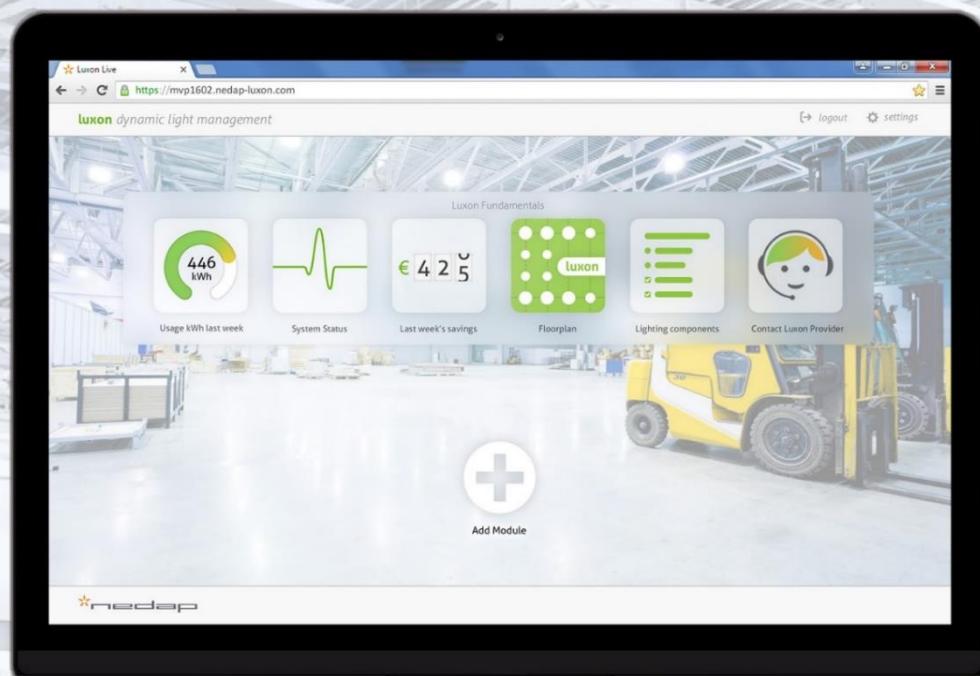


THE NEW LUXON

A research into software expansion of Luxon in the Lighting-as-a-Service market



Antonie Berkel
01-07-2016

Research Information

Research title: The New Luxon
Subtitle: A research into software expansion in the Lighting-as-a-Service market
Description: Nedap offers a light management system (with a web-based interface for the customer) that is able to make lighting smart. By using smart dimming they can cut down energy costs with about 30%. Nedap sees that the market is talking more and more about Lighting-as-a-Service (not selling the lamp, but light). However, they do not know what it is, what implications it brings with it and how Luxon can profit from it. In this research, Lighting-as-a-Service is investigated with the goal of coming up with new functionalities that can be added to Luxon and have value in the Lighting-as-a-Service industry.

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Preface & Acknowledgements

Before you lies the bachelor thesis of Antonie Berkel. The bachelor assignment was carried out for the Industrial Engineering Management programme at the University of Twente. This thesis consists of a research that has been carried out for Nedap N.V. in Groenlo. In this thesis, the research that was carried out between April and July of 2016 will be presented. Here, not only the valuable findings will be discussed, but also the way towards these findings is extensively elaborated. All in all, this research has provided Nedap with valuable new insights on how they can expand the current Luxon proposition in order to serve the Lighting-as-a-Service market and become more valuable.

Before the presentation of the research starts, I would like to thank some people who have helped me in creating this research.

First of all, I would like to thank Nedap for the opportunity that they have given me. Not only was I allowed to work on a very interesting and exciting topic, they also gave me the opportunity to work in and experience a vibrant, innovative and challenging environment. Nedap is a very exciting company to work for. Everything you see there breathes innovation and the people who are making that happen are passionate about their products. Furthermore, the research I carried out was of huge relevance to the entire department, so everybody was very interested in what I was doing. Numerous interesting discussion were held and if I needed any help, everyone was willing to offer that to me.

Special thanks go out to Stefan Bernards, who, as my supervisor helped me a lot with creating this research. Stefan was always in for an interesting discussion, was goal-oriented and could provide me with valuable knowledge about the lighting industry. I would also like to thank Jeroen Smit, who, when Stefan wasn't around, acted as my second supervisor. Jeroen was always able to make some time for me, despite his busy schedule. His way of looking at Luxon really helped me to understand what it was about and helped me in developing the new software modules.

Furthermore, I would like to thank my supervisor Maria Jacob. She always quickly responded to my questions and provided me with guidance when I needed it. When asked for, she critically reviewed my work and gave me tips when things needed to be altered. Besides the professional help, our meetings were always relaxed and pleasant. Thank you to Fabian Aulkemeier for being my second supervisor.

Finally, I would like to thank my girlfriend, my parents and my brother. They provided me with the support I needed to carry out this research. They were there to hear out my stories, but also to shift my attention to things that were not related to my research.

Executive Summary

The lighting industry: an enormous manufacturing market that is undergoing serious changes. The overall development of offering products in combination with valuable services as seen in most of the manufacturing markets, is also finding its way in the lighting industry. This process is called servitization. It implies that services are becoming more and more important and can create a competitive advantage. The servitization process is accelerated due to the adoption of LED (a new light source technology). The growing importance of the role of services, gave birth to a new kind of product-service offering: Lighting-as-a-Service (LaaS). In this model, the lighting providers do not sell a lamp, but light. They do not sell the product, but the function of the product. The industry is talking a lot about Lighting-as-a-Service, but few really know what it is and what it implies. Nedap is active in the lighting market and already provides services in combination with a product. Luxon light management is a software product that makes a lighting installation smart and enables savings of up to 35%. On top of that, it delivers a web-based dashboard with which customers can manage and control their lighting from anywhere in the world. Nedap is aware of the developments in the market and is very curious as to what they will imply and how they can use these developments to make their light management system more valuable. This research aims to analyse these developments and determine how they can be used to achieve this target. The goal of this research is to add or alter functionalities to Luxon that are valuable in the Lighting-as-a-Service and it seeks to answer the following question:

Which functionalities have to be added to the light management system of Nedap to create more value per light fixture in a market where light is sold as a service?

The first step in answering this question was analysing the current situation of Luxon. A software specification and an enterprise architecture was designed (this architecture wasn't available prior to this research) so that an accurate overview of the current situation could be created.

A literature review was conducted to establish a theoretical framework. This framework provides insights into what servitization is and how it is manifested in the lighting industry. In this framework, Product-as-a-Service was described as an integrated product-service (a combination of a product and service) offering that is characterized by: 1) ownership with the provider, 2) no technology needed to implement the product and service and 3) the product-service is of compound nature (which means that the product or services cannot be offered alone and depend on the other). With a newly designed maturity model, the position of Nedap in this market and the readiness of the market for Lighting-as-a-Service could be determined. The first step in the servitization process is stated by the offering of a product alone. Then supporting services (like maintenance and warranty) are added. These services do not differentiate the offering from others. In the third step, differentiating services (like light management are added). These services do differentiate the offering from others. Nedap and the majority of this market are placed in this stage. In the final step of Product-as-a-Service, the product itself is left out of the offering and the only value of the offering lies in the service (the function of the product is sold, not the product itself).



Figure 1: Visual representation of the maturity of servitization in the lighting industry

Next, interviews were conducted with the first pioneering Lighting-as-a-Service companies. By interviewing five LaaS providers and two regular lighting providers, the implementation of Product-as-a-Service in the lighting industry could be analysed. From these interviews and the findings from the literature, the following definition was given to Lighting-as-a-Service.

Lighting-as-a-Service is a service in which companies work side-by-side to offer a service that fully unburdens and removes all the risks for the customers whilst providing a light solution that is adjusted to the customer's needs. Where ownership lies with the provider of the solution, for which the customer doesn't have to invest but instead just pays a recurring fee for the use of the service.

The service enables the customer to be fully unburdened and to remove all risks involved in owning a lighting installation. This new business model fundamentally changes the way in which lighting is sold. Now that the provider remains owner of the installation, they carry all the responsibilities of the product and will try and create and deliver the best solution possible to the customer (as this will limit their costs). Figure 2 provides a visual representation of this new model and shows the shift of responsibilities from the customer to the provider.

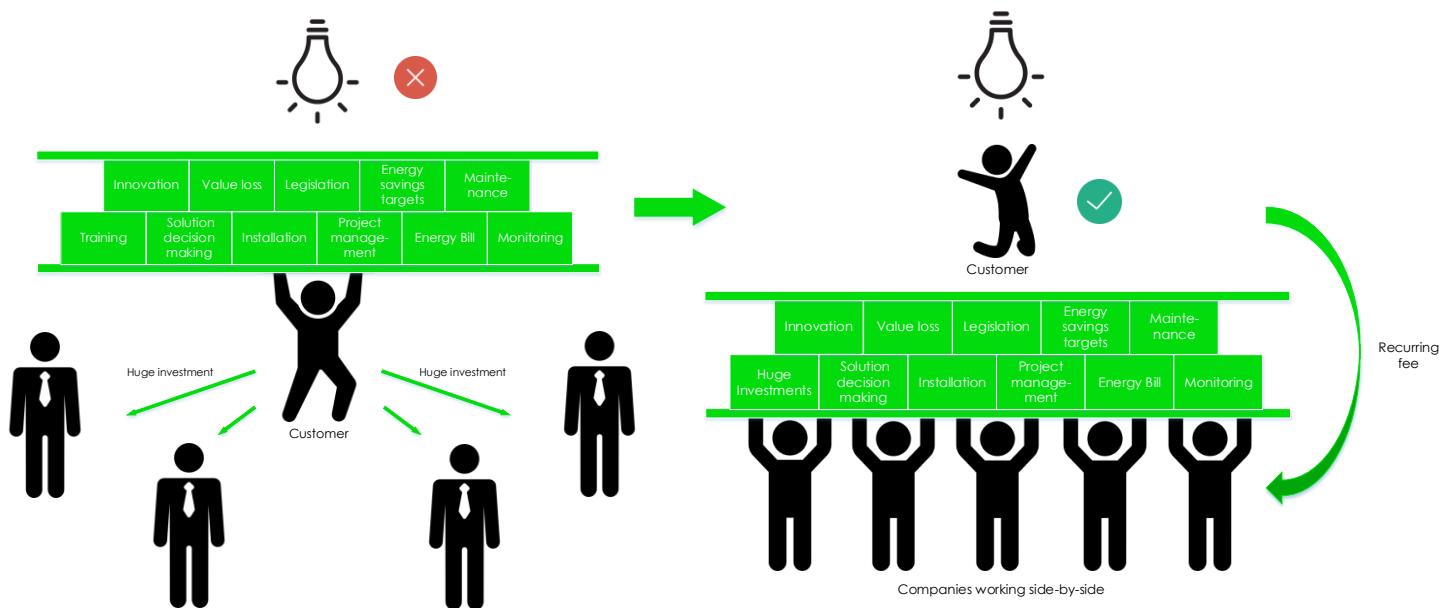


Figure 2: The visual representation of the shift in responsibilities between the old model and the LaaS model

Now that the customers have very little to do with their lighting installations (the provider carries all the responsibilities), it has been found that the customer will have less demands regarding a light management dashboard. On the contrary, the Lighting-as-a-Service provider needs good analytical and monitoring tools more than ever. That is why, the new functionalities will interact with and have direct value for the LaaS providers and they will have indirect value for the customer (better service).

By analysing the transcripts of the interviews, valuable and important themes of Lighting-as-a-Service were identified and they indicated what was necessary to deliver and manage Lighting-as-a-Service. By combining these themes with the knowledge from the literature and light management, a reference architecture was proposed. This reference architecture was designed to use as a blue print for a Lighting-as-a-Service management system. The architecture identifies the services, applications and data needed to deliver Lighting-as-a-Service in its most evolved form.

From the transcripts of the interview, potential valuable chances were identified as well. In total, eleven chances were found. These chances were evaluated using six criteria with different weights. By rating these chances using a Likert scale (of 1-5), the weighted score of the chances were determined. Four of these chances were indicated as most valuable:

- Monitor and analyse performance of the lighting installation. LaaS providers can use this to monitor if they are honouring their commitments and truly unburden their customer.
- Correctly predict energy savings. Used by the LaaS providers to accurately predict the savings that will be achieved by the new lighting installation in order to limit risk and deliver a better price for the service.
- Making processes more circular. Circularity is one of the most important implications of Lighting-as-a-Service and with the mismatch between the growing economy and the limiting resources, it will grow in value over the next few years. Software that can help companies in supporting their circular processes is thus very valuable.
- Maintenance optimization. Organising maintenance is now something that the customer must do, but if full unburdening wants to be achieved, this process should be optimized in such a way that the customer will not be bothered.

These chances were used to design new functionalities for Luxon. Table 1 shows these functionalities.

Chance	Functionality
Monitor and analyse performance	The ability to monitor and analyse the performance of the lighting installation
Correctly predict energy savings	The ability to accurately predict the savings achieved by new lighting
Making processes more circular	The ability to support companies in creating or delivering a circular economy
Maintenance optimization	The ability to optimize maintenance so that the customer will not be burdened

Table 1: Summarizing table in which the valuable new functionalities of Luxon are described

These functionalities provide a basic answer to the research question. However, the research was expanded by taking these functionalities and creating a technical solution for them. User requirements were derived from the functionalities and a new software specification was designed. This software specification introduced three new modules to Luxon: the Performance Manager, Savings Insights and the Circularity Manager. These modules were integrated in the enterprise architecture so that the technical solution was clear and an overview could be given of what was necessary to implement the new modules.



Figure 3: The new Luxon modules: Performance Manager, Savings Insights, Circularity Manager

Further research should be aimed at validating the reference architecture and researching how much the LaaS providers are willing to pay for the new functionalities.

The research succeeded in delivering valuable new functionalities that can be added to Luxon and have value in the Lighting-as-a-Service market. Furthermore, a reference architecture was developed that indicates what is necessary to accurately manage Lighting-as-a-Service using a software system. This architecture could be used as a starting point of a Lighting-as-a-Service management system.

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List of Abbreviations

Abbreviation	Meaning
BCG	Boston Consultancy Group
BMS	Building Management System
BSE	Business Source Elite (database)
CEO	Chief Executive Officer
DSRM	Design Science Research Methodology
EP concept	Extended Product concept
IEEE	Institute of Electrical and Electronics Engineers
IDI	Individual Depth Interview
IPS	Integrated product-service
LaaS	Lighting-as-a-Service
LED	Light-Emitting Diode (light source)
LLC	Luxon Light Controller
MVP	Minimum Viable Product
OEM	Original Equipment Manufacturer
PSS	Product-Service System
RE	Requirements Engineering
SRS	Software Requirements Specification
TCO	Total Cost of Ownership
VAR	Value Added Reseller

Table 2: List of abbreviations used in this research and their meaning

List of Concepts

In this table, you will find the meaning of the concepts that do not get extensively discussed in this research.

