager of a building. Generally spoken this means that the service provider: (1) operates the building on a daily basis, (2) monitors the performance of the building and related PSSs, (3) holds contact with the customers and (4) is responsible for subleasing the office.

Customer

Only a few new insights were created in regard to the contractual relationships between the customers of servitized building and products. Therefore the findings of Kazemi (2016) hold their value. These findings mention that the contract-agreement between the customer and the service provider should define the correct performance indicators, terms and conditions. And, secondly, the end-user would be responsible to pay a periodic payment to the service provider (Kazemi, 2016).

Table 22: Confrontation of theories with empirical findings: Contracts

	Theory	Empirical findings
Service supplier	✓ Extended responsibilities ✓ Vertical integration ✓ Continuous (i.e. life-cycle) value delivery ✓ Responsible for integrated service delivery ✓ Reduction of transaction costs ✓ Risk increase ✓ New business opportunities ✓ Mindset: price-based > performance-based × Changing demands during exploitation	= Extended responsibilities = Vertical integration + Horizontal integration = Long-term value delivery = Mindset change = New business opportunities = Decreasing transaction costs = Risk increase + Usage of internal yield to reduce risk + Creation of SPV to reduce risk + Open form of contracting to reduce risk + Data sharing to reduce risk + Preference for use- or result-oriented contracts + Contract as assets, instead of physical product
Service provider	✓ Demand and supply integration ✓ Deliver services to customer ✓ Translate demands into performances ✓ Purchase services from suppliers ✓ Collaborative approach ✓ Trust building × No investments during development needed	= Demand and supply integration = Deliver services to customer = Translation demands into performances = Purchase services from suppliers = Support suppliers during innovation process = Trust building + Sale and lease-back with investor ≠ Investments in structure, skin of the building ≠ Servitization of 'inner layers' + Superficies not for casco of a building
Customer	✓ Determine performance requirements ✓ Periodic payments to service provider	= Determine performance requirements = Periodic payments to service provider

6.1.2. Network

As mentioned in the existing theories, the overall complexity of a real estate development process will increase when PSSs are being implemented. The need of different parties working together would increase as well (Prins, Mohammadi, & Slob, 2015; Selviaridis & Wynstra, 2015; Van den Brink, 2016). This can be supported by the 'participant observation' of the researcher. The underlying reason for this complexity, according to the researcher is that:

- The implementation of PSSs is new and innovative, resulting in a knowledge gap within the involved parties.
- Within the case studies a mix of 'traditional real estate development approaches' and 'servitized real estate development approaches' was recognizable.

Service suppliers

Internalizing neighboring activities or other businesses

As mentioned before, service suppliers receive a bigger task package when offering PSSs. Vrijhoef and De Ridder (2005) and Vrijhoef (2011) mentioned that in order to be capable to do this, supplier could internalize neighbouring activities or other business with the use of joint ventures and consortia. The case studies confirmed this and showed two strategies whereby suppliers extended their capabilities.

More insight was created by the case studies related to the use of joint ventures / consortia, which are: (1) supplying parties could handle wider range of tasks, (2) expertises are summed up, (3) risk and profit is shared and (4) the integration of different products increases.

Project-independent collaborations

According to the existing theories, service suppliers could develop project-independent collaborations with other parties in the supply chain. Hereby they could pre-develop generic PSSs which because of their flexibility could be implemented in several projects, therefore creating a competitive advantage compared to other suppliers in the market (Vrijhoef, 2011). This phenomenon has not been observed in the empirical findings derived from the case studies. This could be explained by the scope of case study research, which lie on individual real estate development projects and not on a company level.

Special Purpose Vehicles

The empirical findings are built upon the existing knowledge in relation to the use of SPVs. Although Azcárate-Aguerre et al. (2017) mentions the use of SPVs in relation to façade ownership, he does not refer to the underlying reasons and structure of these SPVs. The empirical findings mention the use of SPVs in order to: (1) handle ownership, (2) reduce the risk profile of involved parties, (3) finance the delivered physical product, (4) reduce transaction costs and (5) create bottom-up commitment at the side of the supplying parties.

Service provider

Finding the proper inter-organizational structure

According to the existing theories, the complexity in the real estate sector is relatively high. This because (1) many parties are involved in both the demand and the supply side of construction. (2) Hereby many interest and views should be taken in to consideration, what emphasize that it is (3) difficult to configure the supply chain (Antink, Carrigan, Bonneti, & Westaway, 2014; Miles, Berens, & Weiss, 2007; Wamelink & van Bennekom, 2010). Currently, the main task of the real estate developer in servitized real estate projects, would be according to literature, to manage the real estate development process. Hereby it is important to find the proper organizational structure to contract the service suppliers and other stakeholders. Finding the proper way of cooperation and collaboration with the supplying parties is herein important as the service providers and the service suppliers will be tied together, for a 'long-term' period of time (Van den Brink, 2016; Vrijhoef, 2011).

This steering approach was also found back in the empirical findings. These outcomes indicate that the service provider is the 'spider in the web' and aligns the demand and supply system when implementing PSSs. It would also be the task of the service provider to cluster the proper services together to form well-functioning PSSs. Since the service provider stands in the middle of these clusters, this actor could also make sure that the delivered PSS are well integrated with each other: physically and non-physically.

Also, because the services provider arranges and manages the contracts, it would become possible for this actor to procure PSSs in different ways. It might hereby be important to consider in which inter-organizational structure the service provider procures 'critical' services. For example, in the Boutique Office the ICT systems was purchased as a service from an entity that belongs to the service provider himself. Hereby the performance level is securitized, this is important since the ICT system forms an essential part in the strategy of the service provider. This aspect was not mentioned in the literature study.

Supportive role

According to read literature sources, the relationship between parties should start with building a relationship, then talking about organizational issues and finally arranging the legal aspects when implementing PSS. This creates common understanding of all demands and possible solutions, before the project is organized and fixed in a contract (De Ridder & Vrijhoef, 2007). Hereby trust building and frequent interaction with the customer is necessary (Reim et al., 2015; Selviaridis & Wynstra, 2015). This phenomenon was also recognized while conducting the case studies. In order to reduce the risk and support the service supplier, the service provider in the case studies proactively supported the innovation process at the side of the supplying parties.

Selection of appropriate service suppliers

In line with this, it would also be the task of the service provider to select the 'appropriate' organizations to provide services. As could be seen in the case study of Basisweg, it is needed that supplying parties within a joint venture have a similar mindset and interests for the project in order to create an appropriate synergy. This aspect could not be found back in the existing theories.

Co-creation

In order to make this co-creation and collaborative design approach possible, the focus during the first phases of a design process should lie on the definition of common goals and the alignment of interests between parties. This was an often discussed prerequisite of proper collaboration in the interviews related to the case studies and also mentioned in the literature by De Ridder and Vrijhoef (2007). They mention that it is necessary first to build a relationship, then to talk about the organizational issues and finally to arrange the legal aspects.

Customer

The existing theories barely describe how customers could use their network relationships with external partners to purchase PSSs. The empirical findings indicate that partnerships should be sought to implement innovative business models. The root source of this statement can be traced back towards the case of Triodos Bank. The value of this aspect can be questioned because the customer performed the role the service provider in that case study

Table 23: Confrontation of theories with empirical findings: Networks

	Theory	Empirical findings
Service supplier	✓ Collaborative responsibility for service delivery ✓ Internalization of neighbouring activities ✓ Forming of consortia / joint ventures × Project-independent collaborations	= Addition of new business departments = Forming of joint ventures + Use of SPV to handle ownership of products + Use of SPV to decrease risk + Use of SPV to finance products + Use of SPV to reduce transaction cots + Use of SPV to create bottom-up commitment
Service provider	× Long-term supply chain arrangements ✓ Manage the real estate development process ✓ Stakeholder management ✓ Integration of delivered services ✓ Trust building	= Manage the real estate development process + Determination of clusters + Determination of inter-organizational structure + Determination of used contracts + Selection of appropriate service suppliers ≠ Focussing on co-creation + Manage the building operation + Integrate task of developer and asset manager
Customer	n/a: The studied existing theories did not focus upon the role of the customer in a PSS-delivery network.	+ Finding partnerships that opt for same goals

6.1.3. Marketing

Service suppliers

According to the existing theories, it is necessary that service supplier communicates the added value that will be delivered with PSS clearly, so that the demanding parties (i.e. service providers and customers) would procure a solution that is totally different compared to current approaches (Reim et al., 2015). However, these theories did not provide much insight in the way *how* service suppliers should communicate this added value then. The outcomes of the case studies mention as well, that the service suppliers will provide insight about their delivered performance. It is however not clear *how* this would be done in practice, because the case studies focused mostly on the development phase. And thus, not on the exploitation phase of a servitized project.

Service provider

Unburdening

The existing theories describe that the amount of tasks for the customer will decrease and also their demands could remain on a higher aggregation level when implementing PSSs (De Ridder & Vrijhoef, 2007). As will be explained in the paragraph about customers, this has also been found in the empirical study. However, a similar phenomenon was also seen in the empirical study in the relationship between the service provider and service suppliers. If service providers would procure PSSs in the form of use- or result-oriented services, then

- Their demands could remain on a higher aggregation level since the service suppliers are paid and assessed based on the performance of delivered results and services
- The service provider would receive a guaranteed performance during the contractual period for a stable and predictable service fee
- Investments by the service provider in result- and use-oriented servitized products are not needed.

Improvements as competitive advantage

According to the existing theories, the servitization of real estate would lead to improved relationship building with customers because of "[...] increased contact and flow of information about customer's preferences" (Mont, 2002, p. 240). Hereby supplying parties gain more insight in customer's preferences and could use this information in order to develop new service models. This phenomenon has not been recognized in the case studies since the focus of the case studies did not lie on the exploitation phase of a servitized building.

However, something similar has been seen in the relation between the service provider and the service supplier. In the three cases it was mentioned that the data derived from the servitized products could be used to optimize the performance of these products and make them more efficient. In the case of the Boutique Office, the data derived from the 'Smart Package Company is kept in-house and used to increase the building climate system and the way the building is operated and cleaned. Secondly, since the service provider and the service suppliers are remaining involved with each other and with the building for a longer period, it provides the implementation of PSSs also the possibility to implement new innovative products into a building. This theory was mentioned in both: the case of Triodos Bank and the Basisweg.

New value approaches

According to literature lead the implementation of PSSs to changes on the strategic, functional, financial and physical value of real estate. These values are hard to determine, and relate to their 'willingness to pay' (Azcárate-Aguerre et al., 2017; Den Heijer, 2013). Therefore, the actual service fees for servitized products are hard to determine (Den Heijer, 2013). This facet arrives also from the case of the Basisweg. The implementation of PSSs means that parties that are involved in the development phase of the project, have to oversee more financial categories. This might be difficult for them, since they currently do not have the right knowledge and experience to oversee this.

"Het grote probleem is dat er veel meer kosten in één potje komen. De getallen tijdens exploitatie moeten overeen gaan komen in het denken van de projectontwikkelaar. Pas als er een match is en de gehele periode kan worden overzien, dan wordt het wat. Het moet goed gaan voelen omdat het opeens over veel meer geld gaat [...] " J. Feuth (personal communication, September 22, 2017)

The involved actors in the project of the Basisweg tried to overcome this obstacle by making TCO calculations of several scenarios. Although the outcomes of the service-based scenario were promising. It still remains difficult to grasp what these number actually 'indicated'.

Customer

Flexible service concepts

According to Van den Brink (2016) the service providers delivers a services towards the customer in the form of a constructed building. This means that supplying parties should reverse the supply chain, which should be capable of delivering buildings proactively in the way customer goods are being delivered. (De Ridder & Vrijhoef, 2007). This user-centered approach could be traced back in the case of The Boutique Office. Hereby the service provider was responsible for the development ánd exploitation of the building. By integrating these roles the service provider created a universal product blueprint whereby a more integrated service provision towards the customer could be offered. Hereby (1) the customers (i.e. sub-tenants) actually receive space to work instead of casco office floors, (2) the service provider will offer flexible lease terms and different workplace concepts. Hereby the supplied services could be more in line with the demands of the customer.

Unburdening

In current real estate development projects, the customer is often responsible himself to transform these floors into usable office space and operate the building. Within a servitized project, these tasks would be taken over by the service provider (Reim et al., 2015). De Ridder and Vrijhoef (2007) explain that hereby the demands of the customer remain on a higher aggregation level, decision making is easier and the building would be better suited to its demands compared to current practices (De Ridder & Vrijhoef, 2007). As mentioned in the former paragraph, this aspect is witnessed in the case of The Boutique Office. The serviced office concept delivered by the service provides furnished and operated office space / places to work for a fixed fee per month.

Fees based upon value and service delivered

According to Kazemi (2016), the customer receives actually value for money instead of products for money when PSSs are implemented in real estate development project. The added value for the customer lays – according to Kazemi (2016) - herein that the customer just pays for the delivered services and not for transactional costs made throughout the supply chain. This claim cannot be fully made in the perspective of the empirical study. The outcomes of the empirical study indicated that the transaction costs made in the supply chain would decrease. This would lead to cheaper products for the customer / service provider. It does not, however, directly mean that these parties would just pay for 'a service'.

- Firstly, as described before, it is difficult to actually calculate the value of a 'service' since it relates to the willingness to pay of a customer / service provider (Den Heijer, 2013).
- Secondly, as could be seen in the cases of Basisweg and Triodos Bank, the service supplier will calculate service fees based upon the expected TCO for that product. Material and product purchase prices are part of the TCO.

Table 24: Confrontation of theories with empirical findings: Marketing

	Theory	Empirical findings
Service supplier	✓ Closer relationship with customer / provider ✓ Communication of added value	= Closer relationships with customer / provider = Communication of added value
Service provider	✓ Take over tasks from customer ✓ Analyse market demands ✓ Analyse customer preferences ✓ New valuation approaches × Total quality approach ✓ Relationship building with customers	+ Offering of flexible service concepts = Reversing the supply chain = Analyse market demands = Analyse customer preferences = User-centered approach + Demands on a higher aggregation level + Guaranteed performance + Investment reduction + Flexible lease term + Future improvements in products ≠ New valuation approaches based on TCO
Customer	✓ Determination of demanded services ✓ Changing of demands × Procurement space × Value for money	= Demands on a higher aggregation level + Unburdening by all-in services ≠ Fees based upon TCO = Task reduction + Guaranteed performance + User-centered approach + Increased performance of services + Sustainable organizational footprint + Competitive offer (higher quality, lower fees)

6.1.4. (Product and service) Design

Service suppliers

According to the literature study, the service supplier could use three design strategies that should make the servitization of products possible (Loppies, 2015). These three strategies are:

- **Build with modular or standardized components:** This strategy could be seen within the case of Triodos Bank, hereby the service supplier tried to optimize the quality of the products and to make them as generic as possible to increase the future residual value of them.
- **Design for future disassembly:** This strategy could be seen in the case of the Basisweg. The service suppliers wanted to connect their delivered products 'clickable' to the rest of the building.
- **Lean development:** This strategy has not been recognized while conducting the case studies, an explanation of this could be the limitation of the underlying empirical study.

Service provider

Changing demands

The theories mentioned that service supplier should be capable in adapting the provided products according to the changing demands of customers during the exploitation / in-use phase (Van den Brink, 2016). This aspect was sometimes mentioned during the semi-structured interviews, but no empirical evidence was found that service suppliers would actually be willing to provide flexibility within delivered PSSs yet. Although this flexible approach would create much marketing value towards customers, it could be assumed that the service suppliers are currently reluctant in its offering, because it creates uncertainty about the stability of revenues and investments. This increases the already high profile related to the PSSs. On the other hand, this phenomenon was witnessed at the side of the service provider. The service-based building concept developed by the service provider of The Boutique Office is flexible and able to cope with changes in the demand of the customer. Hereby the building itself will not change, but the different service packages offered provide flexibility in terms of amount of office space and the included services.

Joint decision-making

As mentioned before, the service suppliers are mutually dependent to deliver enhanced services. Therefore, the service provider "[...] should make a platform for joint decision making between the team and the suppliers, since the suppliers have the best knowledge regarding the components (and related services, red.)" (Kazemi, 2016, p. 127). The case study about Basisweg confirmed that statement. The early involvement of service suppliers would enhance the efficiency and effectiveness of service delivery, increase the residual value of used products. Finally, overall building design would be more suitable for service delivery (i.e. the building will become more modular and flexible).

Table 25: Confrontation of theories with empirical findings: (Product and service) Design

	Theory	Empirical findings
Service supplier	✓ Usage of modular components ✓ Design for future disassembly × Lean development × Flexible demands	= Usage of modular or standardized components = Design for future disassembly
Service provider	✓ Platform for joint decision-making	+ Changing demands of customer = Platform for joint-decision making + Early involvement of service suppliers + Development of a product blueprint + Lean development
Customer	n/a: The literature study in relation to the concept of Design focused on the physical product characteristics related to the offering of PSSs.	+ Services based on customer preferences + Product blueprint aiming at 'general' demands + Service package offering in product blueprint

6.2. PROPOSITION

The last step of the theory building process described by Eisenhardt (1989) is development of a proposition, which is presented in the second section of this chapter. This proposition is presented in the form of empirical lessons. These lessons are directed towards the real estate developer in order to support him in the implementation process of PSSs in real estate development projects and in performing the role of service provider. The process whereby lessons are drawn relates to the identification and verification of relationships between theory and the empirical findings derived from the case studies. This implied an iterative comparison between theory and empirical findings, which leads to the generation of the proposition (Eisenhardt, 1989; Vrijhoef, 2011).
During the research it turned out that in order to be able to perform this role, several conditional changes within the real estate sector are necessary as well. The conditional lessons aim to shape a different context, which should make it easier for the real estate developer to change his position. These conditional lessons mostly refer to the service supplier, as the implementation of PSSs imply that many tasks and responsibilities are transferred towards this organization.

Introduction

The incorporation of Product-Service-Systems in real estate development project leads to higher degrees of responsibilities for suppliers and real estate developers. These responsibilities would apply to the product's full life cycle, including the design of the closed-loop system (Mont, 2002; Selviaridis & Wynstra, 2015). This implies that suppliers, real estate developers and service providers, which are in a traditional process normally only involved during the development and realization period, will extend their responsibilities delivered services (i.e. products) during the exploitation and end-of-life phase.

Besides the extended responsibilities concerning the physical product leads the implementation of PSSs also to extended responsibilities concerning the service delivery towards the customers. In a traditional real estate development project, the value delivered by the real estate developer to the customer lies only in the constructed building at the moment of project delivery. However, when real estate development projects become servitized this price-based environment will transform into a long-term value delivery process.

The service provider would get a central and coordinating role within the supply chain of servitized real estate development projects. Hereby the service provider becomes responsible for the transactions between himself and the service supplier(s) as well as himself and the customer(s) (Kazemi, 2016; Van den Brink, 2016). This implies that the service provider would become the 'demand and supply system integrator 'as mentioned by Vrijhoef and De Ridder (2005), this actor would facilitate "[…] supply chain coordination and collaboration to realize outcomes by aligning incentives among supply chain actors" (Selviaridis & Wynstra, 2015, p. 3506).
The role of the service provider would be rather similar to the role of the 'traditional' real estate developer in current practices. Hereby the service provider 'steers' the development process of a servitized building while bearing most of the project-related risks (Miles et al., 2007; Peiser & Frej, 2004). During the exploitation phase of servitized buildings, the service provider performs the role that can be compared to the role of the current asset manager.

6.2.1. Interaction with service suppliers

Contracts

In order to be able to deliver these services towards the customers should the service provider thus conclude service-based contracts with the appropriate service suppliers. In general, three types of categories could be recognized that could be used for this, these are: (1) product-oriented service contracts, (2) result-oriented service-contracts and (3) use-oriented service contracts (Reim et al., 2015; Tukker, 2004). The latter two kind of contract types are preferred to use since (1) they leave the biggest 'procurement space'

(Loppies, 2015) for the service suppliers and (2) the ownership of the provided products remain at the side of the supplying parties. The latter creates more bottom-up commitment towards the supplying parties. the service provider should not invest his own equity when applying these types of contracts. However, result-oriented service contracts cannot be applied on the casco of the building because of difficulties in the use of superficies on 'essential building components' (D. de Jong & D. Van Noort, personal communication, September 29, 2017). If the real estate developer wants to develop a servitized real estate development project, the Structure and Skin of the building could only be servitized with the use of product-oriented service contracts. Hereby the ownership of the products is transferred towards the real estate developer.