Concept	Category	Meaning
Activators (Luxon)	Product (hardware)	Activators are a piece of hardware that is used to make a lamp 'Luxon-ready'. It enables communication between lamps and the LLC using the internet and it collects data.
Application-architecture	Methodology	Architecture in which the different components that together form a product are modelled together with their relationships with other components. It creates an abstract high level overview of a product.
Armature	Product	The complete lamp including the holder, ballast, electronics etc.
Big-box retail	Market	Stores that cover huge spaces (often with a warehouse inside the store)
Channel partners	Market	Parties that distribute product in the lighting industry and mostly sell a complete solution to the customer. Examples are major wholesales.
Connected Light Management market	Market	Segment of the market in which services support the physical product. Light management is a part of this segment.
Luxon Light Controller (Luxon)	Product (hardware)	A controller is the central point of a light management system. The controller collects all data, visualizes the Luxon dashboard and controls the lighting installation.
Design Science Research Methodology	Methodology	Research design methodology in which the eventual goal is the design, development and/or validation of software.
Extended Product Concept	Market	Concept used to visualize the different product-service offerings and to create a maturity model.
Feature	Property	One or more logically related system capabilities that provide value to a user and are described by a set of functional requirements.
Individual Depth Interviews	Methodology	Data collecting methodology. In an IDI there is one interviewer and one interviewee. This way of collecting data delivers rich and detailed data.
IPS Cube	Methodology	Methodology used to categorize the different product-service offerings
Light management	Service	The smart control of light with the ultimate goal of reducing energy costs and creating better and more productive light.
Luxon	Product (software)	The light management software of Nedap. Luxon is an online software platform that can be used to monitor, analyse and control a lighting installation.
Nedap Light Controls	Company	Market group of Nedap who is active in the lighting industry.
Original Equipment Manufacturer	Supply chain	Producer and seller of the armatures in the lighting industry. Examples are Philips, Osram and GE.
Requirements Engineering	Methodology	The field of engineering that specifies how requirements for products can be elicited, described and validated.
Sensors (Luxon)	Product (hardware)	Sensors are used to acquire data that can be used to assess whether a lamp needs to be on or off.

Table 3: List of concepts used in this research and their meaning

1. Introduction

Light. We all use it to find our way when regular daylight isn't enough. We receive energy from it and sometimes even get scared when there isn't any around. We almost cannot live without it. However, we rarely realize the immense market that is the foundation of this product.

In this lighting market, it used to be enough to simply sell a lamp. The customer bought the lamp and you (probably) did not see him or her again. In the market of today however, it doesn't stop with simply selling a product. Many versatile services are added to the product that make the product much more than just a simple lamp. Nedap is active in this market. They offer light management services (smart control of light) in this lighting industry. The process of adding more and more services to a product is called servitization and it is the reason for the existence of this research.

That is, services are becoming more and more important and they might even become more important than the physical product itself. This last development is called Lighting-as-a-Service. The selling of light instead of the product so that the product itself doesn't really have any value (more on this later). This is where Nedap sees chances. Their light management system already provides valuable services for the final customer, but now that the market is becoming more and more hungry for services and that just selling a product isn't enough, Nedap thinks that they can attain a strong position in this market if they expand and/or improve their services.

That's why, in this research, possible valuable expansions or improvements for the Luxon platform in the Lighting-as-a-Service market are investigated.

2. Research Design

With an introduction to the research now given, the research design can be specified. First of all, Nedap and Luxon will be presented. Then, the problem that needs to be solved will be stated. Furthermore, the research question is derived from this problem and the deliverables and scope are specified. Lastly, the research methodology is discussed so that the steps needed to solve the problem are clear.

2.1 Nedap

Nedap is an innovative Dutch technology company with its headquarters in Groenlo. The company develops and produces electrical systems. Nedap is divided into several market groups (each with their own specialization) and one of those market groups is Light Controls. Nedap Light Controls is active in the lighting industry and sells hardware as well as software. The hardware exists of sensors, activators and controllers. This hardware is used as a means to power the software. Without it, the software cannot be used. The software exists in the form of a light management system called Luxon. See appendix A.2 for more information. The market group focuses on large scale projects in the industry (production halls, storage) and big box retail (Ikea, Makro). When, in this research, final customers are mentioned, then the customers in this target group are being talked about. More information on Nedap can be found in appendix A.1.



Figure 4: Logo of Nedap

2.2 Luxon

The light management system of Nedap Light Controls called Luxon, is the most important product that the market group sells. Light management does what it says it does: it manages a lighting system. It controls lights in a smart way in order to deliver more services and create more cost/energy reduction for its final customers. This is done by adding an activator to a light fixture. By doing so, the fixture becomes 'Luxon-ready' and what this means is that it can now talk to other lamps and to Luxon itself. Light management has many capabilities and some of them are listed below (more information in chapter 3):

- Automatically dim the light when no one is around to save energy costs.
- Implement a schedule for the lighting installation so that it automatically shuts down when for instance the shop closes.
- Adjust your lighting to the daylight coming from outside so that it only burns when it is really too dark.
- Keep track of your savings in energy and CO₂ and check your burning hours.
- Control your lighting installation not only from the actual site, but from everywhere around the world.

Luxon is, at the moment, only used by final customers. There is no environment for other parties like Original Equipment Manufacturers (OEMs) or channel partners. However, Luxon does get sold to these parties. This because Nedap isn't always with the final customer. They could be approached by other parties (who are involved with the final customer) who ask them to supply their light management system. Thus, it is important to know that the software is used by the final customer, but sold to the final customer and other parties in the supply chain. So it holds value for multiple links in the supply chain (being able to provide good light management might give you an edge when competing for a client).



Figure 5: Logo of Luxon

2.3 Developments in the lighting industry

The world of lighting is a complex one. Many players are involved and nowadays, it does not stop after fabricating and delivering a simple light bulb. The industry is dynamic and is about to change radically. The shifts that will emerge in the lighting industry are the biggest cause of this research. They are (probably) going to reorganise the industry and big players will have to adapt in order to attain their position. These shifts are all founded upon one technology: LED. In this paragraph, the developments in the market will be discussed as well as the causes of the developments.

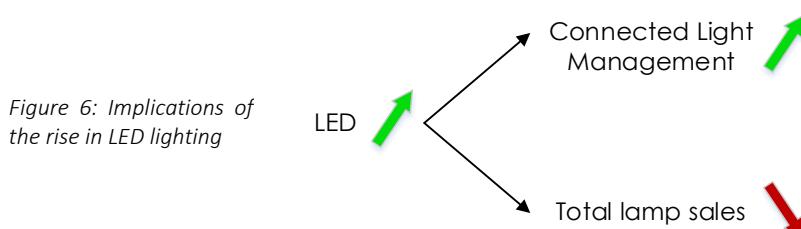
An important source providing insight in the future shifts is an article published in November 2015 by the Boston Consultancy Group (BCG). Nedap was, at the time, aware of the developments and they were already starting to prepare for them. The overall trend is that selling just a physical product isn't enough. Services are expected to be combined with the products in order to create more value for the customer. Light management is an example of such a combination. This trend is called servitization. The BCG article described the following developments.

LED (light-emitting diode) is seen by many as an enormous progress when compared to previous ways of lighting. LED is four to five times more energy efficient than its predecessors, is very versatile (many colour possibilities, small, very suitable for light management) and has a four times longer life expectancy than other lamps (about 15 years). The adaptation of LED will accelerate in the coming years because of the following two reasons:

- Although LED is at the moment a bit more expensive than conventional lighting, it is to be expected that this price will drop enormously.
- Businesses are focusing more and more on Total Cost of Ownership (TCO). As LED is more energy efficient and has a longer life time, the total cost of owning the lighting will be far less compared to conventional lighting.

The acceleration in the adaptation of LED has the following two consequences for the industry:

- Connected light management will become more and more popular. The versatility of LED (in colour and in use) increases the opportunities for light management (it can be quickly dimmed and is already more energy efficient, making the total savings of a new lighting installation about 80%. Besides this, it becomes more and more apparent that efficient lighting can cut down energy costs significantly).
- The total number of lamps sold each year will decrease. This is due to the longer life expectancy of LED lighting. This results on average in less lamps having to be replaced each year.



Because of the emergence of servitization, people are talking more and more often about Lighting-as-a-Service (LaaS) as a sort of ultimate form of the combination of product and service. Although the exact definition and characteristics are unknown (and are therefore researched in this research), people do agree on some of the characteristics. In this model, it isn't the lamp that is being sold, it is lighting. All the responsibilities and the risks of owning a light installation are transported from the customer to the supplier. This LaaS supplier takes care of the lamps themselves, maintenance, training, replacement costs and even the energy bill. In return it just provides lighting to the customer. Thus, the customer

doesn't buy a product, he buys a service. In most cases the customer pays a monthly fee for this service. One of the most important things necessary to deliver this service, is to be able to predict and minimize the risks that come with taking full responsibility for a lighting system. A light management system might be able to help here. Figure 7 visualizes the Lighting-as-a-Service model. Furthermore, the supply chain needs to be completely reconfigured (as only one party is in contact with the customer), the financial structures are very different from the conventional ones and the mind-set of the final customers need to be radically changed. Nedap finds this business model really interesting and thinks that software can help to overcome the difficulties that it poses (some are mentioned above). Thus, Nedap is specifically interested in this area.

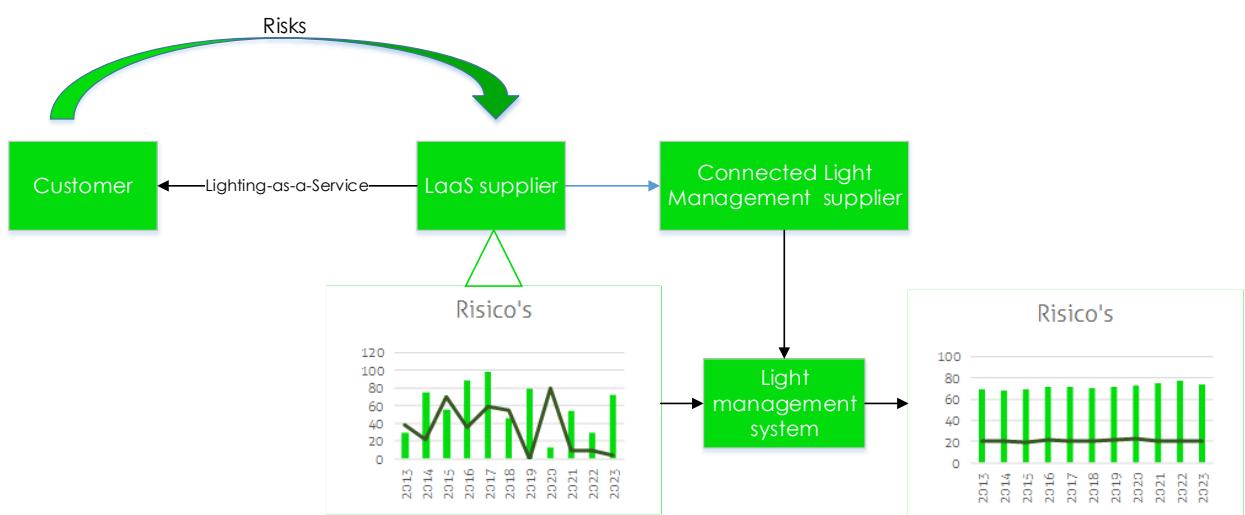


Figure 7: Sketch of the Lighting-as-a-Service business model

2.3.1 Chances for Nedap

These developments are valuable for Nedap. They are already in the Connected Light Management market and they thus have some sort of head start. However, the value of the hardware will also decline for Nedap and the software must become more valuable in order to maintain a strong position in this market. Confidential appendix 11.1 shows the current division in revenues per light fixtures during the current and the next two years. The rise of Connected Light Management and Lighting-as-a-Service gives Nedap the opportunity to actually do this as this market will probably grow a lot. However, knowing all this gives rise to one very important question: how to increase revenue on software services in order to cover the losses in hardware sales?

2.4 Problem identification

How is Nedap going to make sure that Luxon will be more valuable and that they can create more revenues per light fixture based on software? That is the question to which Nedap does not know the answer. This is thus the subject and starting point of this research. To be able to make this question more manageable, a problem cluster has been made (Heerkens et al., 2012). In this cluster the main problem is stated first and for every problem, a cause has to be found. The cause of that cause will then be found and so on until finally, a core problem is reached. A core problem is reached when searching for a cause will lead to a cause that cannot be influenced or is so small that it is too small to be relevant to solve. The problem cluster is stated in figure 8.

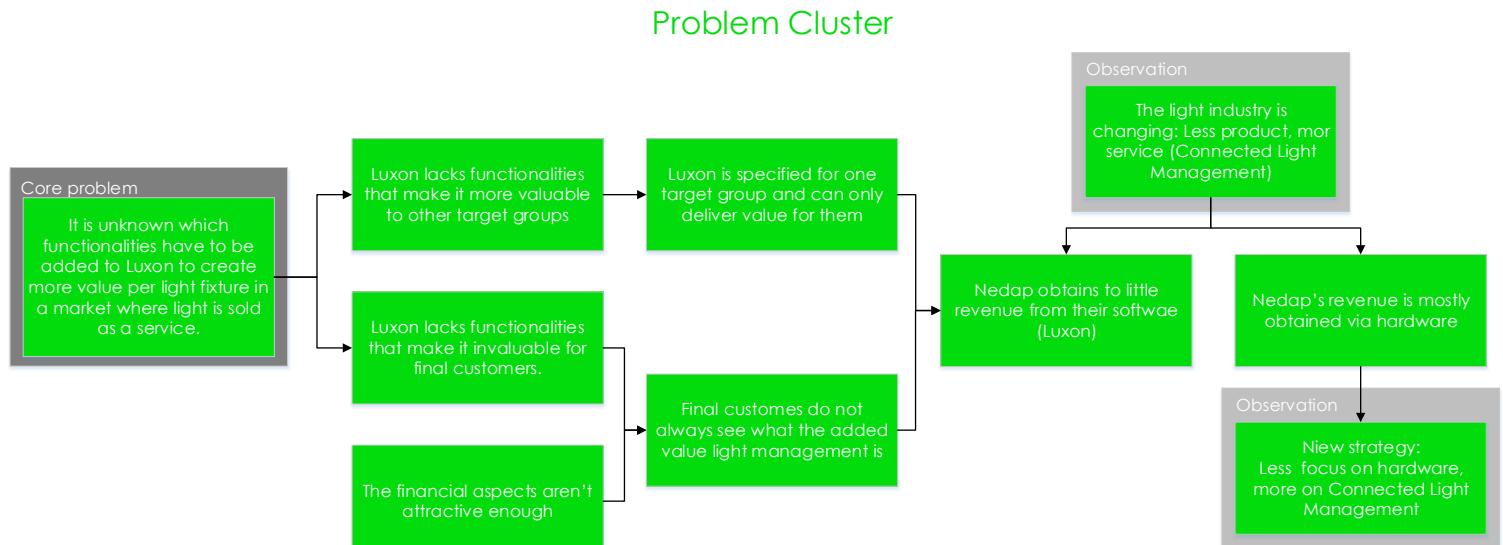


Figure 8: Problem cluster

From the problem cluster, it is clear that the core problem is the following:

It is unclear which functionalities have to be added to the light management system of Nedap to create more value per light fixture in a market where light is sold as a service.

2.5 Research questions

To solve the core problem stated in the previous section, a couple of questions have to be answered. From the core problem, a research question is derived:

Which functionalities have to be added to the light management system of Nedap to create more value per light fixture in a market where light is sold as a service?

This research question is further divided into sub questions. Each of these questions contributes to the answer of the research question.

1. *How servitized is the lighting industry and what is Lighting-as-a-Service?*
2. *What services could be of value to customers when lighting is sold as a service and where are opportunities for the software of Nedap with regard to these services?*
3. *Can a reference architecture be designed that proposes a blue print for a Lighting-as-a-Service management system and what would it look like?*
4. *How can these opportunities be transformed to new software functionalities and how can they be implemented in Luxon?*

2.6 Research goals and deliverables

The goals of this research will be used to guide the research to the outcome and to determine the success of the research when it is finished. The goals have been specified in cooperation with Nedap.

- Goal 1: finding an answer to the research question stated in the previous section that can hopefully be used by Nedap to attain a strong position in the connected light management market.
- Goal 2: drawing up a coherent and comprehensive analysis of the developments in the lighting industry and indicate valuable chances in this market.
- Goal 3: merging the findings into a reference architecture that can in turn provide input for the new enterprise architecture of goal 4 (this is not however the main goal).
- Goal 4: designing of a package of new functionalities that are valuable to Luxon together with an enterprise architecture of the current and ‘new’ Luxon.

With these goals in mind, a set of deliverables has been specified. These deliverables make the research goals more concrete and tangible.

- Deliverable 1: a coherent and comprehensive analysis of the developments in the lighting industry in which the ways of selling light, a maturity model, a classification of services and implications of these services will be discussed.
- Deliverable 2: an enterprise architecture of the current Luxon. As this architecture isn’t available yet, the architecture has to be developed during the research. This will create a clearly structured overview of the current offering and is thus very valuable for Nedap.
- Deliverable 3: a reference architecture that indicates what a future Lighting-as-a-Service management system should look like. This architecture provides insights into the gaps between the current systems and future ones. Being that this business model is fairly new, this reference architecture will provide great insights for the entire market.
- Deliverable 4: a software requirements specification in which the new software functionalities will be discussed.
- Deliverable 5: an enterprise architecture of the current and ‘new’ Luxon in which the relationships and interactions between the current and new functionalities are visualized. This is used to be able to tell what is needed to implement the new functionalities into Luxon.

2.7 Scope

To ensure that the research is achievable and manageable with the time frame of about ten weeks, a scope is defined. A number of delineations have been made in order to make the research to the point.

1. Starting from the core problem, the first obvious delineations have been made by focusing on new functionalities of Luxon, not on the current functionalities or other aspects of Luxon (financing, marketing etc.). This means that there is no research being done into the fact whether the already existing services are used in a correct way. Rather, the current functionalities are seen as the basis of the research upon which the solution is designed.
2. The second delineation concerns the target group for which the functionalities have to deliver value. In the beginning of the research, it is unknown which parties are going to play a big part in Lighting-as-a-Service and it is also unknown how this is organized. To be able to make this research viable and doable in the given time frame, a scope is placed on the target group for which the functionalities have to have value. In this research, all functionalities must eventually be of value to the final customer. What is meant with this, is that the functionalities that are added to Luxon, have to have some sort of value for the final customer. This can be done directly or indirectly. Directly meaning that the functionalities are used by the final customer. Indirectly meaning that another party interacts with the functionalities, but that the final customer will enjoy the benefits of these functionalities (in the form of better services).

3. The third and final delineation specifies that the new functionalities must be relevant and of value in the Lighting-as-a-Service market. Functionalities that only have value in the ‘old’ market will be left out of this research. This however does not mean that other valuable opportunities in other fields of the servitized market will be left out the research as they can also lead to valuable new software.

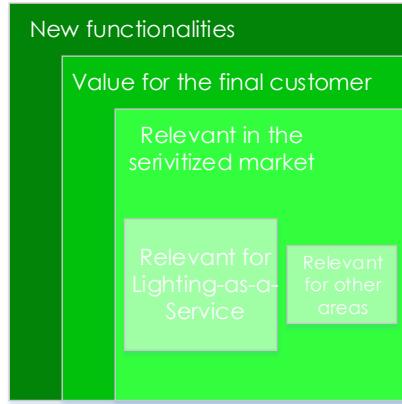


Figure 9: Scope of the research

2.8 Research methodology

As this research is designing new software functionalities, the research in general follows the Design Science Research Methodology (DSRM) (Peffers et al., 2007). This methodology is specifically developed to be able to design and validate new concepts (such as software). The methodology consists of six activities: 1) problem identification, 2) objective specification, 3) design & develop, 4) demonstration, 5) evaluation and 6) communication. In this research, the following phases can be identified:

1) Problem identification

The motivation behind this research is introduced and the problem that needs to be solved is identified.

2) Objective specification

This phase specifies the objectives for this research. It indicates that new functionalities have to be designed for Luxon and that these will be presented in a software requirements specification and an enterprise architecture. It also analysis the current situation of Luxon.

3) Design and development

Here, the market and literature is analysed so that opportunities for new software can be identified. These opportunities are then transformed into new software functionalities and these functionalities are presented in a software requirements specification and an enterprise architecture. With the feedback of activity four, these solutions are altered and eventually finalized. Also, a reference architecture that can be used as a blue print for future Lighting-as-a-Service management systems is proposed.

4) Demonstration and evaluation

Given the limited time in which this research has to be carried out, the demonstration and evaluation phase is limited to determining the value of the chances according to the interviewees and demonstrating of the new functionalities to Nedap. The feedback received in this phase are then incorporated in phase 3.

5) Communication

In this phase, the final solution is sketched and presented together with recommendations for implementation.

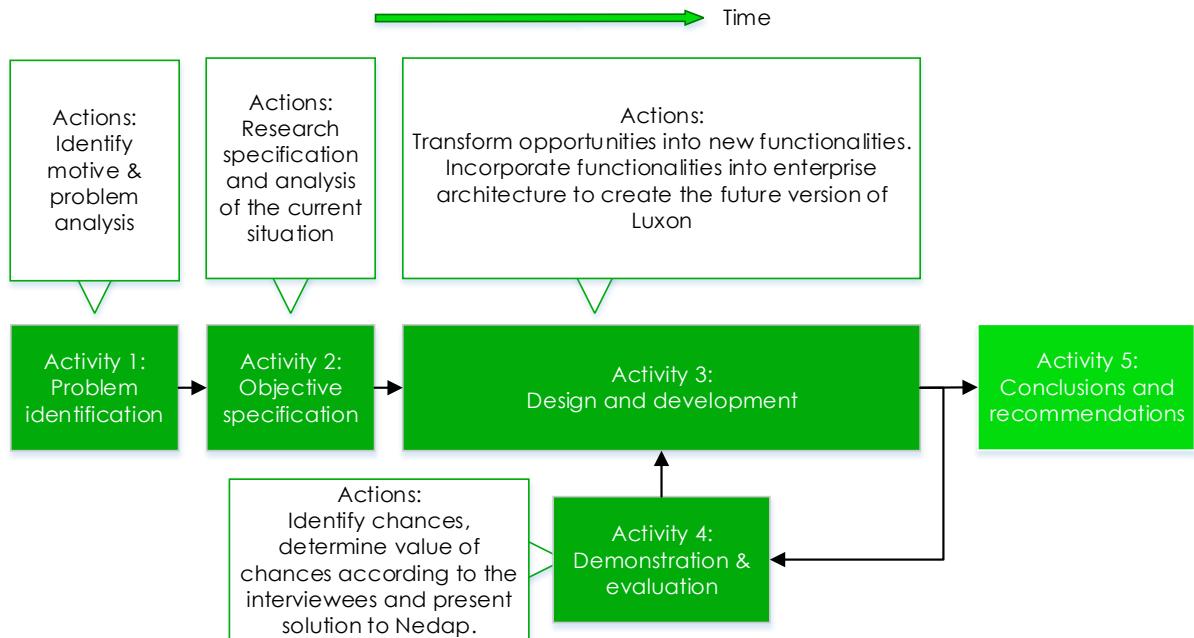


Figure 10: Research methodology used to carry out the research

Next to the DSRM, another methodology is used to perform the research. The input for activity 3 needs to be gathered using Individual Depth Interviews (IDI) (Cooper and Schindler 2011). These interviews have been designed using the qualitative research process proposed by Cooper and Schindler. The goal of these interviews is to find:

Opportunities in the servitized market that may lead to new software functionalities in Luxon that are valuable for the services provided to the final customer.

In order to make this subject more concrete, the definition of opportunities is given by:

- An opportunity could present itself as a known problem. When certain services cannot or aren't sufficiently provided (for whatever reason), then this states a problem that is known. By developing new software functionalities, this problem might be solved.
- An opportunity could present itself as an unknown problem. When a problem hasn't occurred yet but, it becomes apparent that this problem will arise, then this states an unknown problem. These problems could emerge by analysing the literature or the data from the interviews. By developing new software functionalities, this problem might be solved or even prevented.
- An opportunity might present itself as an unsatisfied stated need of a final customer. When for instance a certain service cannot be delivered yet, but it is clear that the value of that service is high for final customers, then an unsatisfied stated need is found.
- An opportunity might present itself as an unsatisfied unstated need for a final customer. When the customer doesn't know that they want a certain service until they have it, then an unsatisfied unstated need is found.

As can be seen, an opportunity might arise in various different ways. Therefore, in the further course of this research, an opportunity (or chance) will be seen as an umbrella term for all the causes that could lead to new valuable software functionalities.

To acquire these opportunities, service providers in the lighting industry are interviewed. A deliberate choice has been made not to interview customers as these customers do not really know what they want to see in a lighting system. Although the ultimate goal is to increase customer value, the service providers are the most reliable source to obtain information on how to do this.

2.9 Thesis structure and reading guide

A reading guide is used to provide an overview of what and when the reader can expect to read about certain topics. Besides that, some parts of this research are confidential and in order to guide the reader (with the right authorization) chronologically through the research, this reading guide is included. Some parts of this thesis are made confidential due to the fact that they present company secrets regarding the way they build a light management system. On top of that, some remarks are made regarding the way Nedap organizes its business. A final aspect of the confidentiality is the anonymity of the spoken parties. They will be addressed using simple letters.

The thesis starts off with an introduction (chapter 1) where the subject is introduced and the research design (chapter 2) in which the chosen methodologies and research questions are discussed. There are no confidential parts here (apart from one figure in chapter 2). Chapter 3 discusses the current situation of Luxon. The software specification in section 3.1 is available in the public version. The enterprise architecture of the current Luxon in section 3.3 however is confidential (and is placed in confidential appendix 11.2). The literature review (chapter 4) provides a theoretical framework on the literature at hand regarding servitization and Product-as-a-Service. Chapter 5 presents the findings from the interviews. In chapter 6, a reference architecture is proposed that can be used as a blue print for a Lighting-as-a-Service management system, a vision of the future for Lighting-as-a-Service management systems and an identification of the gaps between now and the future. Chapter 7 presents the new functionalities for Luxon. Here, the identified chances can be seen as well as the functionalities that will be valuable to add for Luxon. The software specification of the implementation of these new functionalities (section 7.2.2) and the new enterprise architecture (section 7.3) however, remain confidential (and can be found in confidential appendix 11.3 and 11.4). The thesis ends with a conclusion and discussion in chapter 8. The recommendations and options for further research are discussed in chapter 9. The thesis ends with the reference list in chapter 10 and the confidential appendices in chapter 11. Figure 11 captures the structure of the thesis. The top bar indicates the phase of the DSRM, the number inside the green boxes represent the chapter in which the topic can be found. The arrows indicate the chronological order of the thesis and it is recommended that readers with the right authorization follow this order.

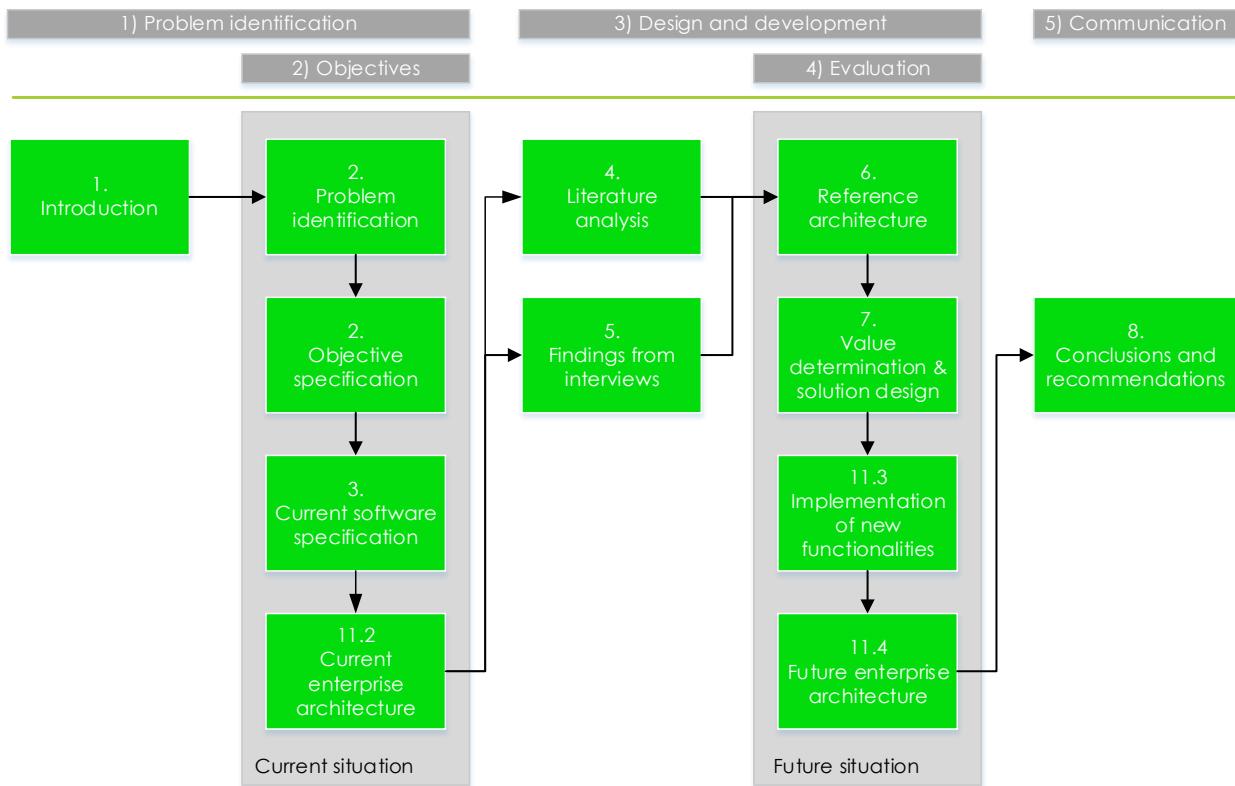


Figure 11: Representation of the structure of the thesis

3. Current Situation

Luxon. The light management software of Nedap is the product around which this research is build. In order to be able to add value to the current proposition, the current proposition must first be accurately described. To do this, this chapter seeks to describe the functionalities of Luxon and the way the different components of Luxon are connected. A list with software specifications and an enterprise architecture is developed. As Nedap did not have such an architecture, the enterprise architecture discussed in this section had to be completely designed from scratch.

3.1 Software specification of the current Luxon

Using motion and daylight sensors, Luxon is able to control a lighting system in such a way that it provides light when and where it is needed but also doesn't provide it when it is not needed (which is equally important). This way, Luxon can create savings of up to 35% and provide the customer with qualitatively good light. Luxon is build-up of three different modules. One basic module called Luxon fundamentals, one called Energy Analytics and one called Maintenance Assist. Luxon has a subscription based pricing strategy which means that the user pays a monthly fee for the modules that he or she desires to use. Prices are determined per light fixture. In this section, the functionalities of the different modules are discussed to show how the user interacts with Luxon and what he/she can do with it.

Luxon Fundamentals

Luxon Fundamentals is the starting point of all Luxon installations. It gives the user the ability to control their installation, provides some basic analytics and provides an online platform from which a customer can manage the extensive network of luminaires, controllers and sensors. It contains the must have features of the Luxon software divided into six different apps: Usage kWh Last week, System status, Last Week's Savings, Floor Plan, Lighting Components and Contact Luxon Provider (as seen in the figure 12 below).