> *"Er komt waarschijnlijk een scheiding tussen drager en inbouw. Voor de inbouw zijn dingen veel makkelijker te regelen van voor de drager" E. van Noord (personal communication, September 21, 2017).*

I In order to be able to extend responsibilities ánd to develop more servitized buildings, the real estate developer shall choose for a sale-and-leaseback structure with an investor. Hereby the fit-out of the building could be servitized by service suppliers with the use of result- or use-oriented service contracts. The advantages of this structure are: (1) a servitized building is being created, (2) the equity of the real estate developer is not 'stuck' in the building, (3) an investment vehicle (i.e. the casco) is being created and (4) risks related to service provision are outsourced towards the supplying parties. This structure is presented in Figure 15, the grey layers represent the components which are sold towards an investor and the blue layers indicate the layers that could be servitized by the service suppliers.

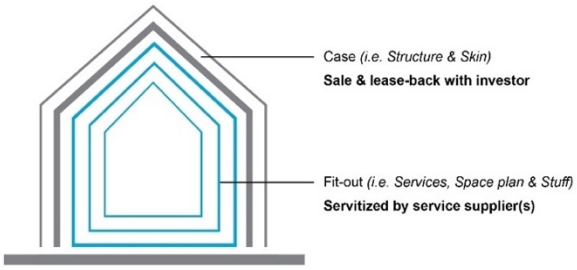


Figure 15: Contractual structure per building layer (own ill., based upon Brand, 1994)

The contractual structure being used to procure PSSs would also be different compared to traditional real estate development project because it is believed that different service suppliers are needed to deliver one integrated PSS. The role of the service provider is herein to select the appropriate service suppliers and cluster them together if necessary. The service provider steers the development process and is responsible and liable for proper service provision towards the customer. It is therefore in his interest to make sure the involved parties collaborate and cooperate in the right structure with each other since they are tied together for a long period and become mutually dependent on each other. Hereby it could be of strategic importance to keep certain services in-house or especially outsource them. It is believed that the proper inter-organizational structure could enhance the overall quality and performance of the service delivery (Van den Brink, 2016; Vrijhoef, 2011).

Lesson1: Sale & lease-back

	A service provider should conclude a **sale-and-leaseback** with an investor for the casco of the building to extend his responsibilities into the exploitation phase. Individual PSS contracts could hereafter be used to procure the servitized fit-out.

Network

Current real estate development projects ae characterized by a complex web of interest and perspectives of different actors (Wamelink & van Bennekom, 2010). When Product-Service-Systems are implemented, the overall complexity of these projects will further increase. Hereby the need of different parties working together would rises as well (Prins et al., 2015; Selviaridis & Wynstra, 2015; Van den Brink, 2016) therefore "[...] the need of parties to use their network relationship with external partners to ensure PSS business models are implemented successfully" becomes important (Reim et al., 2015, p. 70).

During the literature review and while conducting the case studies, it became apparent that one of the biggest obstacles to implement PSSs in the real estate sector is the increased amount of risk for the service suppliers that comes with the implementation of these PSS. According to literature this risk increase is caused by the fact that suppliers become liable for the quality and the overall performance of the delivered products and relating services (Kazemi, 2016; Mont, 2002; Stahel, 2008; Van den Brink, 2016).

Secondly, besides the increased risk profile become the service provider and the service supplier also more mutual dependent on each other. The service provider depends hereby on the performance level of the services provided by the service suppliers, since these services will be transferred towards the customer(s). The service supplier depends on the payments done by the provider, these payments would be based upon the performance level of the delivered PSS. But, the performance level might depend on the services delivered by other service suppliers as well.

In order to overcome the two abovementioned barriers, it would be task of the service provider to use a strategy based upon co-creation, whereby trust building and a close interaction between the service provider and the service suppliers stands central (Reim et al., 2015; Selviaridis & Wynstra, 2015). This demands from the service provider that instead of procuring and demanding from suppliers an offer whereby he acts as a client towards a merely supportive and cooperative approach based on trust and common understanding. Trust between these two parties can be created by opting for a transparent and open book approach during the development process. De Ridder and Vrijhoef (2007) mention hereby that it is important that parties should start with building a relationship, then talking about the organizational issues and finally arranging legal aspects when implementing PSSs. This creates common understanding of all demands and possible solutions, before the project is organized and fixed in a contract.

> *"Als je wat nieuws wil proberen en wil innoveren heb je lef en vertrouwen nodig in de partijen waarmee je het samen doet. […] Als je aan tafel zit met partijen die je recht in de ogen kan kijken en kan zeggen: Wij streven hetzelfde doel na en proberen het samen succesvol te maken, dan is het goed" M. Bierman (personal communication, October 05, 2017)*

This cooperative approach and frequent interaction is possible because of the direct interaction between the service provider and the supplying parties. In current real estate developer this contact is hindered by the presence of a contractor. Since the service provider and the supplying parties become in direct contact with each other and since they become mutual dependent on each other, they can share information more easily. This should in the end lead to the incorporation of the interest of the involved parties. At last, it is believed that this strategy will lead to higher performing PSSs since these parties have worked closely together in order to reach the determined objectives.

> This approach could be recognized in the case study of the Basisweg, hereby started the real estate developer and the service supplier(s) talking about their mutual interests within the project. While arranging the organizational issues concerning both parties worked transparent and 'open book' as financial calculations regarding the TCO of the servitized HVAC installations were shared.

Another approach to stimulate the implementation of PSSs by service supplier is to design contracts in such a way that they are open and flexible. Since service-based contracts relate to several years, it is difficult to determine what the context of a building in which a PSS is applied will look like. The risk related with this is covered by making the agreement between the service provider and the service supplier to decide in the future what will happen with for example used products and ownership. Used contracts should be quite open and flexible to achieve this. Decisions made in the future could be made more easily and based upon common interests.

Lesson 2: Co-creation

	The service provider should use a network strategy based upon **co-creation**, whereby the creation of trust and the incorporation of multiple interests stands central. This approach should lead to equal partnerships and high-quality Product-Service-Systems.

Marketing

With the implementation of Product-Service-Systems in the real estate sector, a performance approach within the real estate sector will be introduced. The performance approach of the real estate sector is "[...] the practice of thinking and working in terms of ends rather than means" (Straub 2009, in Selviaridis & Wynstra, 2015, p.3514). Because of this performance approach, many tasks and responsibilities that are normally spread throughout the supply chain are now integrated backward in the supply chain. This implies that service providers and service suppliers receive a huger task package, but also unburdens organizations forward in the supply chain.

The added value of servitized products for service providers themselves are: (1) demands could remain on a higher aggregation level, (2) the received performance level of services is guaranteed during the contract period, (3) stable and predictive service fees are being created, (4) investments in result-and use-oriented services are not needed anymore and (5) the performance level of the building could be increased in the future. The implementation of PSSs implies a shift in procurement based on the technical specification of products towards procurement based upon the performance of delivered services. This means that the task of the service provider to challenge the service supplier to deliver a certain performance. A possible competition between the service suppliers would herewith become based upon highest added value for the building's user. This implies that the service provider should challenge the supplying parties in order to come with innovative solutions during the development phase of a servitized project (Kazemi, 2016, p.127). These solutions could increase the performance of the delivered services and be herewith beneficial for the service provider. The service provider is able to pose these demands to the service suppliers because of the before mentioned direct contact between these parties.

Because the service supplier and service provider extend their involvement in project into the exploitation phase of a servitized building it becomes easier for both parties to make alterations in the delivered PSSs. These alterations could increase the performance of the delivered services and could be implemented when the functional lifespan of a certain product expires, or when new innovative products become available.

Lesson 3: Connection for innovation

	The service provider should challenge the supplying parties to keep implementing new techniques in the delivered products. These innovative solutions should increase the performance of the delivered Product-Service-System during the complete contract period.

(Product and service) Design

Service suppliers become mutually dependent on each other in servitized real estate development projects because the performance of a certain PSS could influence the performance of other parts of the building. Therefore, it would be important to incorporate service suppliers already in early in the design phase. This stimulates partnerships that leads to more effective and efficient service provision and prevents that decision are made that would negatively the performance of other PSSs. Since the suppliers themselves have the most knowledge about their products, their knowledge is valuable to increase the effectiveness and efficiency of the service provision.

Since the service provider is responsible for the delivered services towards the customer, it is in his interest to lead the design and development phase of the project. In order to make this integration possible, the service provider should - according to Kazemi (2016, p. 127) - "[...] make a platform for joint decision making between the team and the suppliers, since the suppliers have the best knowledge regarding the components (and related services, red.)". The role of the service provider is hereby to manage the development team in such a way that the interests of the individual service suppliers relating to the performance of their delivered products and the modularity / flexibility of these are balanced with the overall aesthetics and functionality of the building.

> *"Het (vroeg betrekken van leveranciers, red.) is een andere manier van denken. […] Als je vanaf begin af aan op een goede circulaire wijze gaat ontwerpen krijg je juist een super demontabele en hartstikke goed presterend gebouw. Deze zijn hiermee heel logisch, een ontwerpteam krijgt altijd te maken met randvoorwaarden en kaders. Het is juist de kunst voor hem om iets goeds mee te maken, je moet binnen deze kaders iets creëren" C. Berning (personal communication, November 14, 2017).*

Hereby the design team should consist of besides the more 'traditional members' (e.g. architect, constructor, contractor, advisor(s), real estate developer) also of a 'delegate of the joint venture / SPV' that delivers a certain PSS. These parties together design an integrated building, whereby a balance should be find between functionality in terms of service provision and circular design and the overall architectural quality of the building.

> *"Aan de ene kant denken wij ook na over de detaillering en hoe we meer naar een sort prefabsystemen kunnen gaan. […] Maar ik geloof er ook wel in dat een gebouw er niet uit heoft te zien alsof het demontabel en circulair is. Het is zoeken naar een balans" E. van Noord (personal communication, September 21, 2017)*

The design should hereby in the first place not focus on the design from the start, but how to deliver collaboratively best value towards the customer / client and guarantee circularity. The products and possible lease contract are only a mean to reach this. The service supplier should therefore be incorporated as early as possible in the design and development of a project. Besides an early incorporation of product as services, the way these servitized products should be procured differs as well.

Lesson 4: Integrated implementation

	The service provider should incorporate service suppliers as early as possible in the development process. The early involvement of supplying parties should lead to the **integrated implementation** of PSSs in a servitized building. A balance should be found between the overall architectural quality of the building and the functionality of PSS in terms of service provision and circular design.

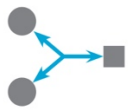
6.2.2. Interaction with customers

Contracts

As mentioned above leads the servitization of real estate to a shift from a price-based mindset towards a long-term value delivery process. This implies that demands coming from customers are not related to physical products and their technical requirements anymore, but would relate to the outcomes of the demanded services (Kazemi, 2016).

The empirical findings indicate that the role of the service provider hereby is to translate these demands into specific services to be delivered and subsequently procure these from the service provider. The PSSs delivered by the service supplier would hereby be integrated with each other in order to form a 'bundle' of PSSs, which can be seen as the building. The underlying contract between the service provider and the customer would be based upon a Service Level Agreement. These SLA's would determine the agreements concluded with the service supplier. This creates a back-to-back service delivery from the service suppliers through the service provider towards the customer(s).

Lesson 5: Translating & Integrating

	The service provider **translates the demands** of the customer as specified in Service Level Agreements into specific performance requirement for service supplier(s). Vice versa, the service provider **integrates the delivered PSSs** by the service supplier into an integrated building in order to develop a servitized real estate development project.

Overview

A possible contractual structure is presented in Figure 16, in this figure the clusters of service suppliers are based upon (1) their expected lifetime, (2) function and (3) degree to which involved parties are involved parties are already cooperating.

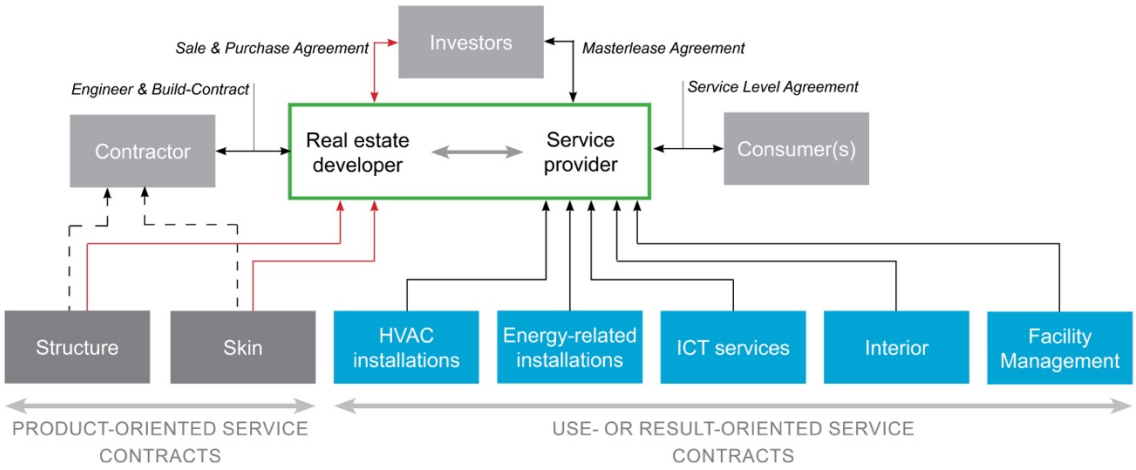


Figure 16: Possible contractual structure (own ill.)

Network

The servitization of real estate opts for a more user-centered approach within real estate development projects, that opts for flexible service concepts, with flexible lease terms. Servitized real estate development projects hereby aim to provide services that align with the actual demands of the customers. This results in a shift from demand-driven supply towards a supply-driven demand in the project organization. Hereby the demands of consumers remain on a higher aggregation level, and the supplying parties must offer an integrated solution based to this demand (De Ridder & Vrijhoef, 2007).
The role of the service provider is hereby to facilitate services that align with the demands requested by the customers. In order to know what these demands are, the service provider should search for more direct contact with the customer(s). This direct contact should create a flow of information about the customer's preferences (Mont, 2002, p.240). This market knowledge could become generated more easily compared to current practices since the service provider has a central position during the exploitation of the building. Herewith the service provider stands in direct contact with the customer(s).

Lesson 6: Direct partnership

	The service provider should opt for a more **direct partnership** with the customer in order to gain more market insight into the customer's preferences.

Marketing

The tasks of the service provider is to use the market information gained from the direct partnership to take over tasks from the customer. These tasks relate both to the development (i.e. fit-out) of rented office space and to the day to day operation of the building (cleaning, catering, hospitality). This unburdens *(ontzorgt)* the customer and makes it easier to occupy office space. Secondly, the service provider (and service suppliers) become responsible for the overall service provision towards the customer. This implies that these parties become bottom-up committed to increase the performance of the delivered services. The empirical finding indicates hereby that the incorporation of PSSs to an overall higher quality of products and herewith performances of services. This would in theory create a more competitive offer towards customer (i.e. former sub-tenants) by the service.

> *"[…] Volgens mij hoeft het gebouw niet goedkoper te worden als het op andere vlakken beter presteert. Er moet een business case zijn voor het totaal. […] Gebouwen met een beter binnenmilieu en comfortniveau waar mensen minder zoek in zijn en beter presteren, dat is de toegevoegde waarde van zo'n gebouw" Ton Glashorst (personal communication, November 14, 2017).*

As a servitized office aims to target at the unburdening and full servitization of a customer, it would be the task of the service provider to think about in which way the highest added value can be created for the customer. This user-centred way of thinking demands from both the customer to rethink the added value of the offered and used real estate and what they would be 'willing to pay' for this real estate (Den Heijer, 2013). This implies a mindset change for service providers based upon long-term value delivery towards the customers instead of short term money-making for themselves.

Lesson 7: Service delivery mindset

	The service provider should base the provided services on the market information gained from the contact with the customer. A **mindset** change based upon **long-term service delivery** towards the customer is hereby needed

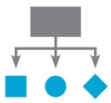
(Product and service) Design

When the service provider knows which kind of services lead to the highest value delivery towards the customers, universal service concepts could be created that could serve as a blueprint for servitized buildings. Such blueprints could increase the efficiency of the development process of said buildings and create sort of 'lean development' process. Hereby only services will be provided for which is actually demand for.

This user-cantered approach could be traced back in the case of The Boutique Office. Hereby the service provider was responsible for the development ánd exploitation of the building. By integrating these roles, the service provider created a universal product blueprint whereby a more integrated service provision towards the customer could be offered.

As the service provider becomes the main tenant of the building and will provide office space to customers in the form of a sub-lease, it becomes easier to provide flexible lease terms ánd different workplace concepts. These could be incorporated in certain service packages, that would align with the changing and specific demands of customers.

Lesson 8: Service packages

	The service provider could integrate the market information relating to customer's preferences into a universal service blueprint that could be used for other development. A blueprint could provide several **service packages,** which aim at providing flexible office space concepts according to the demands of customers over time.

6.2.3. Conditional lessons

Vertical and horizontal integration

The implementation of Product-Service-Systems in real estate development project will have a huge impact on the business model of a service supplier because the supplier has to transform its business model from a price-based environment towards a higher level of performance-based competition (Parmar et al., 2004, in De Ridder & Vrijhoef, 2007). This performance-based approach implies that many tasks and responsibilities will be transferred back into the supply chain, towards the service supplier. Suppliers in the current real estate sector are – most often- specialized in offering one specific product (group). When Product-Service-Systems are implemented in real estate development projects, several products should be working together in order to deliver one integrated PSS. This implies that the suppliers of these products should be collaborating as well in order to expand their capabilities.

This collaboration implies that suppliers needs to integrate its business into the supply chain (Baines et al., 2011; Vrijhoef & De Ridder, 2005), both vertically and horizontally. The vertical integration stems from the integration of tasks from sub-suppliers, contractors and customer. The horizontal integration is induced by the execution of tasks of neighboring companies, such as cleaning and maintenance activities. With the integration in the supply chain extend and diversifies the suppliers its delivered services (Mont, 2002; Roos & Agarwal, 2015). The empirical findings of this research indicate that the service supplier has two options to do this:

<u>1. Internalize neighbouring activities</u>

This implies that service suppliers start to execute activities that were normally executed by other parties in the project organization. The internalization of these activities could done by adding new departments to the existing company.

2. Collaboration with neighboring organizations

Supplying parties could collaborate with the use of a joint venture order to deliver an integrated Product-Service-System. With this approach, the collaborating parties become together responsible for the delivered service and is suitable when complex PSSs are offered. It is believed that the efficiency of product delivery and therefore the quality of products being delivered will increase when joint ventures will be formed and supplying parties become bottom-up committed to cooperate. The empirical findings indicate that the formation of joint ventures has several advantages: (1) Suppliers become able to handle a wider range of tasks, (2) Expertises of different organizations are summed up, (3) Risk and profit margins are shared instead of summed up to each othe and (4) Products – and services- being delivered are integrated with each other and herewith more efficient and effective.

Lesson 9: Vertical & horizontal integration

	Service suppliers should **vertically and / or horizontally integrate** within the supply chain in order to be able to deliver Product-Service-Systems.

Trading in servitized products

The underlying goal of the implementation of Product-Service-Systems in this research is to transform the current real estate sector into a Circular Economy (CE). This CE would be created by the addition of an economic / financial component to the creation of closed material loops (Aminoff et al., 2016), whereby the residual value of products should be optimized in order to come to a enhance the implementation of the CE in the real estate sector (Rampersad, 2016).

However, while conducting the case studies it became apparent that service suppliers currently have difficulties in accepting guarantees on material take-back because of uncertainty about future material prices. This implies that suppliers are not ascertained that future residual value of their delivered products will weigh up against the costs to take-back delivered products. It will become interesting for service suppliers to provide these guarantees on material take-back if the residual value of delivered products is significantly higher than the costs related to the take-back of these products. This is, on the other hand, essential in order to come to a Circular Economy.

A second 'risk-factor' for the service suppliers relating to the take-back of delivered products relates to the functional value of the product. Although materials could be designed for disassembly and consists of modular / standardized materials it could be questioned if service suppliers could re-use these products directly in new projects. This would result in a situation whereby a service supplier makes cost to take-back the delivered products, while these products would be 'worthless' for them.