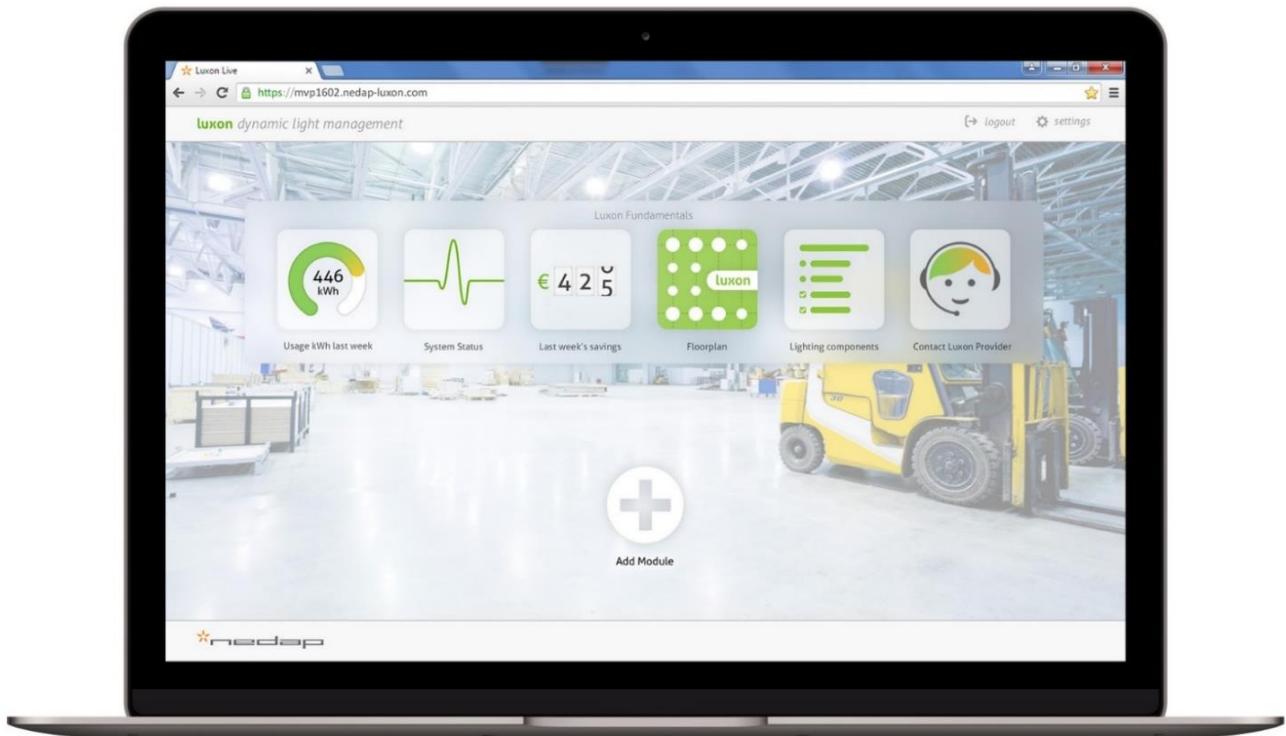


Figure 12: Visual design of the Luxon Fundamentals module

With these apps, the user gets the following features:

Application	Features
Usage kWh Last Week	Insights in last week's usage (stores up to one week of data)
System Status	View and monitor system status. Check when the last synchronization and data processing took place (this does not include errors).
Last Week's Savings	Insights in last week's savings (stores up to one week of data)
Floor Plan	Manage and adjust your lighting online from anywhere at any time Maximize energy savings by applying motion, daylight and time control Clear visual overview & floor plan of your lighting installation
Lighting Components	Check the hardware specifications of your lighting
Luxon Support	Remote support by Nedap Luxon partners if needed
General	Receive software updates periodically

Table 4: Applications and features of Luxon Fundamentals

Luxon Maintenance Assist

Via the app store, a user can add a module to their Luxon dashboard. This enables new features (in the form of apps) and value to the customer. Luminaires need to be reconfigured, cleaned, recalibrated or replaced over time. Maintenance assist helps the customer to plan these activities, send error notifications and provides maintenance reports. These apps are Message Center, Reports and Errors (as seen in the figure 13 below).

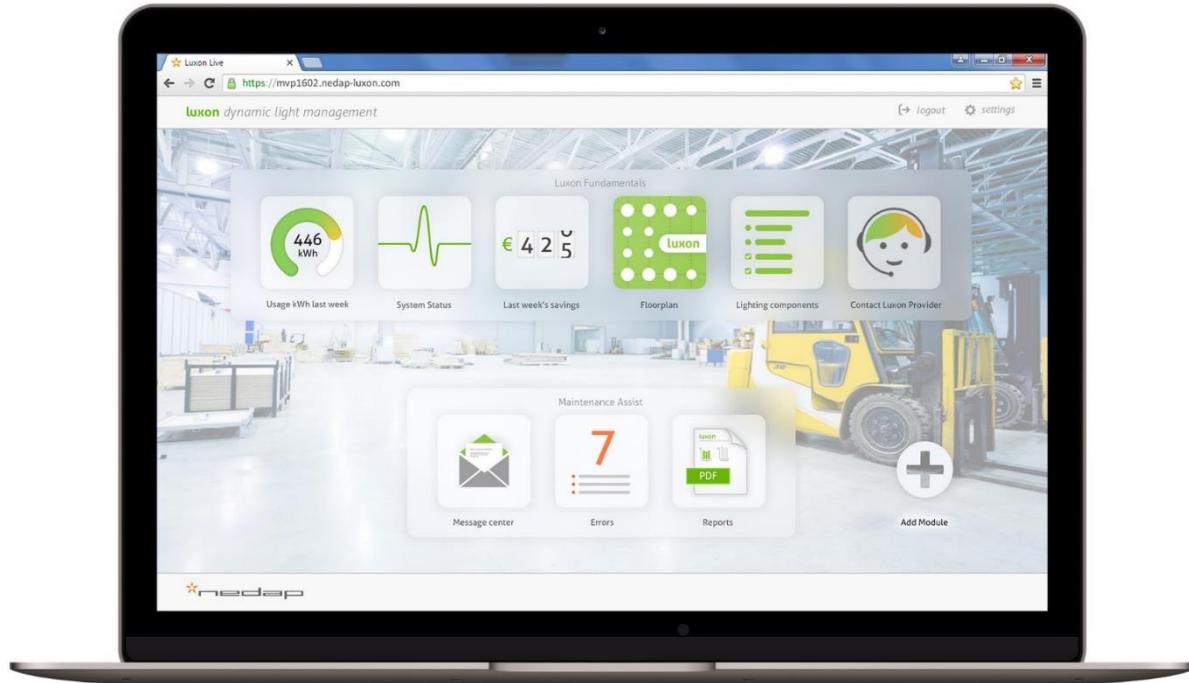


Figure 13: Visual design of the Luxon Maintenance Assist module

These applications deliver the following features:

Application	Features
Message Center	Failure notification services by e-mail
	Plan maintenance activities and receive reminders
Reports	Maintenance reporting (error report and action list report (what has to be done and when))
Errors	Individual luminaire performance history (burning hours, temperature etc.)

Table 5: Applications and features of Luxon Maintenance Assist

Luxon Energy Analytics

This module offers a proof of performance for the customer's lighting system. It gives the user the tools to analyse the energy data and make the energy costs predictable. It does so by providing three apps: Usage Last Month, Usage CO2 Last Month and Reports (as seen in the figure 14 below).



Figure 14: Visual design of the Luxon Energy Analytics module

These applications deliver the following features:

Application	Features
Usage Last Month & CO2 Usage	Easy accessible & understandable energy performance data
	Benchmark/comparison function (within and between locations)
	Long term data storage
Reports	Energy management reports

Table 6: Applications and features of Luxon Maintenance Assist

3.2 Enterprise architecture

With the software specification, an overview of the functionalities of Luxon is given. This is what the users sees and what it interacts with. However, to describe the interactions and relationships between the different components that make up the total system of Luxon (front-end and back-end), an architectural model is needed in the form of an enterprise architecture. To indicate what this architectural model exactly is, the definition of an enterprise architecture needs to be stated. Enterprise architecture is the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution (Winter and Fischer, 2006). Enterprise architecture provides an architecture in which every component of a corporation is modelled together with the relationships between them and the environment. These components represent customers, staff, stakeholders, processes, assets, products, services, data, information, communication and security (Hewlett, 2006). It provides a blue print for a corporation. Being that it is a blue print, the individual components are not discussed in great detail. This would make the overview in general less clear.

In this research, a view on this enterprise architecture is designed so that only the relevant components that have value for Luxon are being modelled. With this architecture, everything that is a part of Luxon is modelled and the opportunities and new functionalities found in this research can be designed in a detailed way. By doing this, Nedap knows not only how the new functionalities will look and interact with the customer, but also what other components need to be used/ altered/ created in order to deliver these new functionalities.

3.2.1 The value of an enterprise architecture

With an enterprise architecture, it is possible to create an overview of a product or company to see what components it is made out of and how they interact. Where the software architecture specifies in great detail what one component of a product is and how it works, the enterprise architecture provides a helicopter view of all the different components that make up the entire product combined and it shows how they interact. In summary, an enterprise architecture provides the corporation with the following advantages (Hewlett, 2006):

1. To present an overview of all components of a company.
2. To present the current and future vision of the business.
3. To support quality decision making (investment choices) and the impact of changes.
4. To use information technology to support business operations in a cost-effective manner.
5. Leverage new technology solutions effectively by the ability to quickly assess what is necessary to implement them.
6. Promote the sharing of systems and data.
7. Improve ability to integrate data across the company.

Advantage 1,2,3 and 5 are particularly important in this research as they provide the tools to indicate what is necessary to implement the new functionalities.

3.2.1 The Archimate language

The enterprise architecture modelling language called Archimate is used to design the enterprise architecture of the current version of Luxon. Archimate provides a graphical language that can be used for the representation of enterprise architectures. Archimate is a lightweight and scalable language in several aspects (The Open Group, 2015):

- Its architecture framework is simple but comprehensive enough to provide a good structuring mechanism for architecture domains, layers and aspects.
- The language incorporates the concepts of the “service orientation” paradigm that promotes a new organizing principle in terms of (business, application and infrastructure) services for organizations, with far-reaching consequences for their enterprise architecture. This is a very important aspect of Archimate as we know that light management is an important service in the servitized lighting industry. It is thus very valuable to be able to implement the service aspect in this architecture.

The Archimate language exists of an architectural framework of 9 cells in a 3 by 3 grid. The framework can be seen in figure 15.

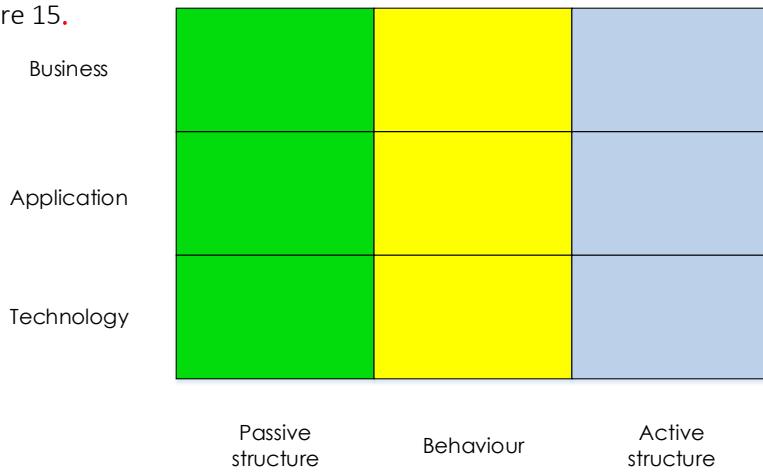


Figure 15: Metamodel of the Archimate language

As can be seen, the framework consists of three layers:

- Business layer. This layer offers products and services to external customers, which are realized in the organization by business processes performed by business actors. More on business processes and business actors in appendix B.
- Applications layer. This layer supports the business layer with application services. These services are realized by (software) application.
- Technology layer. This layer offers infrastructure services (such as processing, storage and communication services) needed to run applications. These services are realized by computer and communication hardware and software.

In this language, services are described as the following: a unit of functionality that a system exposes to its environment, which provides a certain value (monetary or otherwise). It does this while hiding internal operations.

Each of the three layers consists of aspects. Although these aspects aren't explicitly mentioned in the architecture, it's important to know of their existence as they talk about the nature of the concepts:

- Active structure. Concepts being defined as elements that can perform behaviour (such as business actors, applications components and devices that display behaviour).
- Behaviour. Simply represents behaviour that is performed by an actor. Behavioural concepts are assigned to structural concepts so that it is clear who actually displays the behaviour.
- Passive structure. This aspect represents the objects on which behaviour is performed.

3.3 Enterprise architecture of the current Luxon

Due to the confidential information in this section, it has been removed in the public version of the thesis. With the right authorization, the section can be found in confidential appendix 11.2. Readers with the right authorization are advised to continue reading from this appendix in order to follow the chronological flow of the research.

4. Theoretical framework

To provide a good understanding of the subjects that are going to be dealt with in the research, a theoretical framework is created in which all the relevant information regarding these subjects are presented. The main input for this framework is literature. That is why a literature review was conducted. In this chapter, the required output of this literature review will be discussed as well as the search strategy, the search results and a coherent discussion of the findings.

4.1 Required output

First of all, a set of goals are specified that are going to be used to assess whether every topic and aspect of this topic is discussed. The research questions and required deliverables stated in 2.5 and 2.6 indicate that three main topics need to be discussed. The topics and the required output are listed here:

- Servitization. Indicated by the phrase: "...a market in which light is sold as a service?", the research question states that information is needed about this innovation in the market. After all, it is impossible to develop new software without proper knowledge of the market in which the software is placed. The following outputs will be discussed:
 - A description of servitization, its characteristics and types of offerings in such a market (with a clear focus on Lighting-as-a-Service).
 - The implications of as-a-Service offerings
 - A maturity model in which different phases of servitization can be determined. This can later be used to assess the position of Nedap and the lighting industry in the servitization process.
- Requirements engineering. Indicated by the phrase: "Which functionalities...", the research question states that information is needed about the way these new requirements come about and how they are specified. The following output will be discussed:
 - A description of requirements engineering and its characteristics.
 - Standard ways of writing down requirements.
- Enterprise architecture. Again indicated by the phrase: "Which functionalities...". Delivering a document with new requirements is only a job half done. That's why the list of new requirements will be used to alter and add features in the enterprise architecture of the current Luxon. The architectures use the ArchiMate language which is already discussed. This topic is thus not discussed any further in this chapter.

4.2 Search process

The literature review was executed in a systematic way (Webster and Watson, 2002). This means that first of all, search assignments were determined. Secondly, inclusion and exclusion criteria were stated. These criteria created a scope and were used to shorten the list of references that was obtained using the search assignments. Thirdly, the search assignments were executed and duplicates were removed from the results. The search assignments were executed in the following databases: Web of Science, Scopus and Business Source Elite. Google scholar was used to look for interesting papers that didn't came up in the first three databases. Fourthly, the articles were examined using the inclusion and exclusion criteria. Fifthly, the shortened list was read and articles that were not valuable were removed. Also, using backwards reading, other interesting articles were added. Lastly, the concepts were merged and used in the discussion and conclusion of the literature review.

4.3 Results

Using the search strings (stated in appendix C) a total of 438 articles were found. After removing duplicates and applying the inclusion and exclusion criteria, only 69 remained. The articles were read and 5 were added and 53 were removed. The findings of the remaining articles, are stated in the discussion.

4.4 Discussion

4.4.1 Servitization

Every good research start with a clear definition of the concepts they are talking about. This research is not any different. This discussion will thus start with a clear definition of what servitization is, what product-service combination are and what the characteristics of such a market are.

The term servitization emerged for the first time in 1988 (Rada and Vandermerwe). Since then, much has been written about servitization and almost every paper gives a somewhat different definition to this concept (as can be seen in table 7).