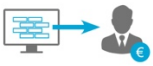
Two strategies were found in the empirical findings that could be used (by service suppliers) to decrease the risks related to the provision of a guarantee on material take-back. These strategies are:

1. Put the materials in an online material databank
2. Pre-finance the material take-back with an internal yield.

One of the current trends in the real estate sector is the use of so-called building material passports. Goals of these building passports is to create a material databank, which could be used to provide insight for external parties in the used materials in a building. These external parties could buy products from the service supplier when the service-based contract terminates. Hereby, a platform should connect the information owned by different actors to form a network and a marketplace.
See also Van Noord (Personal communication, September 21, 2017) and Rooijers (2017).

Within the empirical findings the theory was found that the TCO of PSSs would be lower than the TCO of 'linear' (i.e. current) product approaches because the vertical integration would increase the efficiency of service provision. If a service provider could reward a service supplier for the delivered services equal to the fees of current products (spread out over the contract period), then the internal yield that is created by the savings of the servitization approach could be used to pre-finance big expenditures in the future, such as costs related to material-take back when these materials sold to external arties. This incentives the service supplier to work efficient and effective because a higher efficiency creates maximum savings and increases the attractiveness to provide guarantees on material take-back.

Lesson 10: Online material databank

	Service suppliers should put their materials into **online building material databanks** in order to provide insight in deliver product towards external parties. Internal yield could be used to pre-finance costs related to product take back. The re-take of products becomes herewith financially attractive.

Creation of trust funds

Another risk for service suppliers is bankruptcy of an organization which collaboratively delivers a certain PSS. If a service provider would go bankrupt, then the chance exists that service suppliers could lose the products they have delivered since they are 'in' the building of the bankrupt service provider. If a service supplier goes bankrupt, then (1) the chance exist that a delivered product will be taken out of the servitized building, causing negative effects on the functionality of that building. And, (2) suppliers that collaboratively deliver a PSS with the bankrupt service supplier will not be able to deliver their PSS anymore.

The empirical findings indicate that service suppliers could use an SPV *(Special Purpose Vehicle)* to secure themselves, the customer and the service provider for eventual negative effects caused by the bankruptcy of one of the supplying parties, service provider or customer. This stems from the theory that this SPV is a subsidiary company with a structure that makes its obligations secure even if one of the parent companies goes bankrupt (D. De Jong & D. van Noort, personal communication, September 29, 2017).

An SPV works as follows:

- The ownership of servitized products could be put in this SPV, whereby the joint venture will be responsible to deliver these products as an integrated service towards the service provider. Hereby the joint venture could be seen as 'thé service supplier'.
- The original suppliers will sell their products to the SPV, the SPV will be on its turn financed by a bank (or other financial institution). Hereby the SPV will act as a fund, the asset in this fund is the service-based contracts, which will be secured by the products in that fund.
- Proper agreements and arrangements should be made in order to divide for example tasks, responsibilities, liabilities and the division of risk and profit within the joint venture
- The ownership of the delivered products could be split from the rest of the building by using superficies *(opstalrechten)* or building leases *(erfpachtrechten)*.

A schematic representation of the functioning of such an SPV is presented in Figure 17. It should be noted that this representation is very conceptual, the exact composition of an SPV relies heavily upon the delivered PSS.

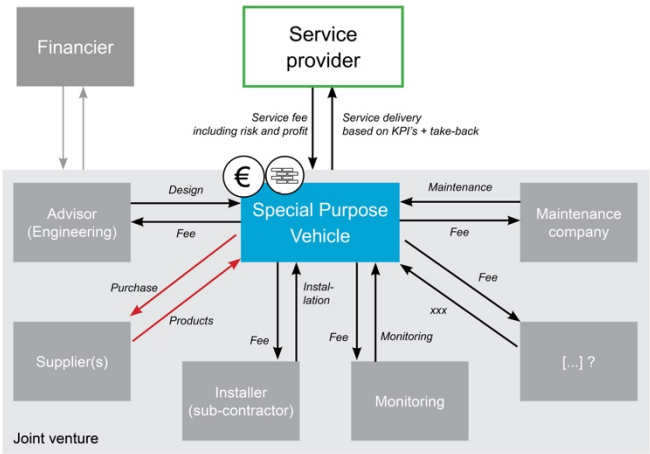


Figure 17: Clustering of service suppliers in a joint venture with an underlying SPV (own ill.)

The empirical findings mention that the use of these SPVs creates advantages relating to the next aspects:

- *Ownership:* An SPV would be owned by the members of the joint venture
- *Risk profile*: When one of the parties within the joint venture or the service provider goes bankrupt the ownership of the façade will be secured
- *Financing:* An external financier will invest in the pool of products within the SPV. Hereby the service supplier could take the products from their balance sheet and the underlying contract will become an asset instead of the used products and materials.
- *Transaction Cost Economics*: Risk and profit is made within the SPV. This avoids supplying parties adding up to risks on top of each other.
- *Bottom-up commitment:* Suppliers in an SPV will become mutually dependent on each other since they will be evaluated on the performance of the integrated service. The partnership within the joint venture would stimulate involved suppliers to make 'an extra step'.

Lesson 11: Special Purpose Vechicle

	Service suppliers could use a **Special Purpose Vehicle** to mitigate risks related to bankruptcy and finance the supplied materials.

6.3. RESEARCH RESULTS

The final research results are presented in this seconds. The final research result are graphically presented in Figure 19, Figure 20 and Table 26 and are respectively the 'interaction model', a possible 'inter-organizational structure' and the tabulated research findings.

It should be noted that preliminary versions of these Figures and Table served as input for the Expert panel, which is presented in Chapter 7. The outcomes of the Expert panel are already processed in the research results presented in this section.

6.3.1. Interaction model

The end-result of this research is the 'Interaction model', which is presented in Figure 18. This model could service as a conceptual working model that could be used by real estate developers in order to implement

PSSs and provides clarity about the needed interaction with respectively the service supplier(s) and customer(s). This model provides herewith an answer to the second objective of this research (i.e. develop a conceptual working model that could be used by real estate developers in order to implement Product-Service-Systems).

The interaction model is developed using the four business tactics from Reim et al. (2015), these business tactics are used to conceptualize this research and are used in the Interaction model in order to make the needed interaction operational. These lessons are used as 'building blocks' for the interaction between the service provider and respectively the service supplier(s) and customer(s). A schematic representation of the Interaction model is presented in Figure 18. The grey arrow in Figure 18 represents the interaction between two parties. The four business tactics are placed on the arrow in order to operationalize this interaction.

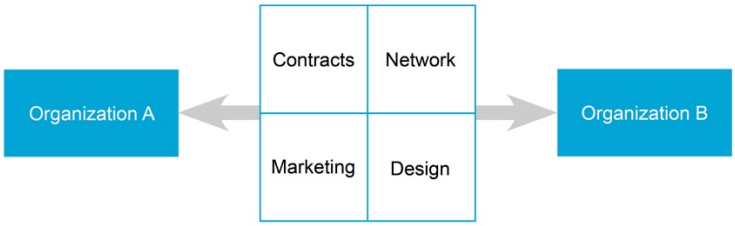


Figure 18: Schematic representation of the ' Interaction model' (own ill.)

As can be seen in Figure 19: Interaction model, are three building blocks separated from the rest of the figure. These three building blocks represent the three conditional lessons as presented in Section 6.3. These three lessons are presented separated from the rest of the model because these conditional lessons apply to the role of the service supplier and do not directly relate to the interaction between the service provider and the service supplier.
If the Interaction Model would be confronted with the Conceptual Steering Model of De Leeuw (2002), then the four empirical lessons could be seen as the 'internal management measures'. The conditional lessons could be seen as contextual influences on the process system related to the implementation of PSSs by service suppliers. However, it will be difficult to operationalize all the concepts in the Conceptual Steering Model because two different sets of Internal management would be needed and also two different process systems.

6.3.2. Inter-organizational structure

A possible inter-organizational structure has been developed in order to operationalize the research findings even further. This inter-organizational structure is developed by combining the research findings as presented in Section 6.2, Section 6.3 and the Interaction Model. In other words, if the 'Interaction model' is applied in practice, the presented inter-organizational could be the inter-organizational outcome. The inter-organizational structure could provide guidance for real estate developers and/or service providers how to divide the building into manageable Product-Service-Systems and cluster different organizations in different joint ventures. The inter-organizational structure can be seen as an elaborated version of Figure 19. This figure has been elaborated while adding the involved parties at the supplier's side when joint ventures are formed and SPV's would be used.

6.3.3. Tabulated research findings

The research findings are tabulated and presented in Table 26, this table mostly provides insight in the functioning of PSSs on an operational level. This table conceptualizes the functioning of circular Product-Service-Systems on an operational level and aligns herewith to the first research objective of this research.

INTERACTION MODEL

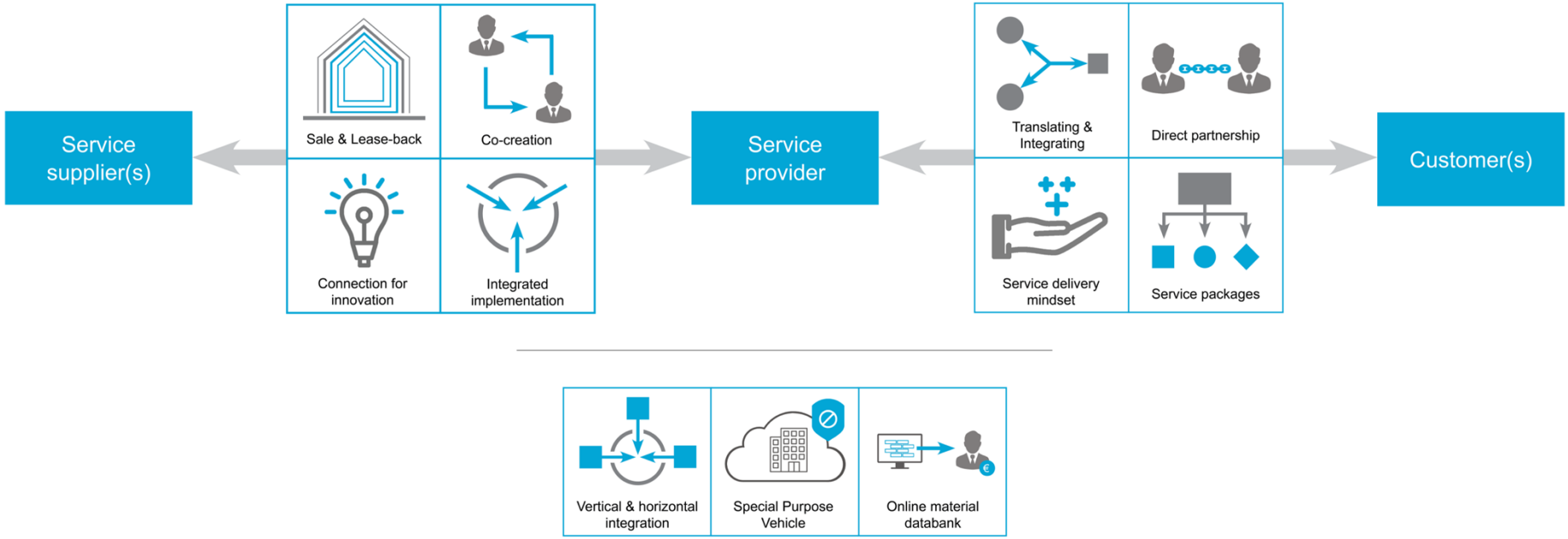


Figure 19: Interaction model (own ill.)

INTER-ORGANIZATIONAL STRUCTURE

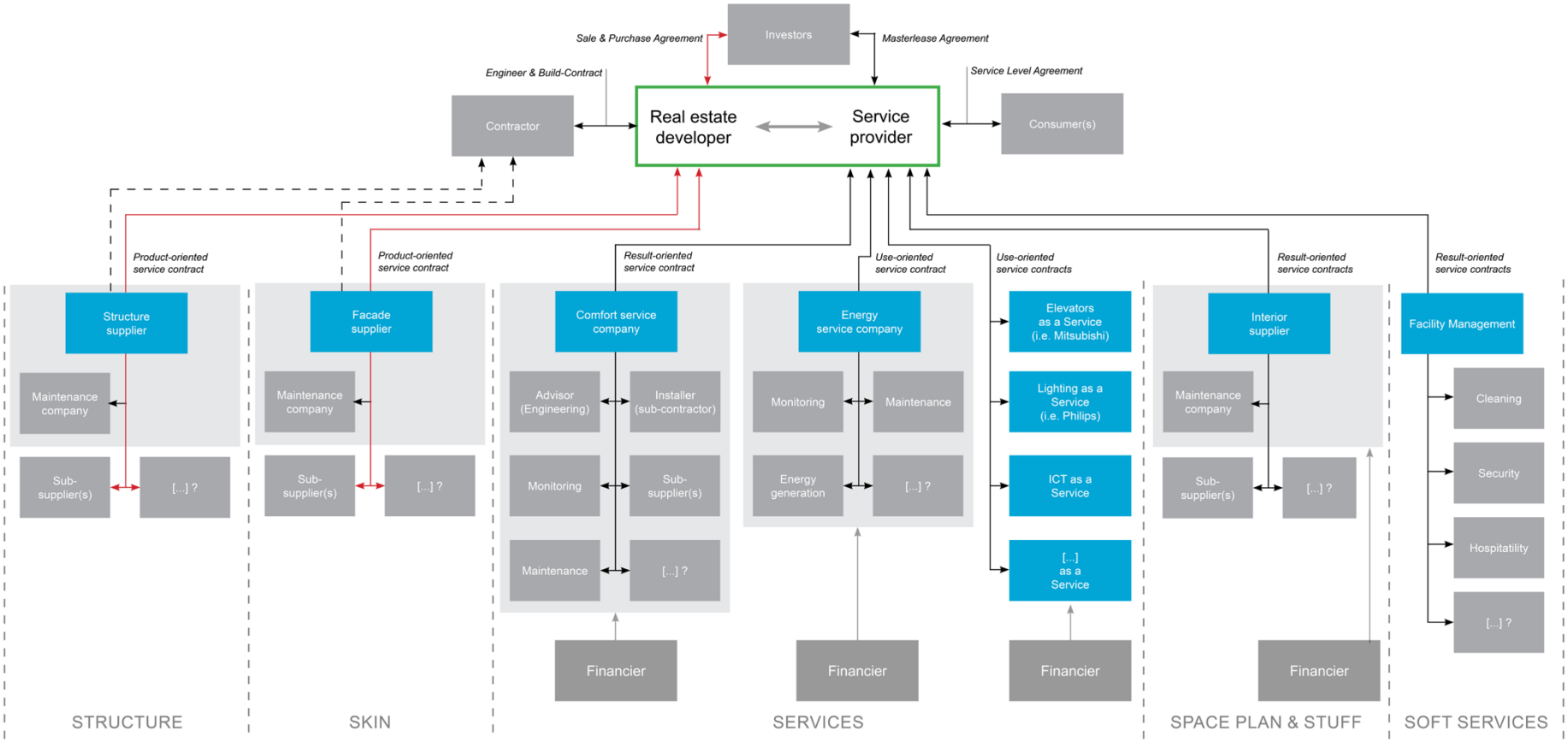


Figure 20: Inter-organizational structure (own ill.)

Table 26a: Tabulated research findings

	Service supplier	Service provider	Customer

Contracts	- Extended responsibilities
	- Vertical integration
	- Horizontal integration
	- Continuous (i.e. life-cycle) value delivery
	- Responsible for integrated service delivery
	- Reduction of transaction costs
	- Risk increase
	- Risk reduction by:
	  - Usage of internal yield
	  - Creation of SPVs
	  - Open form of contracting
	  - Data sharing
	  - Option for demolition
	- New business opportunities
	- From price-based to performance-based mindset
	- Contract as asset, instead of physical product
		- Demand and supply integration
		- Deliver services to customer
		- Translate demands into performances
		- Purchase services from suppliers
		- Investments in structure + skin of the building
		- Servitization of the 'inner layers'
		- Determination of clusters
		- Determination of inter-organizational structure
		- Determination of used contracts
		- Selection of appropriate service suppliers
		- Integrate task of developer and asset manager
		- Integration of delivered services
			- Based on Performance requirement / KPIs
			- Functions as Service Level Agreement
			- Periodic payments to service provider
			- Service packages
			- Based on office space / workplaces
			- Flexible contract duration
			- Flexible contract conditions

Networks	- Collaborative responsibility for service delivery
	- Internalization of neighbouring activities
	- Forming of consortia / joint ventures
	- Use of SPV to:
	  - Handle ownership of products
	  - Decrease risk
	  - Finance products
	  - Reduce transaction cots
	  - Create bottom-up commitment
		- Manage the real estate development process
		- Stakeholder management
		- Trust building
		- Focusing on co-creation
		- Collaborative approach
		- Support innovation at suppliers' side
			- Finding partnerships that opt for same goals

Table 26b: Tabulated research findings (continued)

	Service supplier	Service provider	Customer
Marketing	- Closer relationship with customer / provider - Communication of added value through transparency - Transparency in delivered performance - New way of value delivery of towards the customer - TCO reduction for more straightforward products - Integral value delivery approach for complex PSS	**Suppliers' side:** - Demands on a higher aggregation level - Guaranteed performance - Investment reduction - Future improvements in products - New valuation approaches based on TCO **Customer side:** - Take over tasks from customer - Analyse market demands - Analyse customer preferences - User-centered approach - Offering of flexible service concepts - Flexible lease term - Relationship building with customers - Competitive advantage because better price / quality ratio	- Determination of demanded services - Changing of demands - Demands on a higher aggregation level - Unburdening by all-in services - Fees based upon TCO - Task reduction - Guaranteed performance - User-centered approach - Increased performance of services - Sustainable organizational footprint - Competitive offer (higher quality, lower fees) - Value delivery based upon customer needs - Value delivery difficult to compare with traditional approaches - High-quality building maintenance and operation
(Product and service) Design	- Usage of modular or standardized components - Design for future disassembly - User-centered supply chain - Early incorporation in design process increases performance of products	- Platform for joint decision-making - Changing demands of customer - Early involvement of service suppliers - Development of a product blueprint - Lean development	- Service design based on customer preferences - Product blueprint aiming at 'general' customer' demands - Service package offering in product blueprint

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7. Expert panel

The outcomes of the expert panel are discussed in this chapter. The goals of the expert panel aim to measure the external validity and the internal validity of the findings of this research. Hereby "[...] the strength of a cause-effect link made by a study, in part determined by showing the absence of spurious relationships and the rejection of rival hypotheses" is being analysed (Yin, 2014, pp. 238, 239).

A general overview of the content of the session is presented in the first section of this chapter. The discussed statements are presented in this section, whereafter a short description of the views of the panel members is given. An analysis of these perspectives is presented in the second paragraph of this chapter, this analysis is presented per business tactic per stakeholder. An overview of aspects that add up to the existing knowledge or differed from the preliminary is presented in Table 28.

Research technique

The chosen research technique for this expert panel is the 'focus group'. Within a focus group (1), the emphasis lies on a particular topic and (2) several people are placed together to discuss this topic (Bryman, 2012). Hereby "[...] the focus group offers the researchers the opportunity to study the ways in which individuals collectively make sense of a phenomenon and construct meaning around it [...] This occurs in interrelation and discussion with others" (Bryman, 2012, p. 504). This creates a more naturalistic view around the topic. Therefore, the focus group in this research was used to gain more insight in the perspectives of the focus group participants on the outcomes of the research by creating a group discussion between the focus group participants. In order to enhance the value of the outcomes of the expert panel, a selection of subjects was made. Hereby subjects were selected that were (1) included in the case studies, yet, were not easy to underpin or provide proper conclusions about, or (2) the outcomes of the case study research were different than the outcomes of the literature study. The discussions during the expert panel meeting were based upon statements *(stellingen)* related to one of the four concepts used in this research.

Selection of members

The members of the expert panel were selected based upon their knowledge relating to circularity and / or the application of Product-Service-Systems in the real estate sector. In order to validate the outcomes of the research process internally and externally, the expert panel consisted of people that were interviewed in relation to the case study research and people that were not involved in the research before. In order to gain different perspectives upon the outcomes of the analyses people were selected that could be classified as 'customer', 'service supplier' and 'service provider'. In the end, the expert panel consisted of 12 members, of which:

- 8 People were 'outsiders', and 4 people were interviewed. (5 out of 8 people of the outsider group were interviewed using an explorative interview at the start of the research process).
- 1 Person could be classified as a Customer, 3 as Service Provider, 5 as Service Supplier and 3 as 'other'
- 4 People are employed at the graduation company, 8 were not.

See Appendix C: Research techniques & Appendix E: Expert panel protocol for a detailed description about the used research techniques and the used protocol to organize the expert panel.

7.1. CONTENT OF THE SESSION

In order to enhance the value of the outcomes of the expert panel, the subjects of the expert panel were:

1. Subjects that were mentioned in the case studies but were not easy to underpin or provide proper conclusions about.
2. Or, the empirical findings showed differences with the outcomes of the literature study.

Every statement (stellingen) related to one of the four concepts used in this research, an overview of these statements is presented in Table 27. A short conclusion relating to the validation of these statements is presented hereafter.

See Appendix G: Expert panel, for the complete transcription and a summary of the session.

Table 27: Overview of used statements

Business tactic	Statement	
Contracts	**1**	The integration of different project phases into one contract leads to more competitive products
	2	It is necessary to fix the way products are given a second life contractually
Network	**3**	Dividing up a building into 7 clusters is the most efficient and effective structure to develop a servitized building
Marketing	**4**	The added value of a servitized building for a customer is rather uncertain
(Product and service) Design	**5**	The incorporation of service supplier earlier in the design process while diminishing the role of the contractor leads to a better building

Statement 1

The overall consensus within the expert panel was that if products become servitized and service supplier are held responsible for the performance of their delivered products, this will lead to a higher performance level of the services delivered by these products. For products that just focus on the delivery of a single service, the competitive advantage should lie in lowering the TCO. For more complicated serviced products this approach should in the first place not only necessarily lie on lowering the TCO of that single product-system, but on the overall value delivery towards the customer. This should be made possible with the extension of responsibilities of the service supplier and a more integrated demand from the side of the customer and / or investor.

Thus, the first statement is accepted by the expert panel. However, it should be noted that according to the expert panel a servitized product cannot be compared to a 'linear products' since the value created with it is different.

Statement 2

According to the expert panel is the need to contractually fix the end-of-life of products does not necessarily exists but should definitely arranged in a certain way. The reason behind this is currently supplying parties cannot take these responsibilities and it is difficult to fix the cascading of products contractually. Mentioned possibilities to give used products another life is to (1) use savings (i.e. internal yield) to pre-finance big expenditures, (2) provide tradable Options for demolition.

The statement is accepted by the expert panel. The end-of-life of a product should not be fixed when implementing PSSs in real estate development projects, the added value of these business models is that parties with the same mindset and vision remain involved with each other during the in-use phase of a product. Hereby the proper end-of-life of a product is somehow ascertained as well.

Statement 3

It was difficult to find a general consensus between the perspectives of the expert panel members. The experts had visions based upon several concepts made by themselves or external parties, but these are not applied in reality yet. And, the own organizational / marketing goals of the service suppliers within the panel group might played a role in the overall discussion as well.

To conclude, not all the members of the expert panel agree with the introduced statement. This disagreement could be imposed by the different organizational background of the panel members.

Statement 4

According to the expert panel members the added value of servitized buildings for customers lies in the certainty of a high building performance since parties with the right knowledge remain involved during the exploitation phase of the building. Hereby the integration of the development and exploitation period of a building could also lead to a more competitive offer towards the customer.

This statement is thus rejected. The servitization of products leads in many ways to the creation of added value for customers.

Statement 5

According to the members of the expert panel it would be a good idea that the service suppliers would become earlier introduced within the development of a building, but a large abate of the role of the contractor is not realistic. The mentioned statements and views of the panel members indicate that it would be good if the contractor will be involved during the design process to bring in practical knowledge, but not to claim his central position in the supply chain back. This implies that still direct contracts between the service provider and the supplying parties are favourable and the contractor will become a more advising party during the design phase and will be coordinating party during the construction phase.

To conclude, the expert panel accepts the first part of the statement and rejects the second part of it. The earlier introduction of suppliers, according to the panel members, would be beneficial for the overall building process. The role of the contractor should not be diminished but rather changed into a more advisory role.

7.2. ANALYSES

7.2.1. Contracts

During the discussion around the first statement, one of the panel members suggested that in order to capture material value, the most buildings should not be valued anymore solely on their functional use, but, on the value of the materials of which the building is made from. Hereby contracts would eventually be based upon the 'rights of usage' of materials. The same panel member suggested later in the session that buildings hereby become material depots. A fund that would be linked to such depots would make it possible to invest in rising material prices due to the increasing resource scarcity. Although this approach could be promising and could provide a solution towards the increasing building material scarcity, the application of this in a real life case. would be very difficult because of huge juridical, financial and organizational obstacles. Since this approach goes beyond the scope of this research this perspective is further left out of this research.

The second discussion during the expert panel concerned the second life of products after contracts has terminated or buildings had passed their functional life span. The members of the expert panel mentioned that service suppliers find it difficult to provide guarantees for material take-back because of the financial uncertainty. This uncertainty could according to the panel be diminished with the use of internal savings to pre-finance big expenditures that for example relate to maintenance, repairs and costs relating to the cascading of a certain product. Another option would be to use 'Options for Demolition'. Which provide the right and the responsibility to demolish a building. These options could become tradable and provide a financial interesting option to financially secure the second life of certain materials.

Box 3: Option for demolition

What would an 'Option for demolition' look like?

The scope of a development project would include the demolition and material take-back when the demolition of a building becomes a more integral part of a real estate development project (Koolen, 2015). When this changes and the demolition becomes an integral part of the demolition process it can - according to Koolen (2015) - be assumed that more attention will be paid on the expected lifetime of a building and the way the building will be demolished. Hereby the residual value of the products and materials within the building will rise and the demolition of the building will become more interesting. The next step will be to make the 'option for demolition' a tradable asset, this might become an interesting investment if material prices will rise due to building materials scarcity.
According to Koolen (2015) this approach has three advantages:

1. The realization of a building including the demolition will be assured.
2. Material choices during the design process will become more sustainable.
3. The tradable Option for demolition will provide a flexible solution in the long term.

It should be mentioned that this approach is currently only an idea of a sustainability and has as far as the researcher knows not tested in reality yet. A real life application would form a big challenge for jurists to include the demolition in several contracts and for financial parties to make these option 'tradable'.

During the discussion about the right way of contracting and clustering of the service suppliers, it became clear that the suppliers of facades prefer to be contracted using a result- or use-oriented service contract since they wanted to become challenged to offer their facades in a different way towards their clients. This would imply, that in order to sell the building towards an investor not the 'complete' core & shell of a building could be sold any more towards an investor, as proposed in the former chapter of this research.

7.2.2. Networks

During the third discussion concerning the clustering of the project and the forming of joint ventures and SPV by the supplying parties it became clear, that the expert panel members had not much knowledge themselves about the right composition of these clusters. The members of the expert panel mentioned a concept whereby four clusters are used instead of four, but this project did not take place because of inter-organizational difficulties. Since the proposition made in this study is also based upon the points of view of several interviewees and has not been tested or applied in reality either, it is difficult to come to a proper underpinned solution for the formation of clusters within servitized real estate development projects.

7.2.3. Marketing

Service supplier

During the first statement concerning the competitiveness of servitized products, a difference in the points of views between two supplying parties was recognizable. Hereby one of the service suppliers mentioned that if service suppliers want to deliver a product as a service. The overall TCO of that product should always be lower than traditional products offers. This was countered by a service supplier involved in the delivery of complicated HVAC systems. He stated that the TCO should not per se be lower or equal compared to traditional approaches since the service suppliers will deliver create value in a different way. Hereby the focus would lie on the best solution for the end-user instead of the best (i.e. economically most advantageous) solution for the building owner.

This can be explained by the complexity of the delivered servitized product. The service supplier aiming at the lowest TCO was the service supplier of a more 'straightforward' service while the latter service supplier was involved in the delivery of a more complex climate installation system. The amount of parameters and criteria on which the performance of these systems could be valued and tested differs a lot. This indicates that the performance valuation of more complex PSSs should be based upon a more integral approach related to the entire performance of a building and not only on the single performance of a product and the TCO. Just because the way value is delivered differs and depends more on other products as well.

Customer

One of the outcomes of the expert panels, is that the value delivery of the service suppliers and service providers is difficult to compare with more traditional approaches of value delivery by suppliers and the real estate developer. The reason is that, the products and building being delivered as a service are designed with the end-user in mind and targeted at maintaining the residual value of a material instead of delivering the most economical advantage product for the short term. Therefore, the value delivery of servitized products and building is difficult to compare with more traditional approaches.
This also results in the certainty that the building that is used by a customer will keep performing well during the exploitation phase since the original suppliers and the service provider will be responsible for the operation and maintenance of the building as well. Hereby the knowledge about the building that is created during the development phase will enhance the way the building is maintained and operated.

Service provider

Another added value for the customer is the possible competitive advantage that could be created by the integration of the development and exploitation period of a building. The decreasing TCO and enhanced value and service delivery could on the other hand create a higher quality building and on the other hand a cheaper building because the TCO will in theory be lower than traditional approaches. This implies that service providers could in theory deliver a building towards customers with a better price / quality ratio. This would create a competitive advantage compared to more traditional real estate developers.

7.2.4. (Product and Service) Design

Service supplier

The members of the expert panel agreed upon the statement that the early incorporation of service suppliers in a real estate development process would lead to a more efficient and effective service and value delivery towards the customer. If service suppliers would become responsible for the design and realization of their delivered products, this would imply that current organizational structures used in real estate development processes whereby the contractor has a central role should change. In the former chapter, the idea was proposed that the contractor would only be involved in the realization phase and being a coordinator of the construction process and construction site. The members of the expert panel mentioned that this might be a step too far since currently contractors have a lot of knowledge regarding a proper way of

designing and construction of a building. Therefore, the members of the expert panel favored a constellation whereby the contractor would remain involved during the design phase of a building to use his technical knowledge. This could create a better technically designed building which might also be easier to realize.

Service provider

Also the way the service providers would steer the development process of a servitized real estate development project would change when service suppliers become responsible for the design and realization of their products. The reason for it is that service provider could not transfer the risk relating to the construction of building cannot be shifted towards contractors anymore. Hereby the service provider would become responsible for the overall technical performance of a building. In order to make this possible the contractor could become responsible for the parts that connect the different products as services with each other and should provide guarantees on these points as well.

7.3. CONCLUSION

The insights gained by the analyses of the expert panel are presented in Table 28. Only aspects that added up to the existing theories and empirical findings are presented in this Table.

Table 28: Expert panel analysis

	Service supplier	Service provider	Customer
Contracts	- Responsibility for material take-back too 'heavy' - Options for demolition - Suppliers prefer use- or result-oriented contracts	n/a: The discussion of the expert panel did not provide extra insights in the contracts used by the service provider	n/a: The discussion of the expert panel did not provide extra insights in the contracts used by the customer and their network relations.
Networks	n/a: The expert panel did not create more insights in the network of the supplier	- 4 clusters of companies in another conceptual study	
Marketing	- New way of value delivery of towards the customer - TCO reduction for more straightforward product	- Competitive advantage by offering a better price / quality ratio to customers	- Value delivery difficult to compare with current approaches - Certainty about building performance
(Product and service) Design	- Contractor involved in design process for technical knowledge - Contractor responsible for connecting parts	- Construction risks can't be transferred towards contractor	- Different form of value delivery - High-quality building maintenance and operation

The aspects mentioned in Table 28 are already included in Table 26.

8. Conclusions

The aim of this chapter is to come to conclusions, which are developed while answering the five research sub-questions and the main research question. This is done in the first section of this chapter. A discussion on these conclusions is presented in the second section of this chapter. The limitations of this research are discussed in the third section of this chapter, which is followed by a discussion on the validity and reliability of this research.

8.1. ANSWERING THE RESEARCH QUESTIONS

8.1.1. Research sub-question 1

Objective:	Choose and / or develop a model that could be used to operationalize the implementation of Product-Service-Systems in real estate development projects
Question:	How could the implementation of Product-Service-Systems be operationalized?

The used research methods and -techniques in this research indicate that in order to operationalize the implementation of Products-Service-Systems in the real estate sector, so-called business tactics – as defined by Reim et al. (2015) could be used. These business tactics are: (1) Contracts, (2) Network, (3) Marketing and (4) (Product and service) Design[5] and can be defined as a "company's residual choices on an operational level after deciding which business model to apply" (Reim, Parida, & Örtqvist, 2015, p. 66). These tactics link decisions on a strategic-level with decision on an operational-level. The definition of the business tactics is as follows:

- **Contracts:** Define "[...] the responsibilities of the involved parties during a specific contractual period. A PSS contract is designed to address all aspects related to providing the service and to state the rights and liabilities of involved parties clearly" (Reim et al., 2015, p. 67).
- **Network:** Refers to how actors "[...] use their network relationships with external partners to ensure PSS business models are implemented successfully" (Reim et al., 2015, p. 70).
- **Marketing:** Describe how actors: "[...] interact, communicate and use customer and market insights to implement their PSS business model" (Reim et al., 2015, p. 68).
- **(Product and service) Design:** Relate to how actors "[...] design product and services to meet the diverse needs of customers and successfully implement PSS business models" (Reim et al., 2015, p. 71)

Table 6 provides an overview of the tactics and related key aspects that were used to operationalize the business tactics further.

[5] Reim et al. (2015) defined in their systematic literature review five business tactics to operationalize Product-Service-Systems. However, the choice is made to use only four of them in this research and omit the concept of 'Sustainbility'. A short discussion is incorporated in Section 3.5. that underpins this choice.

8.1.2. Research sub-question 2

Objective:	Conceptualize Product-Service-Systems in real estate development projects
Question:	What are Product-Service-Systems?

In the literature study PSSs were described as: "a marketable set of products and services capable of jointly fulfilling a user's need" (Goedkoop, Van Halen, Te Riele, & Rommens, 1999). After a short discussion the next definition of a Product-Service-System was introduced and further used in this research:

> *"Products-service-systems are longitudinal relational processes, based on the principles of Circular Economy, during which products and performances are integrated, whereby the product is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's evolving needs over time" (Kazemi, 2016, p.68).*

The main concepts mentioned in the definition of Kazemi (2016, p.68) are used to structure the answer of this research sub-question. The answer ends with a redefinition of Product-Service-Systems, based on the outcomes of this research.

Generally spoken, when PSSs are implemented in real estate development projects certain services will be integrated with delivered products. These services should be in line with the value delivered by the physical product and aim to maintain, extend or optimize the performance of the delivered product over time. Product-Service-System herewith integrate the delivery of products and related services.

The services delivered with the implementation of a PSS are hereby aimed at fulfilling the needs of the user of a building (i.e. the customer). As opposed to current practices, value is hereby created during the complete in-use phase of a product and not only at the moment of product / project delivery. Thus, PSS aim at meeting customer's need over time. Secondly, the extended time-scope of involved parties make the delivery of PSSs a longitudinal relational process.

The integration of non-physical services with physical product implies a shift from procurement based on technical requirements towards procurement based upon the outcomes of the delivered services. The business model of the delivered PSS is hereby important as a spectrum is visible between pure product-oriented business models and business models that that aim for pure service delivery (Reim et al, 2015). However, the latter kind of business model could be seen as the most 'developed' kind of PSS. This means that with the implementation of PSSs the delivered products only serve as a mean in order to deliver the demanded services.

Multiple products working together as a system could for a PSS, but these systems could relate to a complete building as well. For example, the building from case study of The Boutique Office could be seen as a complete PSS, whereby the provided services relate to the offering of workplaces to the customers. On the other hand, Philips currently provides Lighting as a Service, whereby they maintain and operate lighting fixtures. Thus, Product-Service-Systems could be related to all different scale levels within a building.

Kazemi (2016) mentions that Product-Service-Systems support the implementation of the Circular Economy. The outcomes of this research indicate that Product-Service-Systems could implement the introduction of Circular Economy, but only (1) if proper agreements are made relating to the end-of-life phase of a project and (2) if the design of the products allow for a second life. To conclude, the implementation of Product-Service-Systems does not guarantee a Circular Economy, but provides a platform that could support circular business models.

A new definition of Product-Service-Systems could be made from the concepts and aspects as discussed above:

Products-service-systems are longitudinal relational processes, which could support the implementation of a Circular Economy. During which products and performances on a variety of scale levels are integrated, whereby the product is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's needs over time.

8.1.3. Research sub-question 3

Objective:	Develop conceptual working model(s) that could be used by real estate developers to interact with service suppliers in order to implement Product-Service-Systems.
Question:	How could a service provider interact with service suppliers?

The four business tactics as defined by Reim et al. (2015) are used to answer this research sub-question.

Contracts

Parties will remain involved during different phases of a project since PSSs create longitudinal relations in the supply chain of servitized real estate development projects. The current real estate developer should extend his central steering position towards the exploitation phase of a servitized building in order to be able to become a service provider. The real estate developer could do this by conducting a 'sale and lease-back' for the casco of the building with an investor. The service provider could hereafter procure PSSs related to the fit-out of the building directly from service suppliers.

Hereby it is important that the proper inter-organizational contractual structure with service suppliers is found. The dependency that comes with the implementation of PSSs increases the importance to make proper arrangements and concluding proper contracts during the development phase. The role of the service provider is hereby to design a proper inter-organizational contractual structure which (1) enhances the performance of the services and (2) is manageable. The clusters that deliver a certain PSS should hereby be composed properly (i.e. the right service suppliers should work together) and the relations between these clusters should be designed appropriately as well.

This inter-organizational contractual structure depends on the desired services to be offered, the overall project context and the capabilities of the involved service suppliers. Every real estate development project takes place in a different context ánd because the demands of customers are different in every project as well. It is therefore difficult to develop a universal inter-organizational structure for servitized buildings.

Network

The research showed that the implementation of PSSs leads to (1) more tasks and responsibilities for service suppliers, (2) increased mutual dependency between service suppliers and the service provider. This makes it difficult for service suppliers to gain enough organizational capabilities to implement the delivery of Product-Service-Systems in their organization. Secondly, these service suppliers have difficulties in accepting the increased risk profile that comes with the implementation of Product-Service-Systems as well.
The service provider should therefore search for interaction with service suppliers that aims for co-creation. This implies that the service provider should create trust within the partnership and should make sure the interests of the involved parties are ascertained when implementing PSSs, which should lead to equal partnership.

Marketing

The biggest advantage of the implementation of PSSs is the unburdening of organizations forward in the supply chain while the user value of delivered products increases. This unburdening is created by the backward vertical integration of tasks and responsibilities. The service provider should hereby search for interaction that challenges service suppliers to come up with value-adding solutions for the operation of the servitized building. This start with posing high demands during the development phase of a servitized building and could be extended during the exploitation phase of a project by providing the option to implement new innovative techniques in a PSS. The equal partnership as mentioned in the former paragraph should support and encourage service suppliers to innovate as well.

Design

It is important that the interests of the supplying parties will be secured in the design of a servitized building as the performance of their delivered services will depend on the overall configuration and technical design of the building. Since most important decisions regarding a design are taken in the design and development phase of a project, it becomes important that service suppliers will become involved during the preliminary design phase of a real estate development project.

The composition of the design team will therefore change compared to current approaches. Delegates of the supplying parties will hereby collaboratively design a building with members of the 'traditional design team' (i.e. real estate developer, architect and advisors). It is believed that such an approach will lead higher quality and better-performing buildings since the design becomes technically more integrated.

Overview

The conceptual model that could be used by real estate developer to interact with service suppliers in order to implement Product-Service-Systems is presented in Figure 18 'Interaction model' and is tabulated in Table 26.

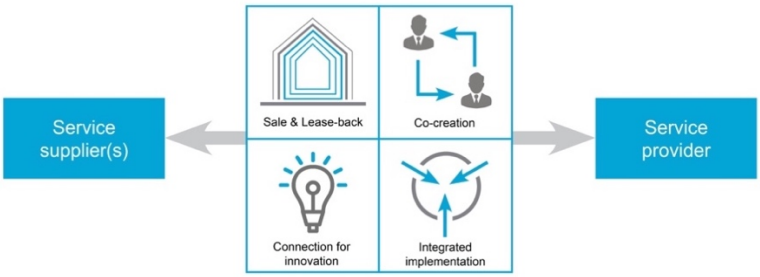

Figure 21: Interaction between the service provider and the service supplier(s)

8.1.4. Research sub-question 4

Objective:	Develop conceptual working model(s) that could be used by real estate developers to interact with customers in order to implement Product-Service-Systems.
Question:	How could a service provider interact with customers?

Contracts

The servitization of buildings implies a shift from price-based procurement to long-term value delivery procurement. Herewith demands posed by customers relate to the outcomes of provided services, rather than the technical performance of the delivered products. To provide these services towards the customer, should the service provider translate and break down the demands and requirements into specific performance requirements for the service supplier(s). The services delivered by the service suppliers should, on the other hand, be integrated with each other by the service provider in order to create an integrated and well-performing servitized building.