<i>Definition of servitization</i>	<i>Author</i>
Market packages or ‘bundles’ of customer-focused combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings.	Rada and Vandermerwe (1988)
A trend in which manufacturing firms adopt more and more service components in their offerings	Desmet et al. (2003)
The emergence of product-based services which blur the distinction between manufacturing and traditional service sector activities	Tellus Institute (1999)
A specific innovation of the business model in which by using service activities that span the life cycle of a product, the manufacturing firm extends the content of its transaction with customers, leaving customers to directly benefit from the utility that the product provides.	Visnjic and Van Looy (2011)
Adding extra service components to core products	Verstrepen and van Den Berg (1999)
Any strategy that seeks to change the way in which a product functionality is delivered to its markets	Lewis et al. (2004)
A change process wherein manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer’s needs, achieve competitive advantages and enhance firm performance	Ren and Gregory (2007)
The innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling product-service systems (PSS)	Baines et al. (2009)

Table 7: Definitions of servitization according to the literature

A couple of aspects stand out in all of these definitions. These aspects can be used to what servitization is and what it implies for companies living in such a market. These characteristics can then be used to determine a definition of servitization. The aspects are:

- Process. In most of the definitions, servitization is seen as an innovative process. It isn't something that is stable. It is rather the transition of a market where more and more a product is combined with services.
- Goal/outcome. There are multiple goals given for why firms servitize. The three that stand out the most are: gaining competitive advantage, adding more value to the core product and

creating a valuable relationship with the customer. Where, in the past, it was enough to just sell a product, companies now realise that these products are becoming a commodity. It is more and more important to differentiate from your competitors by providing services. These services add more value to your product and can thus create competitive advantages. Another important goal is creating a valuable customer relationship. In the past, selling a product was transaction-based. Nowadays, the selling of a product-service combination is relationship-based.

- A combination of product and service. In all the definitions, some sort of combination of product and service is discussed. Although this combination comes in many forms (more on this in section 4.4.2), it is certain that a combination of the two is needed in order to be able to talk about servitization.

By merging these three aspects together, the definition of servitization that is going to be used in this research is the following:

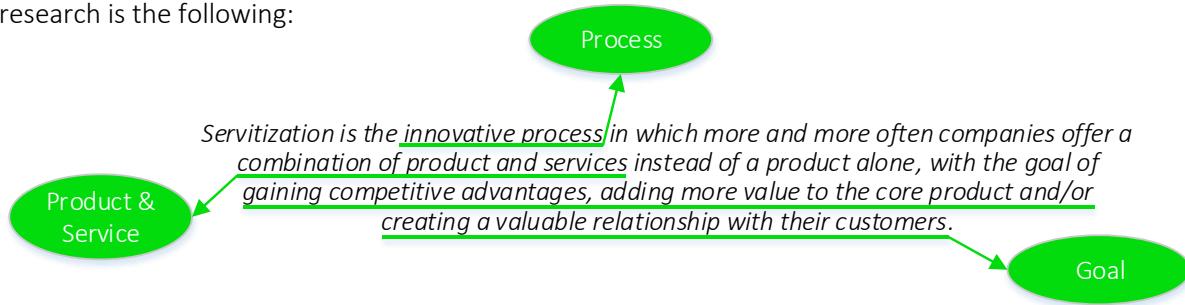


Figure 16: Definition of servitization according to the literature

4.4.2 Types of product-service offerings

Now that a proper definition of servitization has been stated, a closer look can be taken at the offering that revolves around servitization: the product-service combination. It is necessary to establish a model that can classify all the different combinations of products and services. This model can be used further in the research to determine what product-service combinations are offered in the lighting industry and who the companies are that provide them. This makes it easier to analyse the servitized lighting industry.

In the literature, many names are given to the combination of products and services. Some definitions have a different word for the same combination, but there are also some clear differences, indicating that there are multiple variants of this product-service combination. But before a clear definition of the combination is given a quick definition of a product and a service has to be given. In the manufacturing industry, a product is a tangible object. A service is however harder to describe. In this research, a service is an economic activity that doesn't result in ownership of something tangible (Park et al., 2012). Examples of words often used to describe the combination of the two are: bundling, systems selling, full service, service package, product service, solution, integrated solution, product-service system (PSS), functional product and integrated product and service offering (IPSO). In this research, an umbrella term will be used to describe all these concepts: the integrated product-service (IPS) (Park et al., 2012).

To visualise how such an IPS looks like, the extended product concept is used (Thoben and Eschenbächer, 2001). The extended product concept conceptualizes the way in which the value of a product can be 'extended' by adding services to it. Figure 17 visualises the simplistic form of the concept.

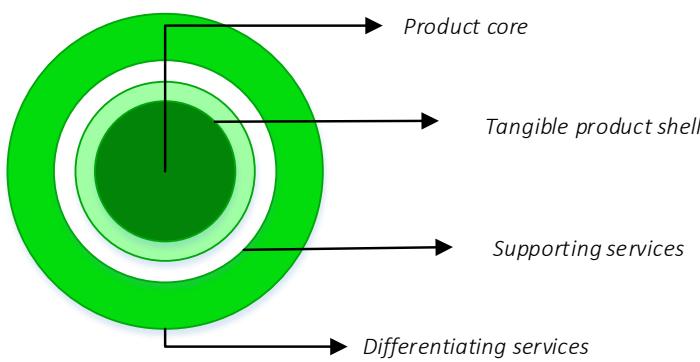


Figure 17: Metamodel of the Extended Product concept (Thoben, 2001)

are the best services to deliver when searching for competitive advantage.

Recently, an addition to this concept has been made. Right now, the services that are added to the product are specifically made for the product. However, this isn't always the case. Services that already exist can be reused in other products. The extended product concept 2.0 (Wiesner et al., 2013) adds two kinds of these services to the model (figure 18).

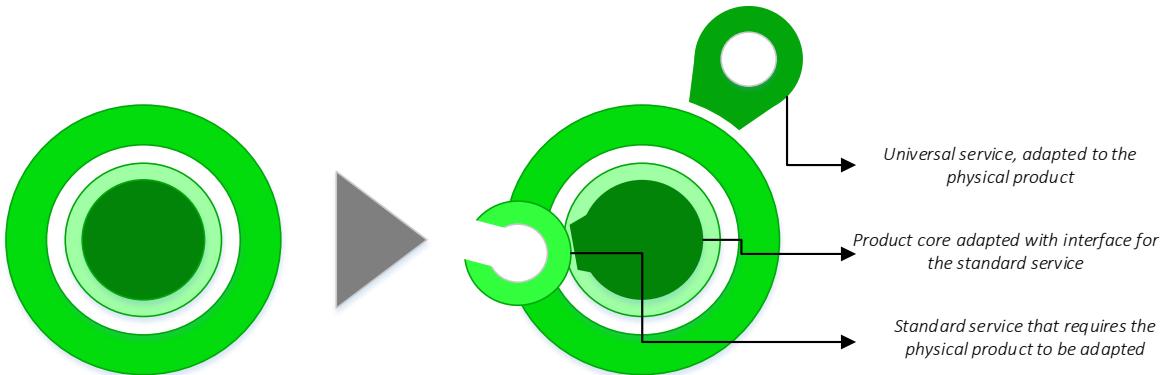


Figure 18: Metamodel of the Extended Product with the 2.0 extension (Wiesner et al., 2013)

In the extended product concept 2.0 the product shell remains the same. The supporting and the differentiating services are also still the same, but are combined as services that specifically aligned for the product. The universal services, adapted to the physical product represent services that already exist, but are somewhat altered so that they can be added to the product. The standard services also already exist, but in this case, the physical product needs to be adapted. That is why the physical product also has a small extension toward the standard service.

Using the umbrella term of IPS and the visual conceptualization of the extended product concept, a model can be made that can be used to classify and visualize every IPS in the market. The framework is called "the IPS cube" and it categorises IPS's along three dimensions (Park et al., 2012).

- The ownership of product dimension. This can be either the customer or the provider.
- The nature of integration. This can be either compound or mixture. Compound IPS's indicate that the product is inseparable from the service and the two are usually already integrate in the design phase (these are called engineering-oriented IPS's). Mixture IPS's indicate that the integration is merely physical and the two can be separated (these are called marketing-oriented IPS's).
- The role of technology in combining the product with the service. This can either be technology-free or technology-involved.

Combining the three dimensions in a cube creates eight different quadrants (see figure 19).

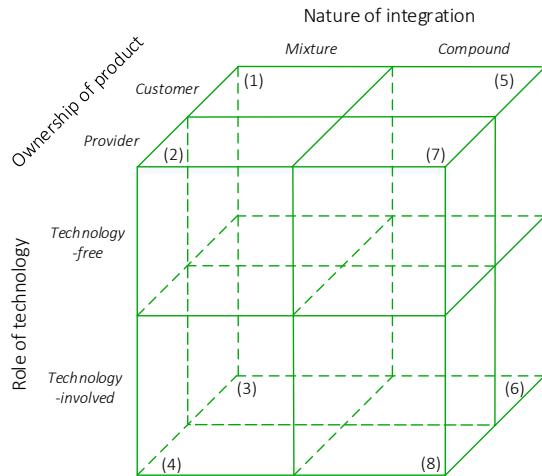


Figure 19: Metamodel of the IPS Cube (Park et al., 2012)

Every quadrant represents a different kind of IPS. In the following section, an example for every quadrant will be given as well as a visualization of the IPS configuration using the extended product concept. These can later be used to classify the different services provided in the lighting industry.

1. *Mixture – Customer – Technology-free*

An IPS type in which the product and service can clearly be separated, where the customer is owner and where no technology is used to combine the two. Examples of these services are supporting services like installation, training and maintenance.

2. *Mixture – Provider – Technology-free*

An IPS type in which the product and service can clearly be separated, but where the provider is owner and where no technology is used to combine the two. Examples of these services are lease or rental services. You pay to use the product, but the product is still owned by the provider.

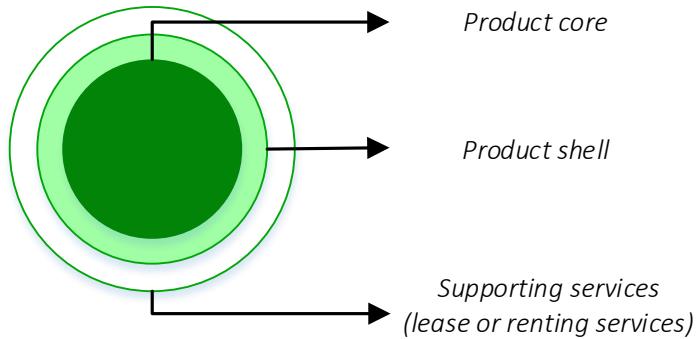


Figure 20: Extended product configuration for quadrant 1&2

3. *Mixture – Customer – Technology-involved*

An IPS type in which the product and service can clearly be separated, where the customer is owner and where technology is used to combine the two. Examples of these IPS's are a Nike + iPod Sport Kit. Comprising two modules, a sensor attached to or embedded in the shoes and a receiver plugged into an iPod Nano, is a device that measures your sport performance. This service differentiate the original product (the running shoe). These services can be specifically designed for the product, but can also already exist.

4. *Mixture – Provider – Technology-involved*

An IPS type in which the product and service can clearly be separated, where the provider is owner and where technology is used to combine the two. Examples of these kinds of IPS's are remote control services in for instance health care. Where everyone with the right authentication can access the medical record of a person from anywhere in the world.

5. *Compound – Customer – Technology-free*

An IPS type in which the product and service cannot be clearly separated and have been integrated from the start of the production, where the customer is owner and where there is no technology-involved. Consulting services are an example of these services. They use the product to base their consultation upon and present is as one final IPS.

6. *Compound – Customer – Technology-involved*

An IPS type where product and service are integrated from the start, where the ownership lies with the customer and there is technology involved to connect the two. Examples of these kinds of IPS's is the Apple iPhone. The iPhone is the physical product but a lot of its value lies in the service of the App Store. This service continuously provides new software applications and updates and controls them for free.

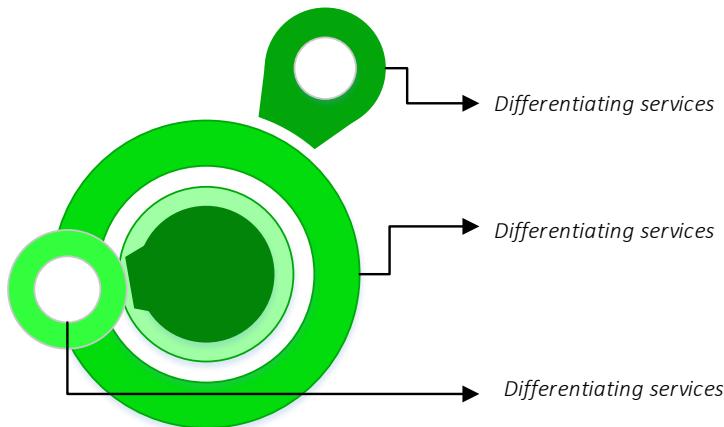


Figure 21: Extended Product configuration for quadrant 3,4,5&6

7. *Compound – Provider – Technology-free*

An IPS type integrated from the start with the provider as the owner and there is no technology involved. Examples of these kinds of services are Product-as-a-Service models in which the user doesn't buy the product, it just pays for what they use. In the Extended Product concept something strange happens. As the physical product isn't actually being sold in this kind of IPS, the physical product doesn't get modelled. The product is just of means of making it possible to deliver the service (however still necessary and thus still an IPS).

8. *Compound – provider – technology-involved*

An IPS type where product and service are integrated from the start, where ownership lies with the provider and technology is used to combine the two. Examples of these kinds of services are Interactive TV. In order to receive this service, you need a set-up box through which you can receive the service. Most of the time the set-up box is rented and again only used as a means to deliver the true value (Interactive TV). That is why again, the Extended Product model changes in configuration.

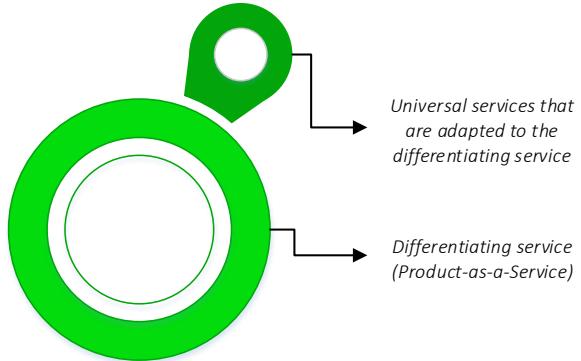


Figure 22: Extended Product configuration for quadrant 7&8

4.4.3 Product-as-a-Service

Given the above concepts, it is possible to give a definition to the Product-as-a-Service concepts. These special types of IPS's are the main topic of this research and their exact definition is ambiguous and unknown to Nedap. Thus, it requires a good definition. Using the definition stated by the IPS cube, the following definition fits the description of Product-as-a-Service:

A form of an IPS in which the physical product is owned by the provider, does not deliver any value to the total offering and doesn't require any technology to be added to the service. In this form, the product is merely used as a means to be able to deliver the service. The usage of the product is sold, not the product itself.

Implications of Product-as-a-Service

With the definition given to Product-as-a-Service, the implications of this IPS can be discussed. In order to be prepared for whatever is going to be found in the interviews, the implications of Product-as-a-Service that are already known can be looked at. This way, there will be enough knowledge available prior to the interviews and the interviews can focus on what they are aimed to do: identifying valuable chances in the Lighting-as-a-Service market.

For the customers, the most valuable implications of Product-as-a-Service are the unburdening of responsibilities and the limitations of risk. Now that the provider will remain owner of the product and they will take care of everything that is necessary to use the product (that is the service part of the IPS), the customers can be fully unburdened and the risks (of for instance value loss, broken products or innovation) are limited.

For the business, another very valuable concept closely related to the Product-as-a-Service concept can now become a reality: the circular economy. This is a very interesting subject as it might revolutionise the way in which the world uses its resources and Product-as-a-Service is the business model that can make this economy a reality.

To find out why Product-as-a-Service will help the circular economy, the term circular economy must first be introduced. The term was proposed for the first time in 1998 by Chinese scholars (Zhu, 1998) and was developed as a new development strategy that aims to alleviate the mismatch between rapid economic growth and the shortage of raw material and energy (Xiao-Lu, 2005). To put it simply, we are using more than we can and if we continue to do this, the world will soon have no resource to use any more (as sketched in the fictive figure 23 (x-axis = time, y-axis = size)). Notice that the resources needed to support an economy in the future aren't available anymore (numbers are made up and exaggerated)). This is a serious problem for everyone living on this earth and it needs an ediquate solution if we want to solve this problem.