Network

The servitization of buildings leads to vertical integration within the supply chain. The service provider becomes hereby in direct contact with the end-user (i.e. customer). This direct contact makes it possible to gain insight in the preferences of customers related to the building during the exploitation phase. For example, by using data gained from the building management system. This information could be of strategic importance since it could be used to (1) optimize the operation of the building and (2) create market knowledge about services to be offered in a building.

Marketing

The market knowledge gained from the customers could be used to create propositions which deliver long-term value towards these customers. This means in practice that service providers should create propositions and concepts which support the organizational activities of the customers. The service provider should therefore rethink his value proposition towards the customer. Which implies mindset change based on long-term value creation for the customers instead of short-term revenue making.

(Product and service) Design

Universal service packages for servitized buildings could be created based upon the market knowledge gained from the customers and the experience of exploitation. A scalable user-centered product could hereby be created that aims for a leaner development approach. As the service provider becomes the main tenant of a servitized building, possibilities to provide flexible lease terms towards customers are created. These flexible lease terms could be combined with different kind of conditions, by which different service packages could be created. These service packages aim at providing flexible office space concepts according to the demands of customers over time.

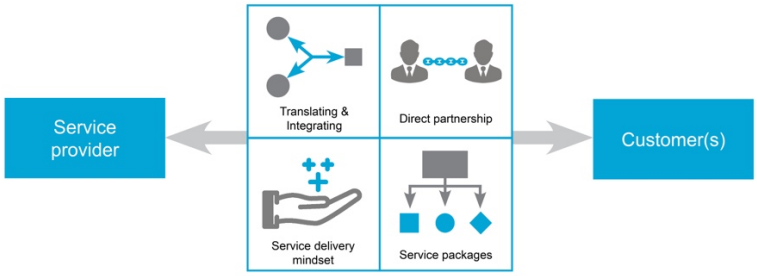

Figure 22: Interaction between the service provider and the customer(s)

8.1.5. Research sub-question 5

Objective:	Develop a conceptual working model that could be used by real estate developer to interact with service suppliers and customers in order to implement Product-Service-Systems.
Question:	How could a service provider connect the demand and supply side of circular real estate development projects?

Contracts

Current real estate developers outsource most tasks, responsibilities and especially risks towards external parties. Risk related to the construction of buildings is outsourced by concluding integrated contracts with contractors. Risk related to the exploitation of the building is outsource towards an investor by selling the developed building. This approach will not work anymore in a servitized real estate development project because the service provider becomes responsible for service delivery and procurement. The mentioned intermediaries are in a servitized real estate development project – partially – not present anymore as the supply chain vertically integrates. Contracts that arrange the delivery of services to the customers should hereby be directly backed with PSS service contracts concluded with service suppliers. The translation of demands from the customer towards the performance requirements posed to the service supplier becomes very important as the contractor is not present anymore in the supply chain. The service provider should integrate the different services into an integrated building. The service provider connects with this translation and integration the demand and supply side of a servitized real estate development project.

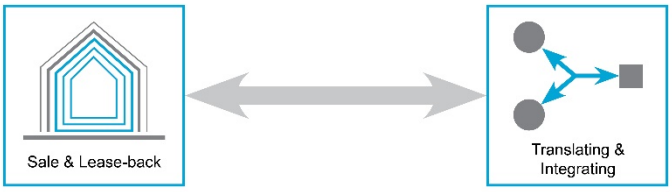

Figure 23: Connection of building blocks (Contracts)

Network

The two building blocks related to the business tactic 'Network' both relate to equal partnership and the creation of trust within the project organization. Equal partnership is necessary as the interdependencies between organizations increases. Herewith leads the implementation of Product-Service-Systems to a shift from a fragmented linear supply chain into a network of partnerships around a specific goal. This demands for sustainable long-term relationships between the involved actors in a servitized real estate development project (De Bruijn & Ten Heuvelhof, 2007). The task of the service provider is to ensure these networks of equal partnerships are actually being established and maintained. Thus, the demand and supply side of servitized real estate development projects is connected because of the created network of supplying parties, demanding parties and the system integrator (i.e. the service provider).

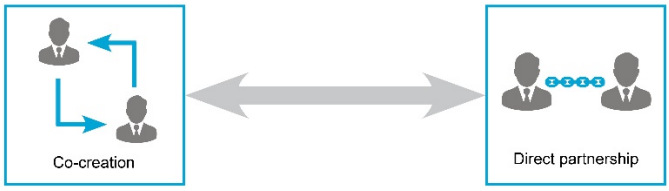

Figure 24: Connection of building blocks (Network)

Marketing

The servitization of real estate requires a mentality shift from the service provider. This organization should act in the interest of long-term service delivery towards the customer instead of short-term revenue creation for themselves. The partnership between the service provider and service suppliers could support this mentality shift that could aim for increased performance of PSSs. This extended relationship makes it possible to upgrade delivered PSSs with new techniques or products. Which in the ends could lead to increased performance of the PSS. Hereby securing the performance-level of the delivered services in the future. The task of the service provider is hereby to keep challenging the service suppliers to innovate and come up with solutions that provide value for the customers.
Thus, the extended connection of the service provider with the service supplier makes it possible to direct market knowledge backwards in the supply chain. This market knowledge could be used to generate new service concepts. These service concepts could be implemented easier as the supplying parties remain involved during the exploitation phase. These innovations and upgrades in PSSs could create more service value.

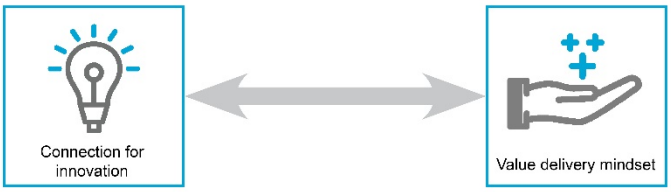

Figure 25: Connection of building blocks (Marketing)

(Product and service) Design

The business tactic 'Design' refers to both the design of delivered services and the design of products which deliver these services. In order to ensure that the performance level of delivered services remains on a high level, it is necessary that: (1) the physical services function well and (2) the services delivered benefit the customer that consumes the service.

The service provider should use a 'lean development' approach in order to reach the two abovementioned points. Lean development at the supply side refers to the collaborative design & development phase of a servitized building. This team should develop a servitized building that provider services according to the customer needs. The complete bundle of services could be divided into smaller pieces as each customer would have specific demands. Herewith specific service packages could be created that provide services. Only services in line with the need of costumers will be provided hereby, in line with lean principles.

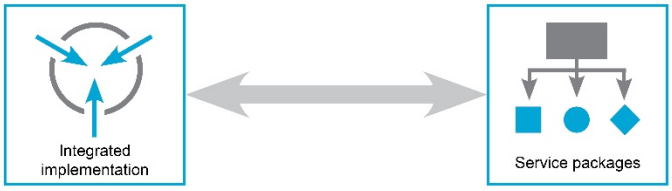

Figure 26: Connection of building blocks (Design)

8.1.6. Main research question

Objective:	(1) Conceptualize the functioning of circular Product-Service-Systems on an operational level and (2) develop conceptual working models that could be applied by real estate developers to perform the role of the service provider within circular real estate development projects.
Question:	How could a service provider interact with product suppliers and customers in order to implement Product-Service-Systems in real estate development projects?
Methodology:	Explorative empirical research

Based upon the outcomes of this research it can be concluded that Product-Service-Systems are longitudinal relational processes, which could support the implementation of Circular Economy, during which products and performances on a variety of scale levels are integrated, whereby the product is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's evolving needs over time.

As Product-Service-Systems aim at meeting end-users needs, service value is created over time. This implies that a mindset change within the real estate sector is needed in order to servitise real estate development projects. Organizations in the real estate sector should hereby aim at long-term value creation for customers and other partners instead of short term value creation for themselves. Hereby actors within the supply chain should opt for equal partnership and form networks of organizations around a specific goal.

The role of the service provider is hereby to find the right partnerships and ensure incentives will be directed towards thig long-term service delivery. The form and content of these partnerships is essential in order to implement Product-Service-Systems successfully.

The service provider could attain this using the 'Interaction Model' as presented in Figure 19. The Interaction Model aims hereby to support the interaction between the service provider and respectively the service supplier(s) and customer(s) on an operational level in order to implement these PSS.

Incentives should be placed in the right direction, equal partnerships should be established, products should fit in closed material loops and buildings should aim at meeting the customers' needs over time. If these aspects are included, then the shift of the real estate sector a more Circular Economy becomes ascertained while more service value is created for customers.

8.2. DISCUSSION

The outcomes of this research are discussed in this section. The main topics that will be discussed are: (1) relation between the outcomes and existing theories, (2) relation between the outcomes and practice, (3) relation between the outcomes and other research projects and (4) the limitations, validity and reliability of this research.

8.2.1. Discussion on theory

The systematic literature study of this research covered – generally spoken – three research themes; (1) The implementation of Product-Service-Systems, (2) Supply Chain Management and (3) Circular Economy in the real estate sector. The relation between the outcomes of this research and the outcomes of the literature related to these three subjects and main sources are discussed.

Product-Service-System literature

The main sources for the first theme were the theses of Reim et al. (2015), Selviraridis & Wynstra (2015), Tukker (2004) and Mont (2002). These sources provided an abstract view on how PSSs could be implemented in practice and what the influence of the implementation of these systems would be for involved actors.

One of the observed differences between the literature sources relating to PSSs and the findings of this research is the general preference of service suppliers to use result- or use-oriented service contracts when offering PSSs. It was expected at the start of this research that the implementation of service-based products by service supplier would go rather incremental. So, product-oriented service contracts would be preferred. An explanation for the preference for use- or result-oriented contract is that these types of contract provide more freedom for service suppliers. The service supplier will hereby not 'have the feeling' that he receives only a bigger task package while not gaining any other advantages.

Many empirical lessons (i.e. building blocks) in the Interaction Model could already be recognized in the existing theories. This research provides more empirical knowledge on an operational level in order to underpin and 'deepen' the existing knowledge related to the implementation of PSSs in practice. Besides, most PSS-literature sources focus on the implementation of these systems in fields outside the real estate sector. The conducted research added up to this by providing insight in the needed interaction and conditions to implement these systems in complex real estate development processes.

Supply Chain Management literature

The literature study about supply chains in the real estate / construction sector was based upon the articles (and dissertation) of Ruben Vrijhoef, Hennes de Ridder and Lauri Koksela (De Ridder & Vrijhoef 2007; Vrijhoef, 2011; Vrijhoef & De Ridder, 2005; Vrijhoef & Koksela, 2000). Supply Chain Management focusses on the entire supply chain and aims to increase the alignment and transparency of the supply chain. Hereby the functional and corporate boundaries are passed, which implies that improvements in terms of integration of business processes can be a focal point (Vrijhoef & Koskela, 2000). A supply chain could therefore be defined as: "the network of organization that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer" (Vrijhoef & Koksela, 2000, p.170).

One of the main ideas of these literature sources is that supplying parties in the construction / real estate supply chain would partner in order to develop product-systems that could be implemented in a wide range of projects. Hereby cases from (for example) the automobile industry were used to build theories from. In this research the long-term partnering of supplying parties has not been observed. This could be explained by the unit of analysis of the case studies, which lie on real estate development projects and not on the

supplying organizations themselves. On the other hand, the researcher questions whether a long-term supply chain integration whereby different parties will collaborate for longer periods for multiple projects will happen if the real estate sector becomes more service-based, because although parties become mutually dependent on each other and the added value in terms efficiency and effectiveness are admitted the construction / real estate supply chain still remains to be quite conservative, fragmented and complicated. Other aspects, such as the way actors would collaborate and interact within the supply chain were both observed in the studied literature relating to Supply Chain Management and the empirical findings derived from the case studies.

'Circular Economy in the real estate sector'-literature

The literature study relating the Circular Economy (in the real estate sector) was mostly based upon the outcomes of the theses of Werner Loppies (2016), Roshan Rampersad (2016), Robert van den Brink (2016) and Alieh Kazemi (2016). The latter two authors focused upon the implementation of CE in the real estate sector and a possible role of the service provider. These theses created herewith a proper theoretical background for this research. However, the empirical findings of both researches were not based upon case study projects wherein the second life of products would be guaranteed. Moreover, Product-Service-Systems were not even included. The outcomes of this research contain therefore many differences with the outcomes of Van den Brink (2016) and Kazemi (2016).
Moreover, the outcomes of this research might be more relating to current practices instead of focusing on the creation of 'futuristic concepts'.

The implementation of the Circular Economy in the real estate sector goes rather slow and many barriers have to be overcome. It was therefore hard to retrieve empirical data from the mentioned studies. The added value of this thesis is herewith that more empirical knowledge is added to the existing body of knowledge, which provides deeper insight and concrete knowledge related to the application of circular business models in the real estate sector.

8.2.2. Discussion on practice

As mentioned in Appendix D: Case study protocol was one of the goals of the case study sampling to cover the four used business tactics in this research. Underlying reason for this is that the empirical findings derived from the case studies cover the entire subject of research. The added value of these case studies is discussed in this section.

Case studies

Case study 1: Triodos Bank

The case study of Triodos Bank provided empirical information about:

- The contractual aspects of servitized products
- The created business opportunities for service suppliers
- The supportive approach of the service provider
- The usage of SPVs and product-oriented service contracts
- Creation of an internal yield to pre-finance big expenditures
- The use of superficies to split the ownership of servitized products from buildings

This case study mostly focused upon (1) the relationship between the service supplier and the service provider and (2) the needed intra-institutional changes within the service supplier.

An unexpected finding derived from this case study was that Product-Service-Systems could be created with the use of a 'simple' obligatory provision. The ownership of a servitized product could herewith still be placed at the side of the building owner (i.e. customer in this case). In the meanwhile, the service supplier would still be bottom-up committed to maintain and operate the façade in such a way so that the residual value of the servitized product would be optimized.

Case study 2: Basisweg

The case study of the Basisweg provided new insights about:

- The usage of joint ventures to deliver integrated Product-Service-Systems
- The usage of Special Purpose Vehicles to handle ownership and financial investments
- The delivery of a new kind of value proposition, based on added value instead of products
- The appropriate synergy within a joint venture
- A more integrated way of designing
- The added value of servitized products for the customer

The outcomes of the case study created herewith more insight in a possible cooperation between supplying parties when delivering integrated and rather complex PSSs. Several other authors mentioned that 'the need for parties to work together would increase when implementing circular business models'. It was however not clear to the researcher what this cooperation would look like and in which organizational form this cooperation and collaboration should take place. The outcomes of this case study changed this.

Case study 3: The Boutique Office

The last case study provided insight in:

- A possible way how real estate developer could transform themselves into service providers
- The interaction between customers and the service provider
- The added value of servitized office space for customers
- The creation of servitized office concepts

This case study provided thus information about a possible transition of the real estate developer towards the role of a service provider. This case study provided herewith the basis for the outcomes of the Network structure as presented in Section 6.2.

Market readiness

The three conducted case studies were, during the research process, part of the few available real estate development projects whereby 'circular' Product-Service-Systems were intended to be implemented. Although many market parties are currently talking about the implementation of circular business models in real estate projects, the actual implementation is not taking place.

There is currently not a universal and well-accepted system that defines circularity. Market parties therefore claim that products and building they have created are 'circular'. For example, during the research process several buildings which are in development or are relized, claim to be 'circular'. However, the focus of the makers of these buildings has only been on the design of the building. Which does not mean that the building products will be given a second life at the end-of-life phase of the project. These buildings are herewith only demountable and could perhaps be classified as 'cradle-to-cradle'. The claim these buildings are 'circular' is perhaps misplaced as not a real 'economic' component is added to the possible re-use of the building products. The most 'value' created with these project is the marketing and branding value for the organization itself.

> *"Dit is ook mijn kritiek op andere bedrijven. […] Zulke projecten zijn fantastisch want het maakt iedereen wakker om circulair te werken. Maar het zijn op zijn best producten die ontworpen zijn om uit elkaar gehaald te worden. Of iemand dat daadwerkelijk gaat doen, hangt af van wie het materiaal tegen die tijd is en wie daarvoor dan verantwoordelijk is" M. Bierman (personal communication, October 05, 2017).*

It can be questioned what the added value of these buildings is for the shift of the real estate sector towards a more Circular Economy. The lack of proper incentive structures, whereby suppliers or owners become responsible to place materials in closed loops, does not create a shift towards a more Circular Economy. The approach used in this research works the other way around. This research advocates to first arrange the organizational and contractual responsibilities concerning products. This 'fundament' should lead to the creation of different incentives which might lead to different design approaches and material usage. Hereby is the implementation of Product-Service-Systems only a mean in order to come to a more Circular Economy.

The added value of Product-Service-Systems

But, the added value of PSSs for the shift towards a more Circular Economy could be questioned as well. The case study around the new office for Triodos Bank proved that only a 'simple' obligatory provision could ascertain product take-back by suppliers as well. It seems therefore that the introduction of – complicated – PSSs might nog be needed to come to a more Circular Economy. Especially the PSSs business models whereby the ownership of products remains with the original suppliers (i.e. result- and use-oriented services) seem herewith unnecessary.

On the other hand, service suppliers will not accept 'guarantees for material take-back' when nothing else is in the deal for them. Providing guarantees on material take-back increases risk for suppliers as it is unknown for them if they could re-use building the delivered products in the future. Product-Service-Systems provide (1) the chance to expand the business model for these suppliers and (2) suppliers remain involved with their delivered material as they become responsible to – for example – maintain it. This creates more certainty related to future material take-back as the suppliers could remain the quality of the material on a high level.

Thus, the use of PSSs could be seen as an effective manner to support the shift towards a more Circular Economy. But, it should always be taken into account what the objective of these PSSs would be in terms of circularity and service provision. Hereby a balance should be found between (1) ensuring closed material loops and (2) the consequences of the shift in responsibilities towards the service suppliers.

Special Purpose Vehicles

One of the conditional lessons, as mentioned in Section 6.3, related to the creation of SPVs in order to finance delivered physical products in a PSS. As the scope – and time – of this research was limited not much attention was paid to the exact functioning of these SPVs. Moreover, these kinds of organizations are not often used yet in practice.

Moreover, it was mentioned during the Expert Panel session that the calculated yield of financiers is quite high as these vehicles include high risks. It is therefore uncertain what the feasibility of these vehicles is. This point was one of the main pitfalls in the research conducted by Azcárate-Aguerre et al. (2017). This research was about the servitization of the façade of the EWI building of TU Delft. It was mentioned in this research that the yield to finance products in SPVs are much higher for private companies then for (semi-)public organizations. Therefore, it was in the case of the TU Delft not financially attractive to use an SPV to finance products since the university could borrow money themselves for a much lower interest rate. The uncertainty about the feasibility of these vehicles is acknowledged by the researcher. More knowledge is needed to provide clarity about these SPVs. *See also: Recommendations.*

Real estate developers as circular service providers

One of the hypotheses of this research was that current real estate developers would transforms themselves into service providers. The real estate developer should extend his central 'steering' position within a project towards the exploitation in order to do this. This implies that the tasks of the current asset manager are taken over.

The focus will shift towards the exploitation phase if buildings become servitized. This makes it reasonable that the asset manager will take the role of the service provider. The asset manager would herewith become involved during the development phase of a building as the integration between the development phase and the exploitation phase remains necessary. On the other hand, the current expertise of an asset manager mostly relate to the operationalization of a building on a daily basis. Thus, the current expertise relates to catering, hospitality and smaller maintenance activities.

It is often mentioned that the real estate developer has a central 'steering' position within a real estate development project. Another organization which has a central 'steering' position within the construction sector is the contractor. Currently contractors outsource many tasks related to the construction of a building towards 'co-makers'. These 'co-makers' are most often suppliers that become responsible for the realization of their delivered products. This approach is similar to the realization of Product-Service-Systems in a servitized building. If service providers would transform into service provider, they should radically change their business model.

- Their current model based upon short-term revenue making based upon fees over the total construction should transform into a model based upon long-term value creation towards customers.
- Their current involvement during the realization phase will herewith be extended towards the entire project life-cycle (i.e. initiative, design, development, realization, exploitation and end-of-life).
- The current customer of a contractor is most often a real estate developer. The customer in a servitized building is the eventual end-user.

As Van den Brink (2016) already described, it remains hard to point out which party is the best to take the role of the circular service provider. On the other hand, the graduation company will exploit their developed buildings in the future. This organization proves herewith that a real estate developer is capable to transform itself into a service provider. Perhaps other companies could take this role as well, but no evidence was found this is happening in the real estate market yet.

8.2.3. Discussion on current research

A research program that focusses on the shift of the real estate sector towards a more Circular Economy is the REPAiR (REsource Management in Peri-urban AReas) research program. Within the REPAiR research project, several challenges on 5 different scale levels were determined (Heurkens & Dabrowski, 2017),

This research contributed most to the 'Inter-institutional' scale level as it applied to the needed interaction between private parties in order to implement circular business models in private real estate development projects. However, during this research it turned out that in order to overcome several 'Inter-institutional' challenges, changes are necessary in the four other scale levels.

Financial-economic challenges

As mentioned by Heurkens & Dabrowski (2017), financiers are reluctant to finance SPV or other 'CE ventures' that should bridge the finance gap of private parties. The usage of SPVs is presented in this research as a 'conditional building block' in order to implement SPVs. It remains unfortunately unclear if these SPVs are feasible instruments to finance 'circular' products as not much empirical evidence is available yet.

Legal-regulatory challenges

Heurkens & Dabrowski (2017) presented legal-regulatory challenges related to implementation of CE in the construction sector. These challenges applied to tight restrictions concerning waste processing and building regulations. However, in this research, the biggest legal-regulatory challenges were found at a legislative level. This challenge related to limited possibilities to use superficies *(opstalrechten)* to split the ownership of certain building layers / building products from the rest of a building. Another challenge found at the legal-regulatory level was the lack of clear standards *(normeringen)* that describe and / or qualify the 'level of circularity' of building products. This makes it difficult for private parties to (1) provide insight in materials they offer and (2) procure 'circular' building products.

Intra-institutional challenges

The three challenges which, according to Heurkens & Dabrowski (2017), apply to this level relate mostly to the municipality. The different interest between departments within this public party are hereby mentioned as the most important intra-institutional challenge. Similar challenges were found in this research, but they applied to private parties. The challenges witnessed in this research mostly applied to the graduation company and are:

- Conflicts in sustainability (circularity) vs. profit making / quick development process
- Asymmetry of knowledge between departments
- Different focus points to innovate in between departments
- Lack of awareness across departments about to the 'market position' related to the implementation of CE in the real estate sector

Behavioral challenges

The gradation company intends to 'show the way' to implement CE in their real estate development projects. However, the intra-institutional challenges mentioned above hamper the challenge to innovate in this subject within this company.

Heurkens & Dabrowski (2017) mention that there is a 'low awareness on CE among producers'. This has also been recognized to a certain extent during this research. The majority of the organizations within the construction / real estate sector wait until other parties have developed more knowledge before they shift. On the other hand, the research visited several meetings / symposia during the research process about circularity. Many other supplying parties joined these meetings as they were searching for new business models in order to make the shift towards a CE possible. These suppliers mentioned sometimes that they are searching for clients that want to innovate together with them in order to implement CE business models. However, not much of these clients (i.e. real estate developers) want to step up and introduce circular business models (Heurkens & Dabrowski). This research proved that there are – fortunately – developers that want to use a cooperative approach and implement these circular business models. Hopefully other developers follow this example.

Conclusion

The case studies in this research incorporated circular business models on a project level. The REPAiR research aims to incorporate circularity on an urban level by connecting urban waste streams with each other. It could be questioned whether the role of the public parties is that important in order to incorporate CE in the construction sector. This research shows that CE could also be incorporated within the construction / real estate sector without major public party involvement. The outcomes of this research indicate that public parties should only facilitate the incorporation of CE principles by applying other legislative and regulatory roles.

8.3. LIMITATIONS, VALIDITY & RELIABILITY

8.3.1. Limitations

First of all, the empirical findings of this research are derived from three case studies which all have a different focus and are owned by one real estate developer. It could be argued that the empirical findings are therefore based 'thin' empirical evidence. The credibility of the outcomes of this research could be harmed by the lack of a strong empirical basis. On the other hand, not many other case studies are available in the current real estate sector that could be used to generate relevant empirical data from.

Secondly, all the analyzed case studies were in the development phase, at the moment this research took place. The implementation of PSSs in these projects were herewith 'in development' as well. It is therefore uncertain if the PSSs studied in the case study concerning The Basisweg and Triodos Bank will actually be implemented in these projects. Still some barriers need to be overcome before this implementation will take place. It remains therefore uncertain whether the mentioned strategies in the Findings chapter will eventually lead to a successful implementation of PSSs. It is for example still uncertain whether financing servitized products with the use of SPVs will eventually be financially / economically attractive.

Thirdly, the unit of analyses of the conducted case studies applied to the development phase of real estate. However, PSSs in this research are all about service provision during the exploitation phase of a building. The extended involvement of organizations during the exploitation phase is therefore not analyzed.

Fourthly, the initial research proposal of this research was mostly about the interaction between the service provider and service supplier(s) in order to implement PSSs in real estate development projects. It has been tried to shift the focus of the study towards the interaction between the service suppliers and the customers while conducting the case studies. However, this part is still behind to other parts of this research. Maybe a bigger focus on this part of the supply chain could have created more outcomes and deeper insights in the subject of servitized office concepts.

8.3.2. Construct validity

Construct validity refers to "[...] the accuracy with which a case study's measures reflect the concepts being studied" (Yin, 2014, p. 238). As mentioned in the Foreword and Research proposal of this research, the aim of this research to implement Product-Service-Systems in real estate development projects in order to support the implementation of the Circular Economy in the real estate sector.

In order to operationalize the implementation of Product-Service-Systems in real estate development projects, the business tactics as defined by Reim et al. (2015) have been used. These business tactics were created by Reim et al. (2015) based upon a systematic literature review about the implementation of PSSs in several fields. These tactics could be defined as a "company's residual choices at an operational level after deciding which business model to apply" (Reim et al., 2015, p. 66). Some alterations are made on the selected business tactics whereby one of the business tactics has not been taken into consideration since it is not a 'choice' but rather an 'outcome'. Nevertheless, it is believed that the used concepts (i.e. business tactics) properly measure the case study's measures.

8.3.3. Internal validity

This concept relates to the question "[...] whether a finding that incorporates a causal relationship between two or more variables is sound" (Bryman, 2012, p. 712). In order to enhance the internal validity of the findings of this research the 'building theories'-method as described by Eisenhardt (1989) and Vrijhoef (2011) is used. This method included a consistent step-by-step approach with the aim to create empirically supported theories from case study data. The research techniques included in this method are, besides others: a within-case analyses, a cross-case analyses whereby pattern matching techniques and narrative analyses are used. The outcomes of these analyses are confronted with existing theories before hypotheses were shaped.

It has also been endeavored to enhance the internal- & external validity of the outcomes of this research with the use of an Expert Panel. Some members of the Expert panel were already involved in the graduation research and others were not. The outcomes of the interviews held with them were herewith internally validated.

8.3.4. External validity

External validity concerns "the extent to which the findings from a case study can be analytically generalized to other situations that were not part of the original study" (Yin, 2014, p. 238).

The external validity is enhanced by (1) conducting several explorative interviews with suppliers that opt to deliver PSSs and by (2) incorporating 'outsiders' in the expert panel. These 'outsiders' are experts that were not involved during the case study research.

On the other hand, the research topic of this research is quite new in practice. Therefore, not much case studies available and the products that are being servitized are quite specific. Moreover, the case studies are all projects from the graduation company. It is believed by the researcher that the corporate strategy and 'way of working' of the graduation company influenced the outcomes of this research a lot. This could be explained in a positive way by mentioning that it is believed that the graduation company is quite an innovative real estate developer compared to other parties in the Dutch real estate market. On the other hand, this decreases the external validity of the outcomes since it is believed that not every real estate developer has the ability to innovate and transform towards the role of a service provider. As mentioned by J.H. Tiedema (personal communication, October 20, 2017) the innovation capacity of a company is determined by the *vision* of a company and the *drive* of the people to really innovate.

At last, researcher acknowledges that other market parties, such as Delta Development Group, are working on similar service-based real estate development concepts. As was mentioned during the Expert Panel the ideas of this market party are maybe a bit more innovative as proposed in this research since they assume that all building layers could be placed within one SPV and the entire building becomes hereby a material depot. Although this concept might be more innovative as the proposed ideas in this research, the question also rises what the value of this concept is since it creates many organizational barriers and therefore does not come 'from the ground'.

8.3.5. Reliability

Reliability refers to "[...] the consistency and repeatability of the research procedures used in a case study" (Yin, 2014, p. 240). In order to provide insight in the research methodologies of the entire research, several protocols were developed and included in the Appendix. These are:

- Appendix D: Research techniques;
- Appendix D: Case study protocol;
- Appendix E: Expert panel protocol.

9. Recommendations

This chapter presents the recommendations derived from the outcomes of this research. The recommendations are based on the conclusions of the main research question, the research sub-questions and the discussion. This chapter is split up in recommendations for (1) practice, (2) policy and (3) future research.

9.1. RECOMMENDATIONS FOR PRACTICE

9.1.1. Service suppliers

Currently suppliers have a rather weak position in a real estate development projects since they are – most often – selected by the contractor based on a lowest price competition. This leads to adversarial relations within real estate development projects. Such mechanisms lead to low levels of trust and it negatively affects the quality of the delivered products. The researcher recommends therefore that supplier should take a stronger position within the supply chain. They could do this by rethinking about what their added value to a project could be if they are involved with a project during the design and exploitation phase. Their expertise and knowledge could increase the performance of a building if it is applied in a correct way. Service suppliers should therefore search for direct contact with service providers and communicate their value clearer. Service suppliers that are willing to take responsibility for their own products could hereby gain a better position within a development as they become in direct contact with service providers.

9.1.2. Service providers

Firstly, "Servitization is an emergent process where existing routines continuously interact differently under changing conditions, rather than the process of overhauling existing routines provides a more informed interpretation of how a service culture is gradually embedded into traditionally product-oriented organisations" (Robinson & Chan, 2014, p. 910). The implementation of PSSs and the transition towards a CE should therefore be an incremental change. This incremental change should according to the researcher happen with the use of pilot-projects within real estate development projects. Lessons learned from a pilot should be applied and added up to other. The Circular Economy will herewith be incrementally applied in the real estate sector. Since service providers (i.e. real estate developers) steer these real estate development projects it would be the task of the service provider to keep implementing innovative service-based business models in these projects while challenging and supporting different suppliers to come up with innovative PSSs.

Secondly, service providers should share the gained knowledge about service provision with other (supplying) parties in the real estate market. This knowledge could be used by service suppliers to innovate as well in order to implement PSSs in their business models. This is also beneficial for service providers themselves since (1) more products would be offered as services and (2) the competition between service suppliers could be enhanced.

Thirdly, the outcomes of this research are not related to specific PSSs. Unfortunately, this could not be a part of this research anymore. The researcher recommends therefore that service providers should determine for themselves which products are the most attractive to procure 'as a service'. The service provider could hereafter contact suppliers of these products and challenge them to deliver that product as a service.

Fourthly, financial institutions are reluctant in financing products in special funds such as SPVs. It is believed that these financial institutions see the risk related to these investments as too high. The researcher rec-

ommends therefore that service providers should use a cooperative approach in order to convince / support financiers to implement accept innovative new ways of financing. This approach would be similar to the approach used to support service suppliers to incorporate PSS business models in their organization. It would herewith be important to involve financiers as early as possible in a project whereby these new forms of financing would be incorporated. However, it is admitted that this mindset change might be more difficult to establish than the mindset change needed to transform suppliers into service suppliers.

9.1.3. Customers

It is difficult to connect the price of delivered services to the 'value' it creates. Service fees are therefore currently calculated based upon a TCO approach. Customers should therefore think more about the added value of the used real estate for their organization. The added value of real estate would hereby connected to financial value. Thus, customers should question themselves what they would be 'willing to pay' for real estate that is perfectly aligned with their organization. Service providers could then be paid based on the actual performance level of the organization, related to aspects influenced by the used real estate of the customer (i.e. sickness leave, productivity level of the workers). The researcher recommends therefore (1) that real estate manager should rethink the demanded services in their real estate portfolio and (2) that real estate managers should challenge service providers more to actually deliver services aligning with the needs of their organization.

9.1.4. Market-wide

As mentioned in the Discussion, organizations that intend to implement circular business models in their projects find difficulties in defining what a circular product is and how 'circularity' can be measured. Moreover, organizations claim to work 'circular', while these organization only produce products which are demountable and re-usable. A well-defined and well-accepted system that allows to 'measure' and define circularity would be helpful to solve this situation. The researcher recommends therefore that such a system will be developed.

9.2. RECOMMENDATIONS FOR POLICY

9.2.1. Legislation

It is currently not possible to use superficies to split the ownership of an 'essential building component' from the rest of the building. New ownership models are herewith difficult to establish, which hampers the implementation of the Circular Economy in the real estate sector. Legislative authorities should be aware of the current obstacles to implement the Circular Economy. The researcher recommends therefore that private parties should proactively encounter the legislative authorities to point out this problem. In the meanwhile, legislative authorities should consult market parties about the obstacles they witness[6]. And, of course, try to take away these obstacles.

9.2.2. Local governments

The design of building should allow for functionality changes in order to become truly 'circular. Therefore should local governments design zoning plans *(bestemmingsplanen)* in such a way that building could

[6] This also been acknowledged by the governing parties in the newly formed government in the 'Regeerakkaard'. Ref: Rijksoverheid (2017) *Vertrouwen in de toekomst*; *Regeerakkoord 2017 – 2021*. VVD, CDA, D66 & ChristenUnie. Retrieved from: https://www.kabinetsformatie2017.nl/documenten/publicaties/2017/10/10/regeerakkoord-vertrouwen-in-de-toekomst , date accessed: December 3, 2017.

change from function easier. Moreover, these zoning plans should allow for changes in the forms and appearance as well. Real estate becomes herewith more flexible and the products that compound a building will maintain their residual value.

9.3. RECOMMENDATIONS FOR FUTURE RESEARCH

First of all, it is recommended to further research the findings of this research in order to enhance their internal and external validity. Currently not many other servitized / circular real estate development projects exist, a new future research based on new case studies would enhance the validity of the findings.

Secondly, a research into the implications of servitized products during the exploitation phase of a real estate development project could be interesting as well. The outcomes could add up nicely to the findings of this research. Maybe the inter-organizational structure of a servitized real estate development would different during the exploitation phase compared to the development phase.

Thirdly, the extended involvement of service providers could create data from the exploitation. This data could increase the efficiency of operation of the building. And, it could be useful to increase the performance of servitized products and the complete building as well. A research in the way this data is being collected, analysed and used could be interesting and useful for service providers.

Fourthly, as mentioned in the discussion, there is still a knowledge gap concerning the feasibility of SPVs to finance servitized products. New research could create more clarity about the applicability of these vehicles to finance delivered products.

Fifthly, some private parties are currently working on online building material passports. These passports should lead to more transparency concerning delivered materials and products. This could support the shift towards a more Circular Economy as it becomes easier to trade used products. However, not much scientific knowledge is available about these passports. This research gap could be filled by new research.

At last, currently parties determine service fees to use products based on the expected TCO. However, in a 'real' servitized real estate development project service fees would be determined based on their 'service', in other words: on their added value for the customer. A research into the 'willingness to pay' for a certain servitized product could hereby stimulate a possible paradigm shift in the real estate sector.

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10. Reflection

The aim of this chapter is to reflect upon the research process of the last semester. This reflection hereby focusses on the research process, -topic, -methods and –outcomes (i.e. dissemination).

10.1. RESEARCH PROCESS

10.1.1. Preparation

In the months before I started with the graduation process I lived in Stockholm because of my Erasmus exchange program. During this time I decided to conduct a graduation research about Circular Economy in the real estate sector, because (1) I already had a lot of knowledge about this subject (due to my bachelor thesis on the University of Applied Sciences) and (2) because this topic stands high on my lists of interests. During a search for a part-time job when being back in The Netherlands a vacancy at OVG Real Estate for a Graduation Internship about Circular Economy came across.

Since this was already early in the graduation process this provided me the opportunity to design a research proposal in such a way that the outcomes of it would be scientifically relevant ánd relevant for the graduation company. Hereby the opportunity was created to conduct case study research on the projects I was working on for my internship at the graduation company. This implied that I could work on the implementation of circular business models during my internship and in the meanwhile use this knowledge to write my thesis about. This created a lot of insight in the different interests and perspectives of the involved actors in the implementation of PSSs in practice. This knowledge was very valuable while writing my thesis report.

10.1.2. Before P2

One week before the graduation process started I found out that there was – luckily – a graduation lab about Circular Economy. Although the intention of this lab was to focus on Urban Area Development, my personal interest lie more on a research on a project level. The main comment during the P1 was therefore that I should keep in mind to also reflect upon an area level at the end of the research. This has been done in Section 8.2 of the report, wherein a discussion about the outcomes of this research and the main problems of the REPAiR research is included.

The period until P2 was characterized by the iterative process in order to come to a relevant and interesting research topic and research objective. Although the research topic was found quite quickly, it took a while to define the research problem, research objective and research questions properly.

10.1.3. Towards P3

The internship made it possible to derive case study related information very easily and ask questions to people involved with the studied projects. This made it possible to 'dive deep' into the case studies and find out what they are really about. This background information made it very clear for me what the roles and positions of the involved actors in these projects were and what the implementation of PSSs would mean for the already existing (or intended) project organization.

The internship made it also possible to contact interviewees very easily and make them enthusiastic about my graduation research. This created the chance to interview people with high functions of involved organizations for the case studies. A good example was the interview with Matthijs Bierman, Managing Director of Triodos Bank The Netherlands.

Conducting the case studies took much more time than expected beforehand. Before I started, it was expected that it would take the most time to conduct the interviews and transcribe them. However, in retrospect, it took many weeks to read the case study documents, describe the case studies and make a concise and to the point description about it. This already took a month more than expected, hereby the case study analyses not included.

10.1.4. Towards P4

The actual analysis of the case studies took more time than expected as well. Main reason for this were the ill-defined research objectives, -questions and -methodologies. Secondly, in that period I also lost contact with the TU Delft mentors. Since the aim / outcomes of the analysis were not clear for me, I was struggling for quite some weeks to find a proper method to analyse the case studies. This method was in the end found in the 'Theory building'-method of Eisenhardt (1989).

This method was very straightforward, therefore were the findings presented in the P4 report maybe too much structured and way too detailed. These outcomes were not that relevant either as the research objectives were not well-defined and clear for me yet.

10.1.5. Towards P5

This resulted in a very lengthy report which was not really to the point. The time between the P4 and P5 was therefore for the most time spent in order to get 'an overview' of the subject and come to the core of this research; the role of the service provider.

In retrospect, the outcomes of this research could have been of a higher quality when the research objectives and -goals would have been better defined. The empirical findings related mostly to:

- The functioning of PSSs in real estate development projects;
- The tools actors have in order to implement these PSSs;
- The interaction between the service provider and the service supplier

The quality of the empirical findings and the quality of the overall research findings could have been better if the focus of the research during the entire research would have been on the role of the service provider specifically. This would have given me more time to sharpen the research outcomes and conclusion towards the P5. This time was now spent on re-writing the complete Synthesis.

10.1.6. Supervision

The contacts with both mentors from the TU Delft were good and become more intense towards the end of the graduation process. The feedback was – so far – always really supportive and helpful to make further steps in the process. The focus during these meeting was mostly on the process of graduation and used Methodologies. This helped me on the other hand to independently focus on the content of the research.

The contacts with the company supervisor were good and supportive. Hereby the cooperative approach during the first months of the graduation project helped me to find a relevant and interesting graduation topic. While conducting the case studies the company supervisor – and other colleagues – were good mentors to discuss content of the case studies with and to gain more insight in the new strategy of the graduation company. On the other hand, the contact with the graduation company became less tight during the last months of the research process. The main reason for this was my choice to work more often in the TU Delft Library or at the Faculty of Architecture. Working in Delft provided me with enough time to focus on the research. However, it also created a sort-of tunnel vision as I did not discuss my work with colleagues and the company supervisor that often anymore. I could have been a bit more proactive during these weeks in order to create some more moment of discussion and ask for feedback.

10.1.7. Motivation

Writing a master thesis is a one-year long journey towards 'destination unknown'. This journey has been characterized by lonely days – and weekends – working in the library or at the OVG Office. Always trying to reach my self-imposed deadlines while striving for a high quality of work.
Especially during the two months before the P3 and the P4 much time was spent on the internship and the graduation process. This resulted in a situation whereby I worked every day on the thesis and did not allow myself to take time off.