Mismatch between a growing economy and shrinking resources

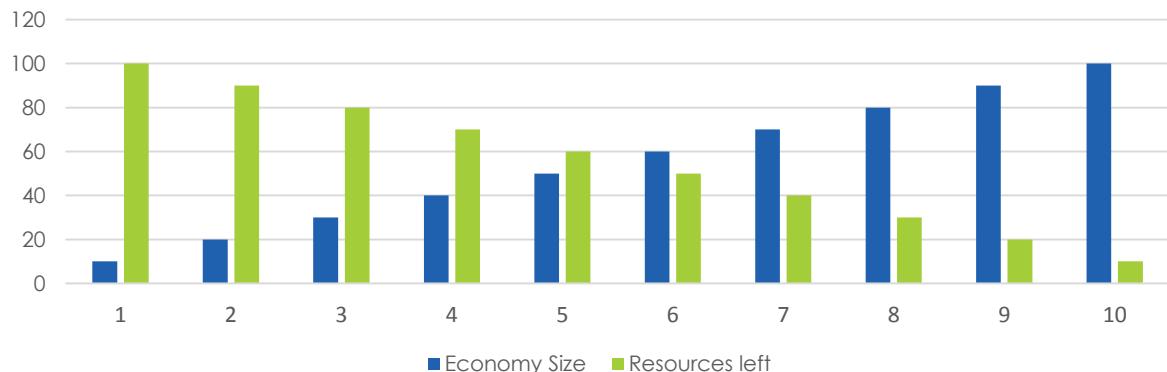


Figure 23: The growth of the worldwide economy versus the remaining resources on this earth

The circular economy is an answer to this problem. Although there is no commonly accepted definition, the core of a circular economy is the circular (closed) flow of materials and the use of raw materials and energy in multiple phases. Ultimately to filter out waste and reuse, reduce and recycle (the 3R paradigm) the materials used to support the economy (Yuan, 2006).

In order to do this, companies must change the way they make money. In the traditional model, where they sell the product, they have no incentive to reuse, reduce or recycle the materials they use. There is no incentive to do this. When something is broken or a better product is on the market, the loss of value of the product, owned by the customer, is a problem for the customer. The company simply sells the customer a new product and makes money whilst the old/broken product gets thrown away and resources are lost. The materials themselves have no value here. Figure 24 represents this linear economy.

Now, in a Product-as-a-Service model, the companies do have this incentive. In this model, they do not get paid for the product that they sell, but for the function this product has. Furthermore, if they cannot deliver this function (the product is broken or old), they do not get paid. This fundamentally changes the way in which companies make products. As they only get paid for the function, companies will start to think about how they can make their products as cheap, as durable and as economic as possible. They do this, so that they can deliver the function for a very low price and thus make a lot of money from the recurring fee that the customers pay. At the end of the lifecycle, instead of throwing the product away (and losing its total value), the company will now reuse as much of the product as possible and create a new product so that it (the material) can enter another lifecycle. This last step creates a circular flow of materials in which only very limited resources get wasted whilst being able to support the continuously growing economy. Figure 25 shows the steps in the circular lifecycle of materials.

LINEAR ECONOMY

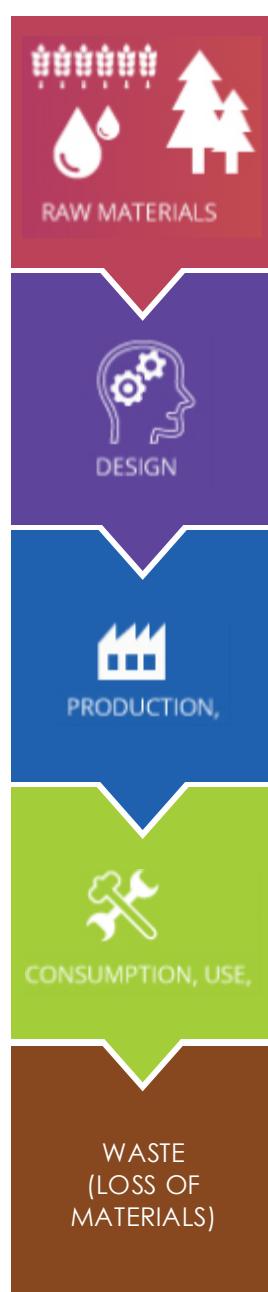


Figure 24: Visual representation of the linear economy



Figure 25: The Circular Economy
(source: European Parliament)

4.4.4 Maturity model of servitization

Now that the different kinds of IPS configurations have been discussed and all the types of services have been mentioned, the Extended Product concept can be used for another valuable concept. Just listing the different types of IPS's isn't enough, a maturity model is needed to assess which services can be easily added to the product core and which services are hard to implement. This maturity model represents the complexity of the total offering. Besides that, it shows the logical order of emergence of these IPS's in a market. Although this doesn't say that when the next level is reached, the other types aren't delivered anymore. It just adds another complex step to the servitization process. The maturity model is visualized in figure 26.

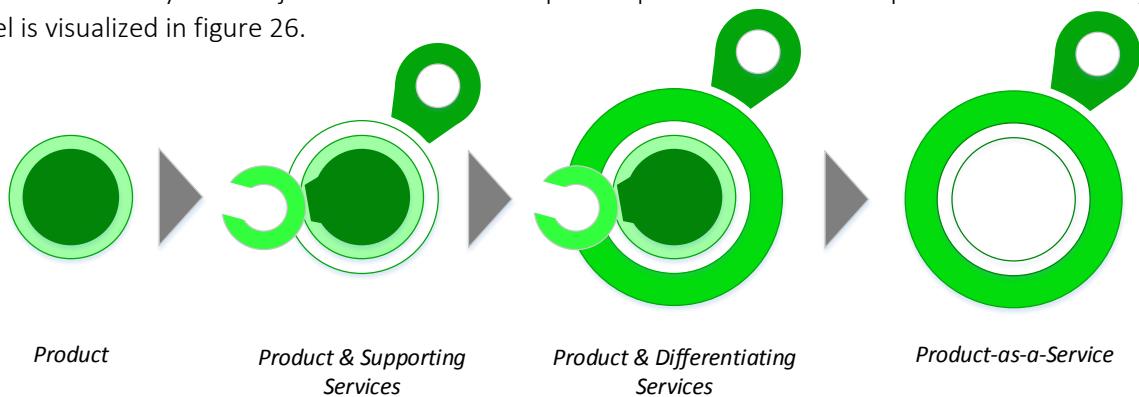


Figure 26: Maturity model for servitization in the manufacturing industry

The basis of the maturity model is of course, the standalone product core with its product shell. No services are added here. This basic product is just sold to the customer and no further services are delivered.

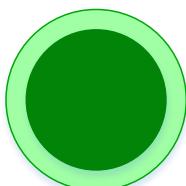
The first step towards a fully matured servitized industry is the product with attached to it the supporting services. These services are easy to realize and deliver and are fairly simple. Supporting services exist among others out of maintenance, training, installation, help (when having questions), leasing and renting. These services do not differentiate the total offering from others as they do not particularly add value to the core product. Instead, as the word says, they support the use of the product.

The second step is adding differentiating services to the supporting services. These services differentiate the product from products who do not have these services and thus make the total offering much more valuable.

The third and final step is offering Product-as-a-Service. By doing this, the product gets eliminated from the total offering as the product core and shell itself do not have any value any more. By selling the usage of a function instead of a product that performs a function, the way this function comes to be has become irrelevant. Thus, the product is now left out of the offering and is merely used as a means of making sure that the function is delivered properly. More on this special kind of IPS in the section Lighting-as-a-Service (5.3.1).

4.4.5 Servitization in the lighting industry (and the position of Nedap)

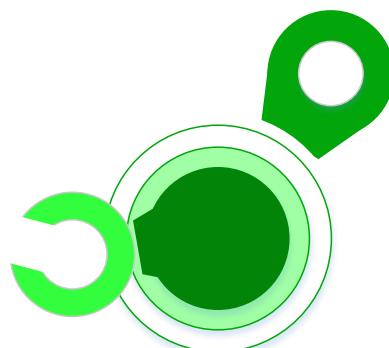
Using the combined model of the IPS Cube and the Extended Product concept and the maturity model stated above, the level of servitization in the lighting industry can be examined. Doing this, helps Nedap to see how servitized the lighting industry is and how close it is to “the next step”, being Lighting-as-a-Service.



Product

Figure 27: The first stage of servitization (product)

Starting off with just the product core and shell. The first type of offering in a truly unservitized manufacturing market. In the lighting industry, this represents the light bulb (as the product core) and the armature (as the product shell). Of course, the lighting industry has long surpassed this stage and simply offering just a light fixture is far from enough to survive in the market.



Product & Supporting Services

Figure 28: The second stage of servitization (product + supporting services)

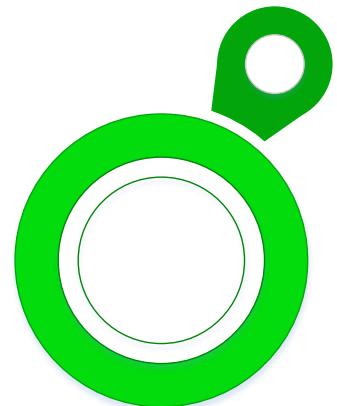


Product & Differentiating Services

Figure 29: The third stage of servitization (product + differentiating services)

The third step in servitization, adding differentiating services is probably the most common type of offering in the lighting industry of today. As already mentioned in section 2.3, the arrival of LED has led to the growing need for other revenue streams (as LED is cheap and has a long lifetime). Thus, the majority of the companies are searching for ways to offer more than just a product with some simple services. A light management system like Luxon (mixture-provider- technology-involved IPS) is one of the best examples of these types of offerings. Consulting services like light design calculations (compound – customer – technology-free) are also part of these services. The majority of the market, together with Nedap, can be placed here.

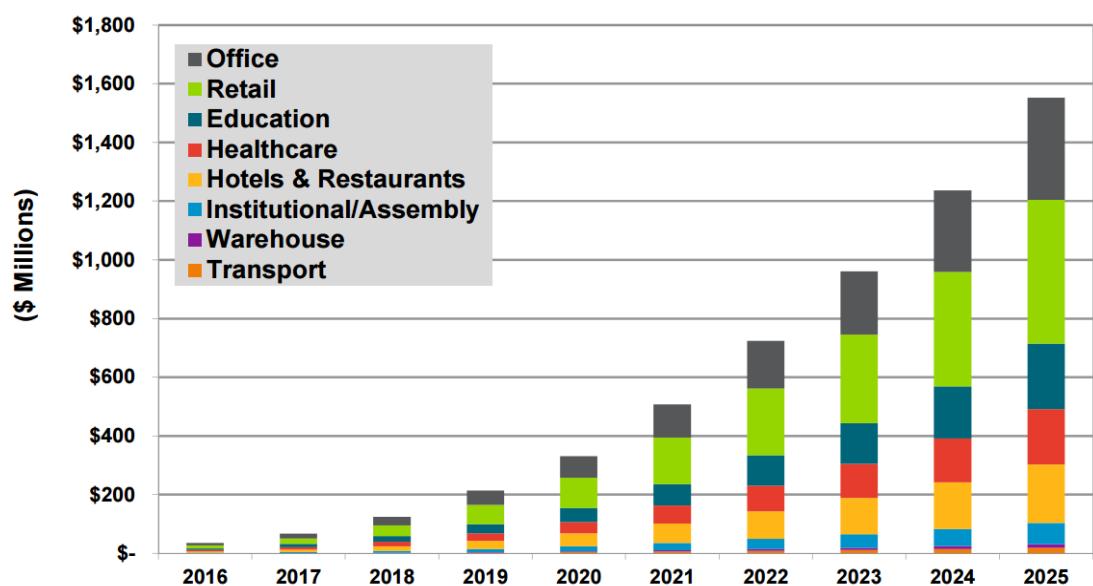
The final step in servitization is now slowly finding its way into the lighting industry. Lighting-as-a-Service is a type of IPS that is mentioned more and more and big companies (like Trilux, Philips and Zumtobel) are now following the same directions as some start-ups (like LEDLease) have already done. These companies are pioneers in the field of this type of offering (more on this in section 5.3.1). Although Lighting-as-a-Service is done by only a small percentage of the market, it is already here and that indicates that the market might be moving to a truly mature servitized market. This is also indicated by an article published by Navigant Research in 2016 in which they show the expected growth of Lighting-as-a-Service in the next ten years. Growing in revenue from approximately 40 million dollars to an astounding 1.6 billion dollars (4000% growth).



Product-as-a-Service

Figure 30: The fourth step of servitization (Product-as-a-Service)

LaaS Revenue by Building Type, World Markets: 2016-2025



(Source: Navigant Research)

Figure 31: Growth of the Lighting-as-a-Service market in the future (source: Navigant Research)

Concluding, the lighting industry could be seen as an almost fully matured servitized manufacturing market. Selling a light fixture alone or even with just simple services is uncommon and is for most companies not enough to survive. Most big companies are in stage three. They've added differentiating services to their product to create a valuable total offering. Nedap is also in stage three. Light management is a service that clearly differentiate their offering from others. Becoming fully mature might take some time, but the first steps have been made, indicating that there are already customers and companies who are willing to make that final step towards a fully mature servitized market.



Figure 32: Visual representation of the maturity of servitization in the lighting industry

4.4.6 Requirements engineering

Once, in this research, valuable chances have been found, they need to be transformed into requirements for the new Luxon in order to provide a proper solution to the problem. To transform these chances into requirements, the field of requirements engineering needs to be examined. Doing this will result in a clear definition of what is meant with a requirement and what form will be used to deliver the solution.

Again, a good definition is the start of this section. According to the Software Engineering Body of Knowledge V3 (SWEBOK: a guide seeking to promote a consistent view of software engineering worldwide) the definition of a requirement is: "A software requirement is a property that must be exhibited by something in order to solve some problem in the real world." This definition however is rather vague. In this research the definition proposed by Haron et al. (2010) will be used:

Requirements are a specification of what should be implemented into a software system. They are descriptions of how the system should behave, or of a system property or attribute.

This is a different meaning than stated in the dictionary. There, a requirement is stated as something demanded or obligatory, a need or necessity. Indicating that without it, the total set of the system cannot work or have value. In software engineering, this is different, because a requirement doesn't have to be implemented in the software for it function and have value. Low-priority requirements might never be implemented, but still they are treated as a requirement (Wieggers and Beatty, 2013).

There are many different forms of requirements. Each represent a way to articulate specific requirements for a specific part of a product/system. To get a feeling of the types of requirements used, table 7 lists a number of them (Wieggers and Beatty, 2013).

Type	Meaning
Business requirement	A high-level business objective of the organization that builds a product or of a customer who procures it.
Constraint	A restriction that is imposed on the choices available to the developer for the design and construction of a product.
External interface requirement	A description of a connection between a software system and a user, another system or a hardware piece.
Feature	One or more logically related system capabilities that provide value to a user and are described by a set of functional requirements.
Functional requirement	A description of a behaviour that a system will exhibit under specific conditions
Non-functional requirement	A description of a property or characteristic that a system must exhibit or a constraint that it must respect
System requirement	A top-level requirement for a product that contains multiple subsystems, which could be all software or software and hardware.
User requirement	A goal or task that specific classes of users must be able to perform with a system, or a desired product attribute.

Table 8: Types of software requirements

For this research, the last mentioned type of requirement is most relevant. The goal of these requirements is to show goals or tasks that a user can perform that in the end results in value for someone. It also includes descriptions of product attributes that are important for user satisfaction. User requirements describe what the user will be able to do with the product. Given the fact that this research is looking for functionalities specifically tailored to deliver value to the customer, this type of requirement will be used to design the new software.