> The quote: *"People who are unable to motivate themselves must be content with mediocrity, no matter how impressive their other talents"* from Andrew Carnegie has been chosen for a reason.

Hard work pays off, but also comes with a certain price. As much time and energy was spent on the thesis during the two months before the P3 and P4, it was difficult to find the motivation back after obtaining the P4. These six weeks could have been perfectly used for taking a step back and paying attention to the details. But, it was very difficult to find back the needed focus in order to increase the overall quality of the thesis. In retrospect, it would have been better if my energy was 'spread' more equally over the entire research process. Herewith some energy would have been left to make a proper final spurt towards the P5.

10.2. RESEARCH TOPIC

10.2.1. Position within the graduation laboratory

This research was conducted in the context of the 'Circular Urban Living Lab' graduation laboratory (the CULL-lab). The 'Graduation Research Projects'-handbook[7] stated that the final result of the graduation projects of this lab "[…] include tested decision-making, governance (other types of) models for circular development projects and urban living labs, and practical circular urban and real estate development guidelines for the building industry and municipalities". The end-result comprehends (sort of) guidelines how to implement Product-Service-Systems as a real estate developer and become a service provider. Herewith stimulating the incorporation of the Circular Economy in real estate development projects and perhaps in the wider real estate sector.

10.2.2. Position within Urban Development Management

The core of Urban Development Management (UDM) is the management of decisions of the many stakeholders involved in urban area development towards a high-quality outcome. One of the current research programs within this chair is the European Horizon 2020 research called REPAiR (REsource Management in Peri-urban AReas). "REPAiR integrates life cycle thinking and geodeisgn to operationalise urban metabolism" (Heurkens & Dabrowski, 2017).

Within the REPAiR research project, several challenges on 5 different scale levels were determined. In order to contribute to the knowledge created in the graduation laboratory and herewith to the REPAiR the recommendations are related to these 5 different scale levels. During this research, new models for circular development projects were created on an operational and inter-organizational level. This research took place within the 'Inter-institutional' context and the outcomes of this research mostly apply to this level as well. On the other hand, in order to implement PSSs in real estate development projects, several obstacles and barriers that could be related to the other 4 defined level have to be overcome as well.

[7] MBE Graduation Research Project – MBE Graduation Laboratory 2016-2017 – version Spring 2017, Department of Management in the Built Environment, Faculty of Architecture and the Built Environment, TU Delft

10.2.3. Position within Design & Construction Management

The domain of Design & Construction Management (DCM) addresses questions of process control in the development and realization phases of the construction of buildings. With building process innovation as a specific area of attention. This research related to the domain of DCM since this research applied to the development processes of servitized real estate development projects. These development projects are 'special' as Product-Service-Systems are implemented in them. The perspective of one of the 'central' actors in the project organization of a real estate development project was taken. The focus was on the role of this actor and the way this actor could interact during the development process with other actors in the supply chain. Much attention in this research was paid to the alignment of the supply-side of the supply chain.

10.3. RESEARCH METHODS

10.3.1. Literature study

The literature study of this research mostly focused upon a possible implementation of Circular Economy in the real estate sector. The role of the service provider and the general implementation of Product-Service were barely discussed in the existing literature. Only the theses of Van den Brink (2016) and Kazemi (2016) did this.

In order to gain more insight in the way organizations could collaborate for a longer period of time, I decided to read more literature about supply chain management and supply chain integration in the construction industry. Although much sources were read it turned out that the main sources that would be really useful were the sources related to the dissertation of my second mentor. This could be explained positively by mentioning that the outcomes of this research could build upon the already existing knowledge in the field. On the other hand, it could also be seen as a 'tunnel vision' within academic research, which could negatively affect the external validity of this research.

At the end of the literature study some articles about Performance Based Contracts were found. In the context of this subject also the literature review written by Reim et al. (2015). This literature review turned out to be a very good source. It provided me much insight about the consequences of the implementation of PSSs on an operational level ánd provided me with useful concepts to use in the conceptual framework of this research. It should on the other hand be admitted that the literature study could have been improved by using literature sources of fields outside the construction / real estate sector.

Thus, not many sources were available about the implementation of PSSs / Circular Economy in the real estate sector. This resulted in a concise literature study, which in the end provided enough background knowledge to create an a prirori construct and knowledge about the topic.

10.3.2. Explorative interviews

Several explorative interviews were conducted to gain more insight in the graduation topic and define a possible research gap. Although these interviews are not really used in the main research report, it provided me with much background knowledge related the position and role of service suppliers. A side-effect of these explorative interviews was the creation of interest and enthusiasm for my graduation project. This made easier to collect enough experts for the expert panel and created support within other companies for this research as well.

10.3.3. Case studies

The case studies that were conducted for this graduation project were – as far as I know – the first projects whereby circular, servitized business models were applied in real life projects. Since I had the chance to be involved in these sub-projects I gained – as mentioned before – much insight in the interests and perspectives of different actors and the aspects that are important in order to implement PSSs.

As mentioned before could the outcomes of the case studies be enhanced if the research objectives and goals were defined clearer. This would have increased the focus of the case study research and would have created better outcomes.

10.3.4. Building theories

The analyses period started when the case studies were finished. Initially this analyses and synthesis was done with the use of "empirical based lesson drawing" (Huijbregts, 2017), which did not provide satisfactory outcomes. The mentors advised me hereafter to use the Building Theories process of Eisenhardt (1989). The underlying techniques provided proper support for the synthesis of the empirical findings. The outcomes of the different analyses were of a higher quality compared to the outcomes of the Lesson Drawing method.

10.3.5. Expert panel

The official goal of the expert panel was to validate the preliminary research findings. Although this goal has been obtained, the outcomes of the expert panel were not really satisfying as they did not bring much new insights. Secondly, on the moment the expert panel was held I was still too much stuck into the subject. Perhaps I was biased by my own research.
If the expert panel would have been held on a later moment, I could have taken an outside perspective during the preparation of the session. The statements used during the expert panel would in that case relate to the role of the service provider and not to the implementation of Product-Service-Systems on an operational level.

10.3.6. Ethical dilemmas

One week before the P2, the researcher filled in the "Ethics review checklist for human research'-checklist. The answers on all the questions of the self-assessment were 'no'. Therefore, the researcher presumed there are no major ethical issues involved in this research project.
However, this research is conducted within the context of the new strategy of the graduation company. Strategically sensitive information has herewith been incorporated in the graduation report. Since the graduation report will normally be put online and herewith made publically accessible some parts will be put under embargo.
One of the major ethical dilemmas that exist is according to Bryman (2012) is the 'harm to participants'. The summaries (i.e. transcription) of every interview was sent to the interviewees to validate them. This to prevent that interviewees are being interpreted incorrectly. Secondly, the actual interview transcripts will not be put in the repository either.

10.3.7. Personal learning goals

One of the determined personal learning during the P2 was to develop my scientific and research skills more. During the P2 I had the feeling that I almost figured out all the research methods I needed and no further development of these methods would be necessary. The contrary proved to be the truth, while conducting the case studies, analyses and synthesis many alterations were made to the research methods and many new insights in research methods were gained. Just by doing research. This resulted in a change of the conceptual framework, another report structure and new concepts to be researched. In retrospect, I think these research skills were developed quite a lot during the research process.

10.4. DISSEMINATION

10.4.1. Societal relevance

As mentioned in the first chapter of this research: one of the underlying aims of this research to introduce the Circular Economy within real estate development projects. The real estate sector is responsible for 30% of global energy usage, 40% of global solid waste streams and 50% of the world-wide raw material detraction (Antink et al., 2014). It is believed that with the introduction of circular business models and -principles the current unsustainable practices of the real estate sector could be ended.

The outcomes of this research support therefore the objective of the Dutch government to bring to transform the Dutch economy to a circular one before the year 2050 (Ministerie I&M en EZ, 2016). The societal relevance is hereby that the incorporation of PSSs could support the implementation of Circular Economy in the real estate sector, which eventually leads to lower emissions and raw material detraction.

10.4.2. Scientific relevance

Current PSS literature does not discuss business models extensively (Reim et al., 2015). Therefore, more scientific knowledge should be created before PSSs could be implemented in practice. This research created empirical knowledge regarding the implementation of PSSs in real estate development project, which created more scientific knowledge on an operational level regarding this subject.

This research took place within the Circular Urban Living Lab of the MBE-department, which took place within the REPAiR research project. As mentioned in the discussion of this research created this research knowledge on the inter-institutional level, which is one of the five levels on which problems and challenges were defined on which the REPAiR research focusses.

10.4.3. Sectoral relevance

The Circular Economy is already for several years a 'hot topic' within the real estate sector. This results in a lot of talking between practitioners on congresses and symposia about their vision on circularity for the real estate sector. Hereby creating a lot of marketing value for themselves. Therefore, is the implementation of the Circular Economy not taking place at the moment currently since the buildings that claim to be circular are rather gimmicks than building whereby circularity is guaranteed. This research could change this by providing more clarity about the consequences and needed steps related to the implementation of new circular business models in practice. The outcomes go beyond gimmicks and target at what the Circular Economy is about: closing material loops

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APPENDICES

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Appendices

A. Glossary

Abbreviation[9]	Term	Explanation
	Building lease	(in Dutch: erfpachtrecht) The right to use buildings, works or plants on / in / at the immovable property of others
CE	Circular Economy	"[...] an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models" (Ellen MacArthur Foundation, 2013a).
CEaaS	Comfort & Energy as a Service	The servitization of the climate installations of a building
	Customer	Actor / organization that makes use from delivered services (most often the end-user of a building)
	Contracts	Define "[...] the responsibilities of the involved parties during a specific contractual period. A PSS contract is designed to address all aspects related to providing the service and to state the rights and liabilities of involved parties clearly" (Reim et al., 2015, p. 67).
	Design	Relate to how suppliers "[...] design product and services to meet the diverse needs of customers and successfully implement PSS business models" (Reim et al., 2015, p. 71)
	Design phase	Phase in the project wherein the (sketch, definitive and technical) design for a building are made
DA	Development Agreement	Agreement for the development of a real estate object
	Development phase	Combination of the 'Initiative phase, 'Design phase' and the 'Realization phase'
	End-of-Life Phase	Phase whereby the technical / function / financial lifespan of a building and / or its products has terminated and the products are brought back into a closed material loop
E&B-contract	Engineer & Build contract	Contract whereby the contractor takes the responsibility and related liabilities for the engineering and realization of a building
	Exploitation phase	Phase wherein a building is used by the customers, ends at the day of project delivery and ends when the End-of-Life phase starts
	Framework Agreement	Agreement stating the scope of a certain real estate development project

[9] The choice has been made to present the terms in alphabetical order instead of the used abbrevations.

HVAC	Heating, Ventilation, Air Conditioning system	
	Initiative phase	Phase in the project whereby the real estate developer takes the initiative for a certain real estate development project and makes the first studies for the development of a building
	In-use phase	See: Exploitation phase
	Joint Venture	An organization consisting of two or more separate organisations that jointly perform a commercial enterprise
	Marketing	Describe how suppliers: "[...] interact, communicate and use customer and market insights to implement their PSS business model" (Reim et al., 2015, p. 68).
MLA	Masterlease Agreement	Agreement for the master lease of a real estate object
	Network	Refers to how supplier "[...] use their network relationships with external partners to ensure PSS business models are implemented successfully" (Reim et al., 2015, p. 70).
	Obligatory provisions	Contractual obligations
	Option for demolition	An organization consisting of two or more separate organizations that optionally perform a commercial enterprise
OVG	OVG Real Estate	Graduation company, see also Appendix I: OVG Real Estate.
PSS	Product-Service-System	"Products-service-systems are longitudinal relational processes, based on the principles of Circular Economy, during which products and performances are integrated, whereby the product is not a goal but a subordinate to the performance and service that are aimed at meeting end-user's evolving needs over time (in De Grauw, 2015, p.58)".
RED-project	Real estate development project	Project relating to the development of certain building, from the moment the initiative for this building is taken until moment of project delivery
	Realization phase	Phase wherein construction works of a certain real estate development project are performed, ends at the moment of project delivery
SPA	Sale & Purchase Agreement	Agreement relating to the sale of a certain product / real estate object
	Service	Mainly a non-physical action or operation whereby the performance is optimized over time (adopted from De Grauw, 2015)
SLA	Service Level Agreement	Agreement stating the required performance level of delivered products and / or services
SP	Service provider	Organization that integrates services as delivered by the service suppliers and delivers them towards the customer
SS	Service supplier	Organization that performs a service with an underlying physical product (adopted from Van den Brink, 2016)
	Servitization	The process whereby physical products are combined with services

SPV	Special Purpose Vehicle	A subsidiary company with an asset/liability structure and legal status that makes its obligations secure even if the parent company goes bankrupt (adopted from Investopedia.com). SPVs could be used as funds to secure the ownership of building products
	Superficies	(in Dutch: Opstalrecht) The right to claim or obtain ownership on buildings, works or plants on / in / at the immovable property of others (adopted from AKD, 2017)
	System integrator	Focal firm in the supply chain that integrates the demands of the supply chain with / and the supply side of the supply chain (with each other) (based upon Vrijhoef & De Ridder, 2005)
TCO	Total Cost of Ownership	All costs involved with the use of a product or building

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B. Case study references

EXPLORATIVE INTERVIEWS

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CASE 2: BASISWEG

Semi-structured interviews

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Rampersad, Roshan. (2017, 27 September 2017) Semi-structured personal interview/Interviewer: I. De Blok. Amsterdam.

Van Noord, Eric. (2017, 21 September 2017) Semi-structured personal interview/Interviewer: I. De Blok. Amsterdam.

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Madaster. (2017). Vision, mission, aims. Retrieved from https://www.madaster.com/en/about-us/why-a-materials-passport

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CASE 3: THE BOUTIQUE OFFICE

Semi-structured interviews

Tiedema, Jan Hein. (2017, 20 October 2017) Semi-structured personal interview/Interviewer: I. De Blok. Amsterdam.

Ummels, Thomas. (2017, 02 October 2017) Semi-structured personal interview/Interviewer: I. De Blok. Amsterdam.

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C. Research techniques

The used research structure and research techniques will be introduced in this Appendix. This builds upon on the methodological structure as presented in chapter 2 of this report.

INTRODUCTION

This thesis will follow a deductive and inductive strategy in order to build new theories. Hereby a collection of theories will be used to generate a general theory that leads to a theoretical framework and an conceptual framework for the implementation of PSSs in real estate development projects. This in the form of a literature study.

Hereafter, a more inductive approach of theory building will be used by applying the multiple case study approach of Yin (2014). Hereafter the theory building approach of Eisenhardt (1989) will be used to develop theories from the empirical findings of the case studies, see also Figure A. This approach is inspired upon the research strategy used in the dissertation of Vrijhoef (2011).

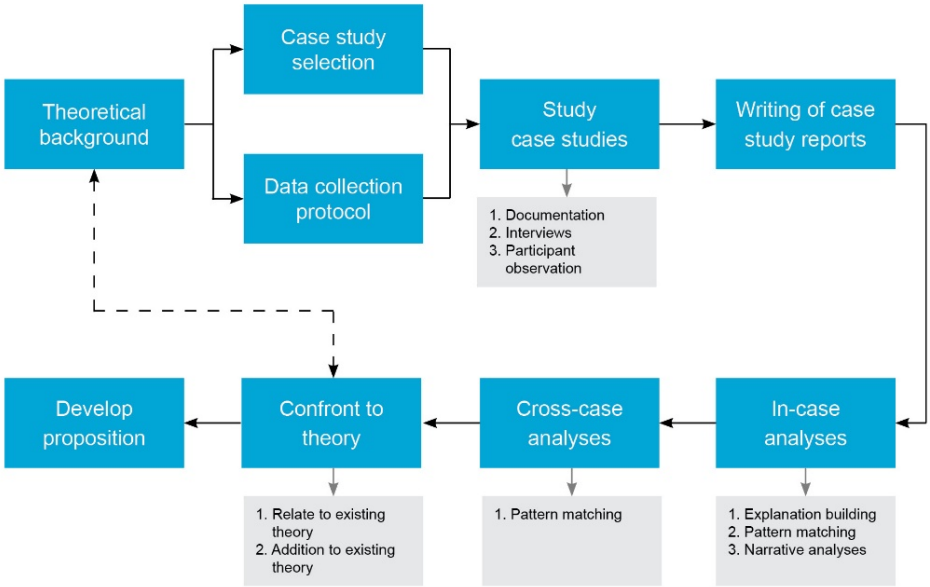

Figure A: Case study & theory building approach (based upon Vrijhoef, 2011; Yin, 2014; Eisenhardt,1989):

As could be seen in Figure A, the research process leads to the development of a proposition and therewith to the development of a theory. The underlying inductive process follows the Eisenhardt's theory generating process (Eisenhardt, 1989). Eisenhardt's strategy follows 8 steps, these 8 steps are spread over several chapters in this report.

PART 1: CONCEPTS

Exploring the field

In the first chapter, the field of Circular Economy, Product-Service-Systems and its implementation of these in the real estate sector are explored. By doing this, (1) the research becomes focused, (2) an initial definition of the research question is made and (3) a priori specification of constructs will be shaped (Eisenhardt, 1989). By doing this, a review of the most important concepts related to PSSs in the real estate sector is made and research gaps are identified (Kumar, 2014).

Conceptual model

In order to understand what the implementation PSSs mean for real estate development project, these project should be made operational. In order to make this operation, a managerial perspective is used. This managerial perspective is taken by using the Conceptual Steering Model as described by De Leeuw (2002) and Heurkens (2012). In order to make the Conceptual Steering Model operational, the business tactics as defined by Reim et al. (2015) are used.

PART 2: THEORIES

Literature study

A literature review on the implementation of Product-Service-Systems from three different perspectives (being: service supplier, service provider and customer) is executed and presented in the third chapter. This research takes places on an operational business level, hereby business tactics are introduced that link decisions on a strategic-level with decision on an operational-level in order to create, deliver and capture value on an operational level. These tactics can be defined as "company's residual choices at an operational level after deciding which business model to apply" (Reim et al., 2015, p. 66).
According to Bryman (2012) this theoretical review provides a foundation for the theory building later in the thesis.

PART 3: PRACTICES

Case studies

The reason to choose case studies to be part of the research process is that this research opts to solve real-life problems. Therefore it is important to link this research with practice. It is often argued that while doing scientific research theoretical knowledge is more valuable than practical knowledge. But since predictive theories do not exist in social sciences, it must be concluded that "context-dependent knowledge is, therefore, more valuable than the vain search for predictive theories and universals" (Flyvbjerg, 2006, p. 224). Therefore case studies are used to gain data that will be used to induce the theoretical framework..Critics of case study research say that case study research holds a bias towards verification, which means that there would be a tendency to confirm the researcher's own beliefs. However, Flyvbjerg (2006) argues that the possibility of falsification is bigger than the possibility of verification, because the researcher himself has the possibility to adjust the proposition during the research process because he can reflect on the data found in the case studies.

See Appendix D for the case study protocol

The case studies will be analysed using a so-called cross-sectional case study design (Bryman, 2012; Yin, 2014). While analysing the case studies, the derived information will be linked to the conceptual model as presented in Section 1.4. As said, the different case studies will be seen as individual research studies. This analytical design consists of two types of analyses: (1) in-case analyses per case study and an 'overall' cross-case analyses, covering the three case studies.

In-case analyses

The first analytical technique to build theories is an in-case analyses. The in-case analyses is manually done without the use of qualitative data analysis software. Therefore the main analytical techniques used for the in-case analyses were pattern matching and explanation building (Yin, 2014).

Cross-case analyses

In order to learn from the case studies, a cross-case analyses will be made. In the cross-case analyses, the information will be categorized back into the four business tactics. This data is tabulated and herewith added up to each other (Eisenhardt, 1989).

PART 4: SYNTHESIS

Developing proposition / Findings (Chapter 6)

Confronting theory with practice

By confronting outcomes of the literature study and the cross-case analyses, insight will be created in the empirical lessons that could be drawn from the case studies. These lessons form an extension of existing theory. This forms the theoretical contribution of the thesis and marks the closure of the theory building process of the research according to Eisenhardt (1989, in Vrijhoef, 2011).

Develop proposition (i.e. draw empirical lessons)

The existing theory and the empirical findings are later added up to each other in order to build a complete theoretical framework that describes the implementation of PSSs from three different actors on an operational level. As Eisenhardt (1989, p. 541) states, this is a highly iterative process whereby "[...] the researchers constantly compare theory and data – iterating toward a theory which closely fits the data. [...] It takes advantage of the new insights possible from the data and yields an empirically valid theory" (Eisenhardt, 1989, p. 541). The developed proposition will function as empirical lessons that for real estate developers that could support this organization in the implementation of Product-Service-Systems in real estate development projects.