User requirements are represented using use cases (for example “check in for a flight”). This form is a plain and straightforward way of representing user requirements. Another way of representing them is using user stories (for example “as a passenger, I want to check in for a flight so I can board my airplane”). In comparison to the use cases, user stories add value and context to the requirement and they mention the stakeholder for which the requirement has value. Important to note is that a system often has many user classes (different types of people) interacting with the product. When determining user requirements, the type of user must be clearly specified. In this research, the user requirements will be represented using user stories.

Once all user requirements are listed using the user stories. They will be grouped together to form features. The definition of these features are also mentioned in table 8. These features are used to create a good overview of what the user requirements together imply. Features were also used to describe the current situation of Luxon in chapter 3 and can thus be used to analyse the current and new features of Luxon.

5. Analysis of the LaaS industry

In order to accurately determine what is valuable when the Lighting-as-a-Service model grows in popularity, interviews have been conducted. The goal of these interviews (as specified in paragraph 2.8) is to look for opportunities in the servitized market that may lead to new software functionalities in Luxon that are valuable for the services provided to the final customer. The focus on these interviews lies on finding chances that are of value when Lighting-as-a-Service is implemented, but it also isn't blind to see other valuable opportunities in the market of tomorrow. In this chapter, the findings from these interviews are discussed.

5.1 The interviews

During the research, seven interviews have been conducted. These interviews were done with people who work at companies that actively innovate towards the future. Most of these companies offer Lighting-as-a-Service (5). Other companies (2) do not offer this service and have deliberately decided not to. By including these companies as well, certain nuances could be created between the quote made by the interviewees. This way, the research is less biased and a critical not could be made (if there was any).

The population of LaaS offering companies is very small as it is a new model that has just been introduced. The best estimate of LaaS offering companies based in the Netherlands is probably around 15 (high estimation based on internet research). One company even told us they are the only Dutch company offering true LaaS. Leasing is mentioned more often, but true LaaS where the customer is fully unburdened, where he doesn't have any risk and where he isn't the owner of the installation any more is seen rarely. So, assuming that this estimation is true, interviewing 5 of these companies will represent one third of the LaaS offering companies in The Netherlands. The rest of the companies were unable to reach, did not have time, did not want to talk (due to secrecy) or weren't identified as being a LaaS offering company. In table 9, a summary of the contacted and interviewed companies is made. Letters are used here to indicate the companies as their identities are confidential (the identities can be found with the right authorization in appendix 11.5).

Company	Spoken?	Reason (if any)
A	Yes	/
B	Yes	/
C	Yes	/
D	Yes	/
E	Yes	/
F	Yes	/
G	Yes	/
H	No	Did not want to talk (shortly spoken on the Light & Building exhibition in Frankfurt)
I	No	Did not want to talk (shortly spoken on the Light & Building exhibition in Frankfurt)
J	No	Did not want to talk (due to secrecy)
K	No	Did not want to talk
L	No	Too little time

Table 9: Summarizing table with the approached parties for interviews

5.2 Data analysis process

As little is known about the subject LaaS and the chances it gives for a light management tool, an inductive approach was chosen to analyse the data (Burnard et al. 2008). This means that there was no method of analysis chosen before the data was acquired. The data itself would be used to determine a good framework of analysis.

First, the data was transcribed word for word and entered in the software programme (ATLAS.ti). The full transcripts can be found in appendix E. Then an analysis method was chosen. What emerged from the data was that certain themes of Lighting-as-a-Service were discussed. These themes were discussed as being more or less relevant in the LaaS model when comparing them to the conventional business models. As themes emerged from the data, the thematic content analysis was used to analyse the data (Burnard et al. 2008). This analysis methods tries to find themes or categories in a set of data. This research will use this method as a basis, but will add some elements to make it more relevant for this research. The steps of the process in this research are discussed below:

- First, the transcripts were coded using open coding. By using this coding, the paragraphs were brought down to simple words or phrases that could be used in multiple cases throughout the text.
- Then, the codes were grouped together into different categories. Each category being a theme that could be important in Lighting-as-a-Service. The themes used in the research are: Performance Monitoring, Savings Measuring, Creating Awareness, Circularity, Integrability (with other systems), Readiness, Process Optimization (light related), Process Optimization (not light related), Light Management Optimization, Customer Description, LaaS Description, Success Factors and Other. Codes could be attached to multiple categories.
- Within this theme, different labels were given to the code. These labels represent the type of statement made on this topic. The labels used are: Problems, Chances, Definitions, Value and Solutions.
- Using the labels and themes, the findings were checked on frequency to determine their importance.
- Finally, the findings are discussed in section 5.3 (Discussion).

5.2.1 Themes

The transcripts are, as already mentioned, coded and grouped into categories (themes). In table 10 below, the meaning of the themes are presented. It is important to know the meaning of these themes as the results from the interviews are discussed using these themes. In appendix F, a table is presented with the specific codes and frequency of appearance belonging to each theme.

Theme	Meaning
Performance Monitoring	Codes relating to the ability to monitor the performance of the lighting system (by the provider or the customer)
Savings Measuring	Codes relating to the ability to measure the savings obtained via the lighting installation (before and after the installation)
Creating Awareness	Codes relating to creating awareness among employees of the customer's company
Circularity	Codes relating to the circular economy that is closely related to LaaS
Integrability	Codes relating to the integrability of light with other systems in a building (heating, ventilation, identification etc.)

Readiness	Codes that relate to the way the market reacts on this new model as well as things that need to be done to further mature the model
Process Optimization (light related)	Codes relating to the ability to optimize certain processes that are related to the lighting system
Process Optimization (not light related)	Codes relating to the ability to optimize certain processes that are not related to the lighting system
Light Management Optimization	Codes relating to the optimization of light management (Luxon) itself that cannot be described to one of the above categories.
LaaS Description	Codes that give a description of what LaaS is and what it implies
Customer Description	Codes that give a description of customers that are (not) interested in LaaS
Succes Factors	Codes that describe what is necessary to make Lighting-as-a-Service a success and what is valuable about LaaS to customers
Other	Codes that cannot be grouped under any of the above mentioned categories.

Table 10: Themes used to code the transcripts of the interviews

5.3 Discussion

From the interviews that were conducted during the research, a number of conclusions can be drawn. These conclusions will be discussed in this section. First, the definition, the customer profile, the financial organisation, the problems and other relevant statement of Lighting-as-a-Service will be formulated according to the Lighting-as-a-Service providers. Secondly, this definition will be compared to the definition given to the Product-as-a-Service concept by the literature in chapter 4.4.3. Finally, the most valuable chances (relevant for light management) will be discussed and presented.

5.3.1 Lighting-as-a-Service

In this research, the term Lighting-as-a-Service has been mentioned a lot already. However, a proper definition has not been given yet. Using the findings from the interview and the literature, this section will provide this definition and designs the characteristics of Lighting-as-a-Service. The findings from the interviews are presented using bar charts in which the statements of the interviewees are shown. In every chart a distinction is made between LaaS offering providers and “normal” light providers.

5.3.1.1 Definition of Lighting-as-a-Service

Looking at the statements of the interviewees on the question “what is Lighting-as-a-Service?” in figure 33, it is clear that the interviewees are quite unanimous about what it is.

Characteristics of Lighting-as-a-Service

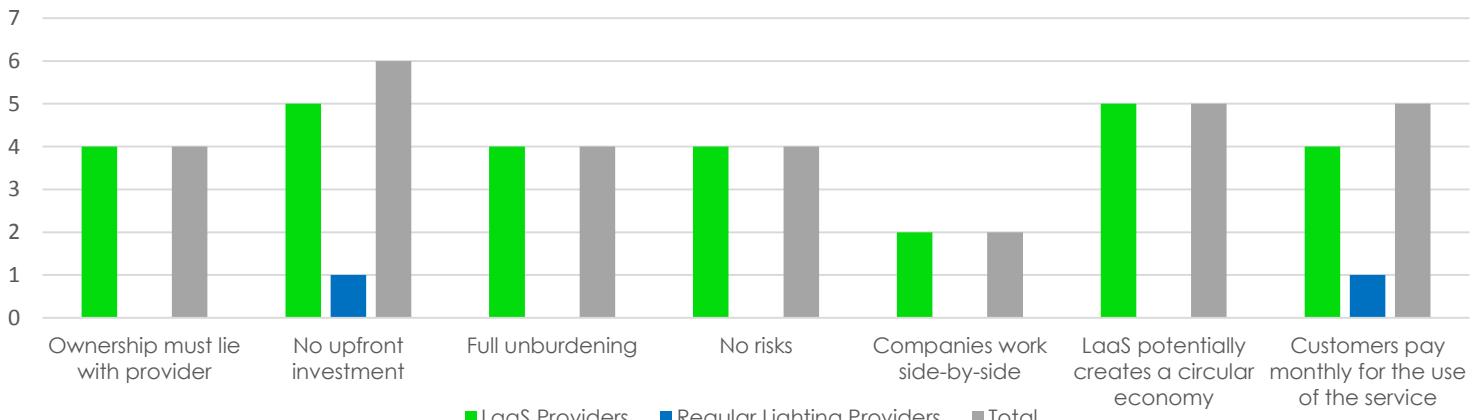


Figure 33: Characteristics of Lighting-as-a-Service according to the interviewees

Only one characteristic of LaaS has been mentioned less than half of the times. The others are mentioned in more than 50 % of the interviews. These characteristics are: the ownership lying with the provider (56% of total interviewees, 80% of LaaS providers), the lack of investment (85% of all interviewees, 100% of LaaS providers), the full unburdening (56%, 80%), the lack of risk (56%, 80%), the potential creation of a circular economy (70%, 100%) and the recurring payment for the use of the product (70%, 80%).

Combining all these characteristics, a definition of Lighting-as-a-Service can be proposed:

Lighting-as-a-Service is a service in which companies work side-by-side to offer a service that fully unburdens and removes all the risks for the customers whilst providing a light solution that is adjusted to the customer's needs. Where ownership lies with the provider of the solution, for which the customer doesn't have to invest but instead just pays a recurring fee for the use of the service.

A long definition, for a fairly difficult concept. By comparing it with the “old” traditional business model, the definition becomes clearer. In figure 34, the tradition business model is sketched.

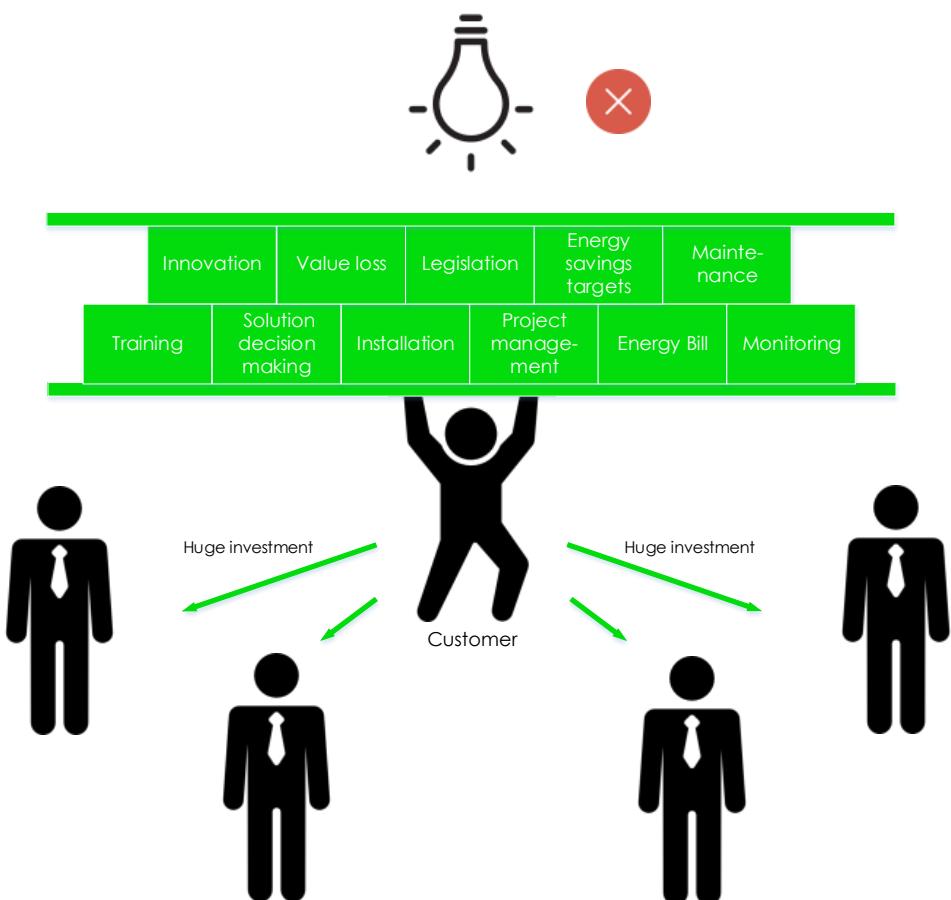


Figure 34: Representation of the customer carrying all the responsibilities in the old model

The sketch above shows the customer “carrying” all the responsibilities that are related to owning a lighting installation. The customer is responsible for all the building blocks that make up a good lighting installation and, as shown in the picture, it is almost unbearable for him to carry all these responsibilities and risks. The only thing the customer is really interested in, is qualitatively good and comfortable light. Still, he has to take care of all these aspects and on top of that, he has to pay a huge upfront fee to all the suppliers of the different components of the lighting system. All these things he needs to take care of create a barrier between the customer and the thing he simply wants to enjoy: his lighting.

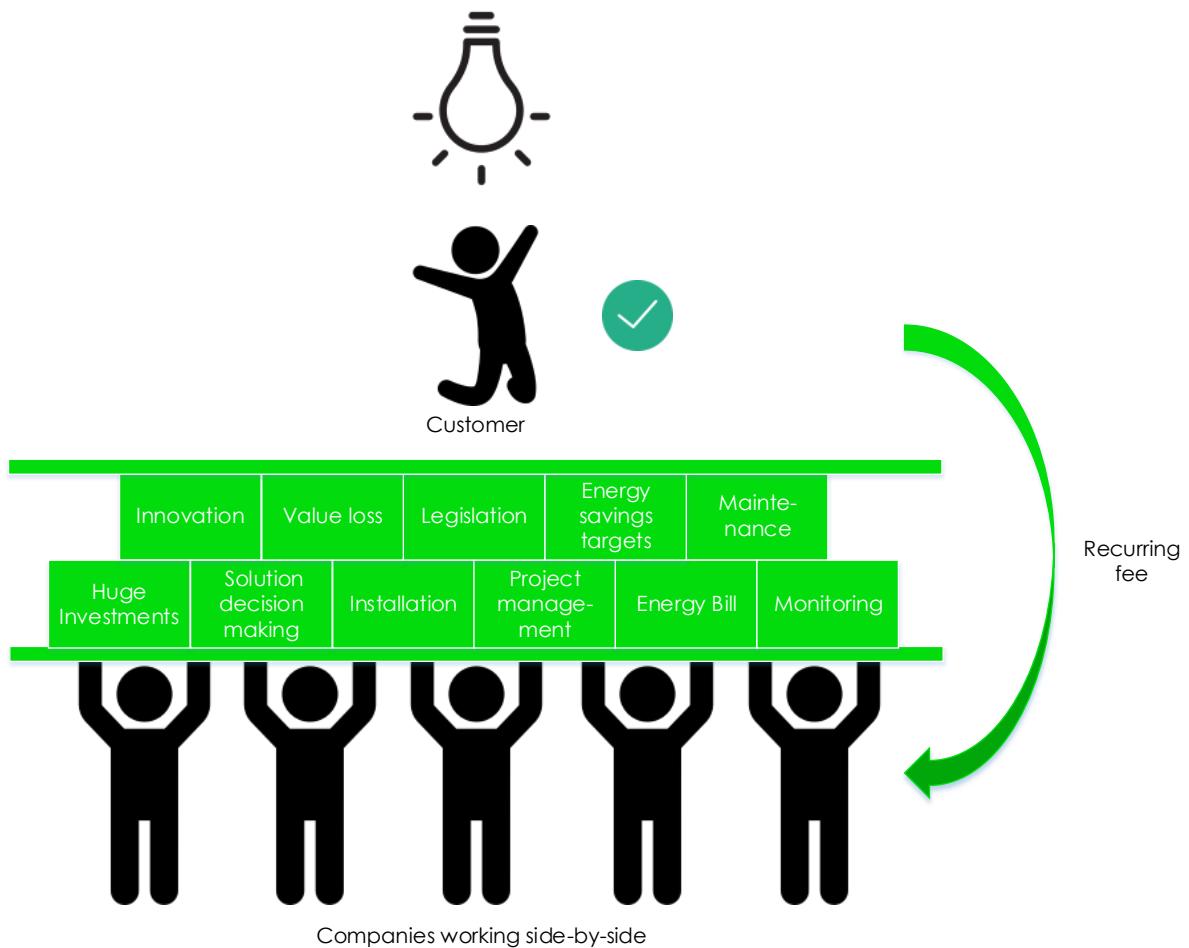


Figure 35: Representation of the companies carrying all the responsibilities in the new model

In the new situation, all the different building blocks are “carried” by the companies. They work side-by-side and take responsibility for each and every one of the building blocks that make up a good lighting system. As seen in the figure, the companies can easily carry these building blocks as they have the capacity and, most important of all, knowledge to deliver this lighting system. In this model, the distance between the customer and his lighting installation has become zero and he can simply enjoy his lighting without having to worry about the uninteresting aspects. In return, he pays a recurring fee to the companies.