Conclusions & Reflection (Chapter 8 & 9)

In the conclusion, the main research questions are answered. In the reflection, the main contribution of the thesis to theory are summed up, implication for the real estate sector are mentioned and directions for future research is given.

JUSTIFICATION OF THE RESEARCH APPROACH

According to Yin (2014) articulating a theory what is being studied and what is to be learned helps to strengthen a research design when doing a case study. The quality of the design in relation to social science research are (a) construct validity, (b) internal validity, (c) external validity and (d) reliability. In this section, the relation between these four concepts and the research design is evaluated. This section could therefore be seen as a reflection on the designed research methodologies.

Construct validity

Construct validity refers to "[...] the accuracy with which a case study's measures reflect the concepts being studied" (Yin, 2014, p. 238). In this research, the construct validity is enhanced by defining a clear but practical conceptual framework. Several concepts (i.e. operations measures) will be coupled to this framework and the outcomes of the case studies will be generalized towards these concepts. Another important aspect of construct validity is the use of multiple sources of evidence. In this resource several types of data sources is used, hereby triangulation will be enhances. The resources that are used in this research and the related research methods are presented in figure B.

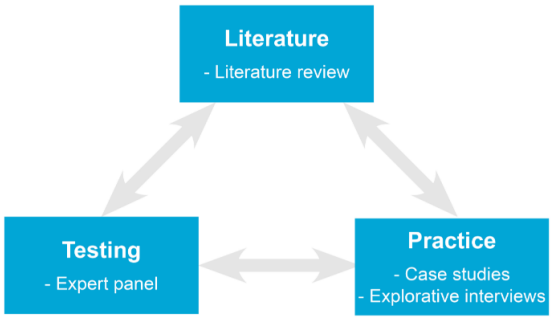

Figure B: Triangulation in this research project (own ill.)

Internal validity

This concepts relates to the question "[...] whether a finding that incorporates a causal relationship between two or more variables is sound" (Bryman, 2012, p. 712). In order to enhance the internal validity of this research, a pattern matching technique will be used to link the existing theories, with the outcomes of the case studies and the to-be developed recommendations (Yin, 2014). And, secondly, an expert meeting was held, see Appendix E, Appendix G and Chapter 7.

External validity

External validity concerns "the extent to which the findings from a case study can be analytically generalized to other situations that were not part of the original study" (Yin, 2014, p. 238). Since the research topic of this research is quite specific and new in practice, there are not much case studies available and the elements that are servitized are quite specific. An attempt to be able to generalize these findings will be done by conducting an 'outsider focus group' (referred to as expert panel in this research). The expert panel protocol is introduced in Appendix E: Expert Panel protocol.

Reliability

Reliability refers to "[...] the consistency and repeatability of the research procedures used in a case study" (Yin, 2014, p. 240). In order to provide insight in the research procedure of the case studies, a case study protocol will be developed. Next to this, as much steps as possible will be made operational and explained

D. Case study protocol

The used study protocol will be introduced in this Appendix. This protocol is part of the Research techniques as presented in Appendix C: Research techniques.

UNIT OF ANALYSES

The unit of analyses is the process system in a circular / servitized real estate development project. This process is managed by the project organization of the inter-organizational system. The process system relates to the whole development process in order to deliver and / or manage the circular / servitized real estate development project (Heurkens, 2012).

SAMPLING

In this research three cases will be analysed during the case study period. Some author say that often one case study is enough to generalize findings. For example, Flyvbjerg (2006) tries to argue that single-cases studies can be used to generalize findings. But when he comes to his conclusion he admits that "formal generalization is overvalued as a source of scientific development, whereas 'the force of example' is underestimated" (Flyvbjerg, 2006, p. 228).

In the perspective of the researcher, formal generalization is necessary to come to scientific conclusions for the real estate sector. Therefore a case study consisting of one case cannot be used to generalize outcomes, unless the content of the case is not much influenced by its context. Bryman (2012, pp. 69-70) mentions hereby that the findings from one case cannot be generalized unless it is a representative case.

Since in the real estate sector, every project is unique and strongly influenced by its context, conducting a single-case study is questionable. Moreover, since the concept of circular / servitized real estate development projects is so new, there are no representative cases available. That's why a multiple case-study approach is appropriate and used in this research project.

This research involves a qualitative research design. This means that an information-oriented selection is most appropriate (Yin, 2014). Hereby the expected information content forms the basis of case selection (Flyvbjerg, 2006). The objective of conducting case studies is to collect relevant empirical data. In order to gain this data, a *criterion sampling* approach is used, whereby cases are selected that meet certain criteria (Bryman, 2012, p. 419).

Selection criteria

In order to be a case study in terms of available and usable information, the project should be in the development, realization or operational phase, because in this phase (some) contractual arrangement are already present. From this, information about the inter-organizational system could be derived. If projects are still in the initiative phase, no formal inter-organizational agreements are made yet. Related to the amount of available information, it is preferred that relevant project information is easily accessible and that information about for example contractual arrangements is available as well. Therefore a case study is preferably a project of OVG Real Estate or one of its subsidiaries.

As this research project is about the implementation of Product-Service-Systems in the real estate sector and therefore into real estate development projects, some elements of a Product-Service-System should be applied in the case study. In order to break the existing split incentive (Rau & Oberhuber, 2016), actors

should become responsible for their handling. Therefore it is important that the service suppliers and / or service provider remains responsible for the delivered services during the exploitation phase. Therefore the supplier or provider of the leased product in the case study should remain responsible for the delivered product during the operational phase of the project.

The data derived from the case studies relates should provide insight in all the used business tactics (Reim et al., 2015) of organizations while implementing Product-Service-Systems. Therefore the chosen case studies should provide information relating to the four used business tactics (i.e. Contracts, Network, Marketing and (Product & service) Design).

So, this means the next selection criteria will be applied in order to select case studies:

- The project should be in the development, realization or operational phase
- Relevant project information should be easily accessible
- Elements of Product-Service-Systems should be applied in the project
- The supplier or provider of the leased product in the case study should remain responsible for the delivered product during the operational phase of the project.
- Insight in inter-actor interaction
- The chosen case studies should together cover the four business tactics (i.e. Contracts, Network, Marketing and (Product & service) Design).

Selection criteria summarized

- A case study is preferably a project of OVG Real Estate.
- The real estate development project should be in the development, realisation or operational phase.
- Within the real estate development project, some elements of a Product-Service-System should be applied
- This product should be part of the three 'core' layers of a building defined by Brand (1994). This means: the product is part of the structure, skin or services.
- The supplier or provider of the leased product remains responsible for the delivered product during the operational phase of the project.
- Coverage of the four business tactics.

Selection method

The researcher of this research project conducts a graduation internship at the graduation company (i.e. OVG Real Estate). This means that the researcher has easy access to relevant project information and contacts with other organizations that are involved in projects are easily made.
Therefore a pragmatic first selection of case studies was made in based upon the current projects of the real estate developers. This implies that the sample of potential case studies was limited to project of the graduation company.
The first selection of the case studies was done based upon selection criteria 1 to 5 (see former section). This resulted in a list of three potential case studies:

1. Triodos Bank – Zeist
2. Basisweg 10 – Amsterdam
3. The Boutique Office – Amsterdam

An overview of the case studies and their relation to the selection criteria was made afterwards in order to check whether the three potential case studies together meet the selection criteria. This overview is presented in Table A.

Table A: Case study selection overview

	Criteria	Triodos Bank	Basisweg	The Boutique Office
1	**OVG Real Estate project**	✓	✓	✓
2	**Project phase**	✓	✓	✓
3	**Element(s) of PSS**	✓	✓	✓
4	**PSS part of 'core layers'**	✓	✓	✓
5	**Extended responsibilities**	✓	✓	✓
6	Contracts* Network* Marketing* Design*	✓ × ✓ ✓	× ✓ ✓ ×	✓ × ✓ ✓
	Business tactics	✓	✓	✓

**Expected outcomes*

As can be seen in Table A meet the three selected projects all the above mentioned selection criteria. Therefore, the three selected projects from the 'first round' will be used as case studies in this research.

DATA COLLECTION

During this research project, the researcher will conduct a graduation internship at OVG Real Estate. This real estate developer is the developer of the three abovementioned case studies. This internship allows the research to directly access multiple sources for conducting case studies. The next sources of evidence, as described by Yin (2014), will be used while conducting case study research:

- **Participant observation:** As a graduate intern the researcher might become involved in the projects that are subject to the case study research.
- **Semi-structured interviews:** interviews with project team members, suppliers, financiers, customers and other members of the project organization.
- **Documentation:** Case / project document analysis, administrative documents progress reports, internal records, proposals and other case related documents.

It is acknowledged that participant observation comes with major challenges towards potential biases. This is caused by the special role of the researcher within the project, which can influence the credibility of the case studies and the outcomes of the research (Yin, 2014). In order to prevent a tunnel vision in this research, a validation will take place in a later stage of the research project, see Chapter 7 and Appendix E: Expert Panel.

DATA ANALYSES

The within-case study analyses was done in three stages, whereby the Conceptual Steering Model functioned as a guideline. Hereby each case was seen as a stand-alone entity.

- The first step was analyses of documentation referring to the 'project context' and 'general inter-organizational system' of the project (i.e. the part of the case not relating to the introduction of PSSs). This part of the case study research was based upon documentation study (i.e. contracts, presentations, Programs of Requirements etc.) and participant observation. This provided the research with background information before diving into the actual process system relating to PSSs.
- The second step was analysing the parts of the project that related to the implementation of Product-Service-Systems in the case study. The main techniques used in this step were semi-

structured interviews and documentation. The business tactics of Reim et al. (2015) lie at the basis of the used interview protocols of the semi-structured interviews.This research tries to incorporate the three perspectives in a servitized real estate supply chain (service supplier, service provider and customer), therefore these actors were, if possible, interviewed per case study project. See Table B for an overview of the interviewees per case and per perspective.

- The third step implied writing up the case studies. Hereby the data that was categorized according to the used business tactics was induced towards a description of the inter-organizational system. The techniques to analyse the information refer to narrative analyses, pattern matching and explanation building, as explained by Yin (2014).

Table B: Interviewees per case and perspective

	Triodos Bank	Basisweg	The Boutique Office
Service supplier	Nils Eekhout	Jasper Feuth	Thomas Ummels[10]
Service provider	Constantijn Berning	Roshan Rampersad	
Customer	Matthijs Bierman	Paul Wentink	Jan Hein Tiedema[11]
Architect[12]	*n/a*	Eric van Noord	

CASE STUDY PROTOCOL

The case study protocol is based upon the case study protocol used in the dissertation of Vrijhoef (2011). Hereby the cases were aimed at studying three application of Products-Service-Systems in real estate development projects. The next procedure was used:

- Potential cases of the graduation company were identified together with the company supervisor
- The application, diversity and used strategy of the (to be) implemented Product-Service-System was leading for the selection of the cases
- A check was made to see whether the selected case studies together meet the defined selection criteria.
- A data collection plan had been made including a list of potential data sources
- Data sources for background information had been assessed whether they could provide data
- Data collected had been documented and stored
- Data had been analysed by narrative analysis
- Interviews had been prepared based on the collected and analysed background information
- Multiple interviews had been taken per case study
- Interviews had been transcribed and summarized
- Case studies had been presented in the report
- A within-case and cross-case analyses had been made

10 Within the case of The Boutique Office, OVG Real Estate is the developer and will also exploit the building. Therefore OVG can be seen as the service supplier and the service provider.

11 OVG Real Estate takes can be seen client in their own development project, and no big tenants for the building are found yet. Therefore the interview with Jan Hein Tiedema focused upon the interests of OVG to deliver services towards sub-tenants (i.e. customers).

12 In order to gain more insight in the project context, the architect of both the Basisweg and The Boutique Office was interviewed as well.

E. Expert panel protocol

The used protocol for the expert panel will be explained in this Appendix.

INTRODUCTION

As mentioned in Appendix C, the external validity of this explorative research is increased by organizing a 'focus group meeting'. The goal of this meeting is to increase the 'external validity' and the 'internal validity.

- The external validity is defined by Yin (2014, p. 238) as: "The extent to which the findings from a study can be analytically generalized to other situation that were not part of the original study" (Yin, 2014, p. 238). The external validity is according to Kumar (2014) called 'Transferability' in qualitative research. Transferability can hereby be defined as: "[...] The degree to which the result of qualitative research can be generalised or transferred to their contexts or setting" (Trochim & Donelly, 2007, p.149 in Kumar, 2014, p.219).
- The internal validity refers according to (Yin, 2014, p. 239) to: 'The strength of a cause-effect link made by a study, in part determined by showing the absence of spurious relationships and the rejection of rival hypotheses". According to Kumar (2014) this refers to 'credibility' in qualitative research, which is judged "[...] by the extent of respondent concordance when you take your finding to those who participated in your research for conformation, congruence, validation and approval" (Kumar, 2014, p. 219). Hereby the highest level of confirmation relates to a higher level of internal validity.

In short, the objective is to increase the external validity and the internal validity of the Findings of this research. The goals are hereby to:

- Validate to which degree the Findings of this research are confirmed by several interviewees of the case studies.
- Validate to which degree the Findings could be used in other real estate development projects.

METHOD

The chosen research technique for this expert panel is the 'focus group', within a focus group (1) the emphasis lies on a particular topic and (2) several people are placed together to discuss this topic (Bryman, 2012). The particular topic can hereby be defined as 'Findings of the research' and using several people enhances the external validity because of their different perspectives on the topic.

Hereby "[...] the focus group offers the researchers the opportunity to study the ways in which individuals collectively make sense of a phenomenon and construct meaning around it [...] This occurs in interrelation and discussion with others" (Bryman, 2012, p. 504). Hereby creating a more naturalistic view around the topic. In short, the focus group can be used to gain insight in the naturalistic view of the focus group participants around the topic. This by discussion and 'interrelation'. Therefore will the focus group in this research be used to gain more insight in the perspectives of the focus group participants on the Findings by creating a group discussion between the focus group participants. This information will also provide insight to which degree the findings of this research can be externally validated.

PARTICIPANTS

In order to increase the quality of the validation, the participations should preferably have a background from a 'wide range', but would still be 'valuable'. Therefore the next selection criteria have been applied:

- The participant is 'expert' in the field of circularity and / or Product-Service-Systems
- The participant works in the real estate sector or the construction sector

The next selection criteria have been applied to create a mixed group:

- The group should consist of interviewees from the semi-structured interviews of the case studies ánd 'outsiders' (people not related to the case studies).
- The group should consist of 'customers', 'service providers' and 'service suppliers'.

The participants are selected using a 'snowball-sampling' method (Bryman, 2012), whereby the network of the graduation company is used. The next group of participants was selected:

Table C: Expert panel members

Name	Company	Function	Case study	Interviewee	Role
Jim Teunizen	Alba Concepts	Partner	n/a	Explorative	n/a
Michiel Schillemans	Philips Lighting	Key Account Manager	n/a	Explorative	Service supplier
Jan Bergman	Alkondor Facades	Head of Sales	n/a	Explorative	Service supplier
Martijn Veerman	Alkondo Facades	Specialist Circular Facades	n/a	Explorative	Service supplier
Stingo Huurdeman	VMRG	Project coordinator	n/a	n/a	n/a
Jeroen van der Waal	Municipality of Amsterdam	Sustainability advisor	n/a	Explorative	n/a
Ronald Dikstaal	Eneco	Developer Energy projects	Basisweg	n/a	Service supplier
Ton Glashorst	DWA	Senior project manager	Basisweg	n/a	Service supplier
Constantijn Berning	JOIN / OVG Real Estate	Associate Development Director NL	Triodos	Semi-structured	Service provider
Roshan Rampersad	OVG Real Estate	Associate Development Manager	Basisweg	Semi-structured	Service provider
Nena Rood	OVG Real Estate	Development Manager	n/a	n/a	Service provider
Sandra Gritti	OVG Real Estate	Development Manager New Strategy	n/a	n/a	Customer (OVG's new strategy)

CONTENT

The selection of the content of the expert panel was based upon findings of the case studies that were not easy to underpin or on subjects that showed differences with the studied literature. Hereby it has been tried to bring focus in the discussed topics while targeting on increasing the value of the outcomes of the expert panel. Hereby statement *(stellingen)* are used as guidelines to structure the expert panel. Each statement relates hereby to a specific concept (i.e. business tactic).

PROGRAM

Date: November 14th, 2017
Time: 15:30 – 17:30
Location: Office OVG Real Estate (Theatre Room)
The Edge
Gustav Mahlerlaan 2970 – Amsterdam

Table D: Expert panel time schedule

Time	Description
15:15 – 15:30	Entry
15:30 – 15:45	Welcome - Introductory round - Goal of the meeting
15:45 – 16:00	Research introduction
16:00 – 16:15	Discussion Concept 1: Contracts
16:15 – 16:30	Dicussion Concept 2: Network
16:30 – 16:40	Break
16:40 – 16:55	Discussion Concept 3: Design
16:55 – 17:10	Discussion Concept 4: Marketing
17:10 – 17:30	Any other business
17:30 – xx:xx	Drinks

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F. Case study reports

This Appendix contains confidential information.
For more information, please contact:

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G. Expert panel

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H. Interview transcripts

This Appendix contains confidential information.
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I. OVG Real Estate

Source for this Appendix: OVG Real Estate (n.d.)

Figure D: Logo OVG Real Estate (source: OVG Real Estate)

WHO IS OVG REAL ESTATE?

OVG Real Estate was established in 1997 and was founded by Coen van Oostrom, who is still the CEO of OVG Real Estate. As a novice in the world of real estate, he saw possibilities that others failed to notice. As such, he managed to create opportunities and to establish special projects. OVG does not settle for a set framework, on the contrary, they question it. As a result, a unique method emerged, which is the guideline for our four business units.

OVG Real Estate is one of the most successful project developers in Europe, leading in the development of office properties. The company has been setting new benchmarks for well-being, sustainability and technology-oriented buildings for over 20 years. Specialized on intelligent and future-oriented solutions, OVG grew from a classic developer into a technology firm.

VISION

Never before did so many people live in urban areas. At present it is more than half the world's population, but it will increase. This new reality is a world where more people are living, working, recreating and travelling with- in a small area. How does one keep our habitat healthy? How does one most efficiently use natural sources? And how does one cleverly implement the use of new technologies in this respect? OVG Real Estate seeks answers to these questions on a daily basis, because OVG believes that buildings are more than merely a combination of materials.

PILLARS

We are convinced that there is always a better way: greener, smarter, healthier. This belief is put into practice through three pillars, which are the foundation of our method: Sustainability, Technology and Well-being.

Sustainability

For OVG Real Estate, sustainability means using natural sources as cleverly as possible to offer buildings that are not only attractive, but also affordable, efficient, healthy and safe. Sustainability is therefore one of the three pillars which forms the basis of everything OVG Real Estate achieves.

Living & working

OVG Real Estate wants to contribute in a healthy environment with its projects. This reflects in our vision on sustainability, but also in our efforts to create a healthy balance between 'living and working'. OVG wants to establish a work environment where people are happy and, above all, healthy. Therefore, OVG alternately makes use of advanced technology as well as logical thinking.

Technology

In order to develop buildings that excel in sustainability and create a healthy environment for users, smart technology is essential. OVG is convinced that in the future, with the aid of technology, even much more is possible to make buildings yet even more intelligent.

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The implementation of Product-Service-Systems (PSSs) in real estate development project could support the shift of the real estate sector towards a more Circular Economy. With the implementation of these systems, responsibilities of delivered products remain with the suppliers of these products. This incentives suppliers to design products which fit in closed material loops. Much attention was paid by scientists and practitioners about the implementation of these PSSs in practice. However, a knowledge gap still exists about how Product-Service-Systems function on an operational level in real estate development projects. Therefore, actors in the real estate sector do not know how to implement PSSs in real estate development projects. The central role of the service provider (i.e. former real estate developer) is hereby seen as important since this actor would manage the overall performance of a servitized building and steers the development of it.

The objective of this research is therefore to (1) conceptualize the functioning of circular Product-Service-Systems on an operational level and (2) develop conceptual working models that could be used by real estate developers to perform the role of the circular service provider. Herewith, the main research question: 'How could a circular service provider interact with service suppliers and customers in order to implement Product-Service-Systems in real estate development projects?' is answered.