5.3.1.2 Lighting-as-a-Service in practice

Now that a good definition of Lighting-as-a-Service has been proposed, the delivery of such a service in practice can be examined. In this section, the statements made by the interviewees about the delivery of Lighting-as-a-Service are analysed.

Lighting-as-a-Service customers

Starting off with customers that are suitable for the Lighting-as-a-Service model. In figure 36, the statements of the interviewees are presented in a chart.

Target group of Lighting-as-a-Service

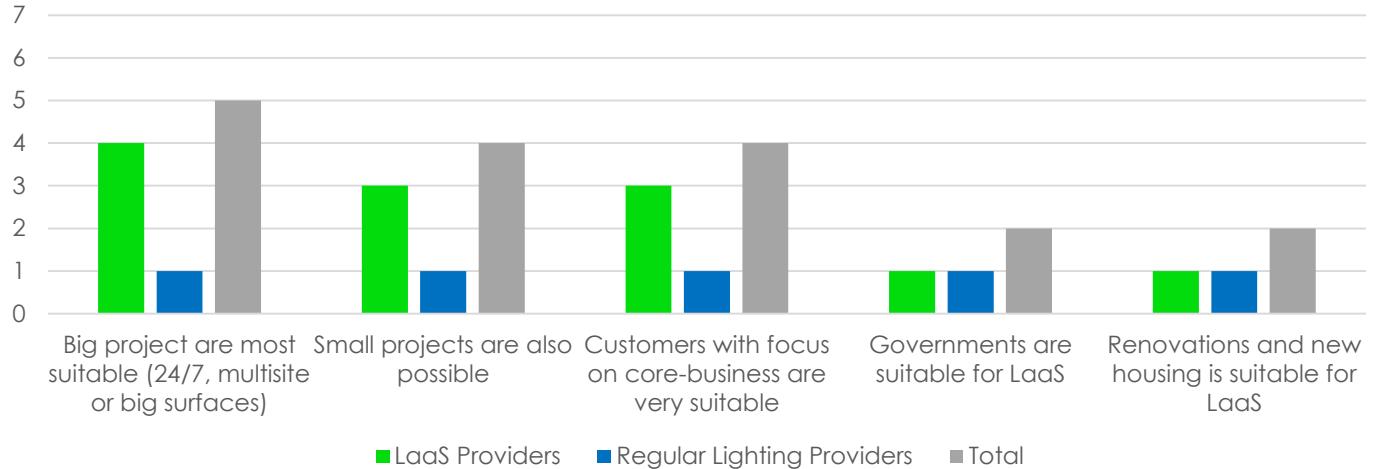


Figure 36: Target group of Lighting-as-a-Service according to the interviewees

As seen in the figure, there are a lot of customers suitable for Lighting-as-a-Service. However, two types of customers are deemed to be the most suitable:

- Customers with big projects where lighting is needed in a 24/7 industry or for a very large building or for multiple sites (80% of LaaS companies, 85% of total interviewees).
- Customers who want to entirely focus on their core-business and do not want to deal with any hassle that isn't related to their core business (60% LaaS companies, 70% of total interviewees).

Other types of customers (governments and small projects) are also potential customers, but were not mentioned as the main target group.

Financial Organisation

Lighting-as-a-Service requires a very different financial organisation. Incomes come in during a period of a couple of years instead of all at once at the beginning of a buy. However, someone has to make the investment now that the customer won't do it. In figure 37, the statements made on financing and pricing are presented.

Financial Organisation

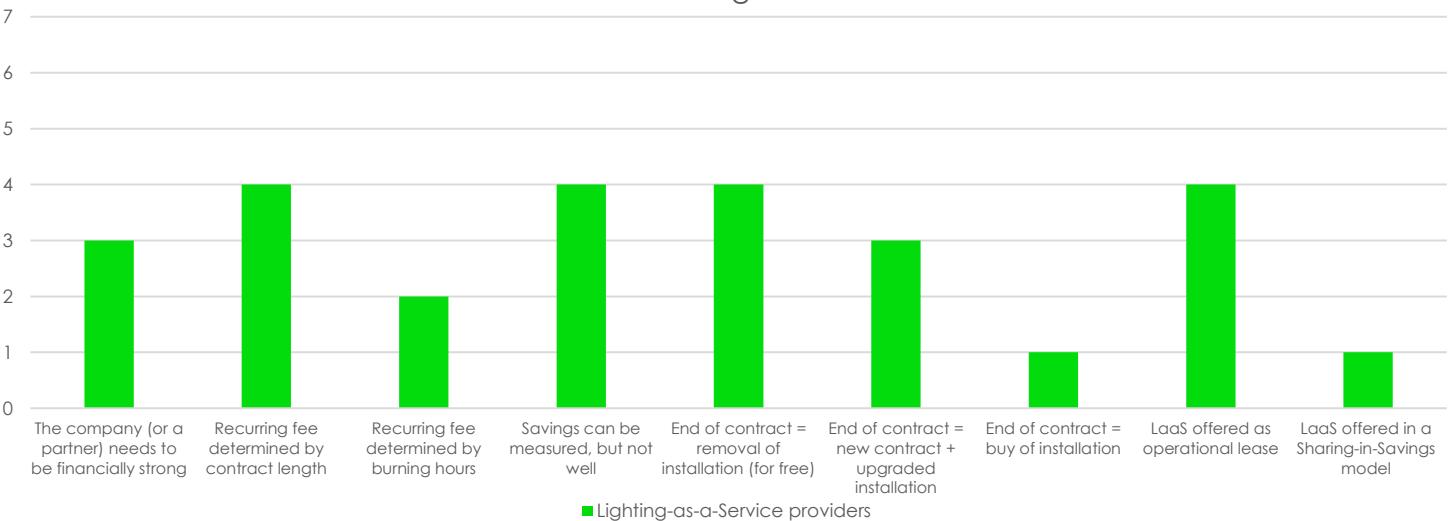


Figure 37: The financial organisation of Lighting-as-a-Service according to the interviewees

The statements by the interviewees indicate that in order to deliver LaaS, a strong financial position of the company or a partner company is needed. They make the investment that is needed to implement and develop the solution and see the lighting installation as a sort of security. Lighting-as-a-Service is mainly offered in the form of an operational lease (ownership with the provider where the customer leases the use of the product). One company offered it in a Sharing-in-Savings construction where the monthly fee is determined by the savings realised in that month (compared to the old installation). Half of these savings are then paid to the provider. At the end of a contract, three things can happen:

- The installation can be removed for free (80% of LaaS companies)
- The installation can be upgraded and a new contract can be signed (80%)
- The installation can be bought for the residual value (20%)

One final important remark on the financial organisation is about the pricing of the fee. The total cost of this kind of installation over the contract period is determined as follows: hardware costs + installation costs + maintenance costs + energy costs. The first two point can be easily measured and are quite solid numbers. The latter two however are very variable numbers as they are influenced by the burning hours (more burning hours over the contract period lead to more energy costs and more failures). These numbers are hard to estimate and can potentially be very unreliable (as stated by 80% of the LaaS offering companies).

Companies have developed two way for customers to pay for their installation:

- The first is paying a recurring fee that is based on the contract length (mentioned by 80% of LaaS offering companies). Companies make an estimation of the total costs and divide the total costs over the period of the contract so that at the end of the contract, the total costs + some margin is paid. In figure 38, a simple example is given.



Figure 38: Determination of the recurring fee by contract length

- The second option is paying a recurring fee based on the expected burning hours (mentioned by 40% of the company). Companies again make an estimation of the total costs and divide the total cost over the expected burning hours. Thus, in this model, you truly pay for what you use (pay-per-use). However, this is risky for companies as burning hours are extremely variable. This is valuable for people in need of flexible lighting systems. In figure 39, a simple example is given.



Figure 39: Determination of the recurring fee by burning hours

Problems with Lighting-as-a-Service

Being that this business model hasn't matured yet, it is obvious that there are still problems that need to be overcome. In table 11, the problems mentioned by the interviewees as well as proposed solutions to these problems are mentioned.

Problem	LaaS (%)	Reg ular	Solution (if any)	LaaS (%)	Reg ular
It is hard to accurately predict the savings realised by new lighting beforehand	5 (100)	1	/	/	/
It is hard to simply monitor the performance of all systems and checking whether the service level is being obtained.	5 (100)	1	/	/	/
Customers are hesitant to use LaaS as they do not know if the LaaS works or not	5 (100)	0	Create more references, the LaaS model falls or stands with references	2 (40)	0
			Give them time to get used to the model.	4 (80)	0
It is hard to draw up a legally good contract as the law states that anything that is attached to a building, belongs to the building	3 (60)	0	/	/	/
People higher in the company are mostly very interested, people on the working floor however couldn't care less about savings	2 (40)	0	Make employees more aware. This can be done by simple showing them how well they are using their lighting (using a monitor in the canteen for instance)	1 (20)	0
The installer finds it hard to get used to the new model as their way of income changes (loss of margin on the hardware they sell)	2 (40)	0	Installers need time to get used to the new way of creating revenues (because it is inevitable)	3 (60)	0
			Not all companies have to work with their own installer per se, in this case, other installers can be hired.	1 (20)	0
Customers sometimes expect things that cannot (yet) be realised (mostly about savings)	2 (40)	0	/	/	/
It is difficult to see whether the estimated savings have been realized	2 (40)	0	/	/	/
People at C-level (CEO, CTO) are hesitant to buy new installation as they do not want to disturb their processes	1 (20)	0	/	/	/

Table 11: Problems (and possible solutions) in the Lighting-as-a-Service market

Other

Besides statements about the characteristics, the organisation, the customers and the problems, there are some other relevant statements made by the interviewees. In this short section, these points are shortly discussed.

- About 5% of the market is ready for LaaS. This number will keep growing in the future, when more and more references are available and when the business model has fully matured (40% of LaaS offering companies).
- Despite the fact that the supply chain is reconfigured and fundamentally changed (linear to parallel), working together with companies goes quite well (40% of LaaS offering companies).

- For businesses, Lighting-as-a-Service became a viable option when they saw that it was hard to sell new lighting installations. This model took away the barrier of the investment (lease) and was later expanded with a fully unburdening service landscape (80% of LaaS offering companies).
- Lighting-as-a-Service providers support the business model as they find that customer relationship is very important. This model greatly supports that (80% of LaaS offering companies).
- Customers have very different preferences for the solution they want (LaaS or other) and the way they want to pay for it. There is no one single best service (40%) or pricing strategy (20%).
- Lighting-as-a-Service providers work most of the time with an open calculation when deciding the recurring fee. The customer can thus see what he will be paying for and why (60% of LaaS).

5.3.1.3 Comparing Lighting-as-a-Service (in practice) with Product-as-a-Service (theory)

Looking back at the description given to Product-as-a-Service in section 4.4.3, we can now compare the characteristics given the market (in practice) with this definition (the theory). Remember, Product-as-a-Service is:

A form of an IPS in which the physical product is owned by the provider, does not deliver any value to the total offering and doesn't require any technology to be added to the service. In this form, the product is merely used as a means to be able to deliver the service. The usage of the product is sold, not the product itself.

In the definition, the combination of three characteristics make it Product-as-a-Service:

- Provider is owner
- The integration of the product and service is technology-free
- The integration of the product and service is compound (the product isn't actually even part of the value offering).

Given these characteristics and comparing it to the definition given to Lighting-as-a-Service, the following overlap can be seen.

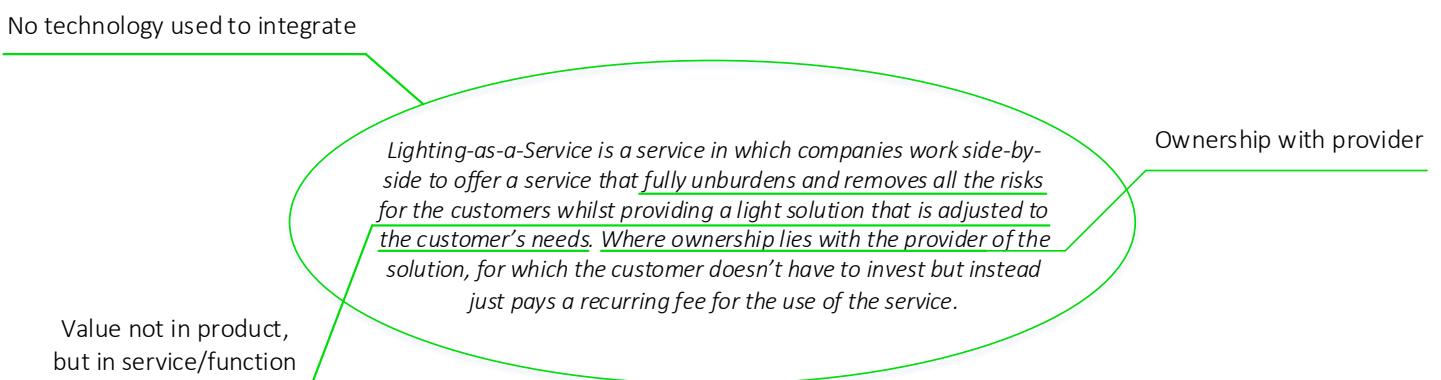


Figure 40: Definition of Lighting-as-a-Service as compared to Product-as-a-Service

All the characteristics mentioned by the literature are implemented in the model in practice. The Lighting-as-a-Service definitions adds to these characteristics a way of developing this model ("companies working side-by-side") and a financial model ("for which the customer doesn't have to invest but instead just pays a recurring fee for the use of the service") that make this definition sound more like a true business model. (What do we do? How do we do it? How do we get payed?).

5.3.2 Valuable themes in Lighting-as-a-Service

Now, the most important question: what are the most valuable chances for software in Lighting-as-a-Service? What are problems that need to be solved, that have great value for the provider and the customers in the Lighting-as-a-Service model? In total, eleven chances have been mentioned by the interviewees. Some are chances that have value for the industry as a whole, some have grown more important due to the rise of LaaS and some have emerged from the rise of LaaS. The chances are related to the following topics:

- Circularity
- Creating awareness
- Integrability
- Light Management Optimization
- Performance Monitoring
- Process Optimization (light related)
- Process Optimization (not light related)
- Savings measuring

In figure 41 and the section below, the chances provided by the interviewees are presented.

Chances in the Lighting-as-a-Service industry

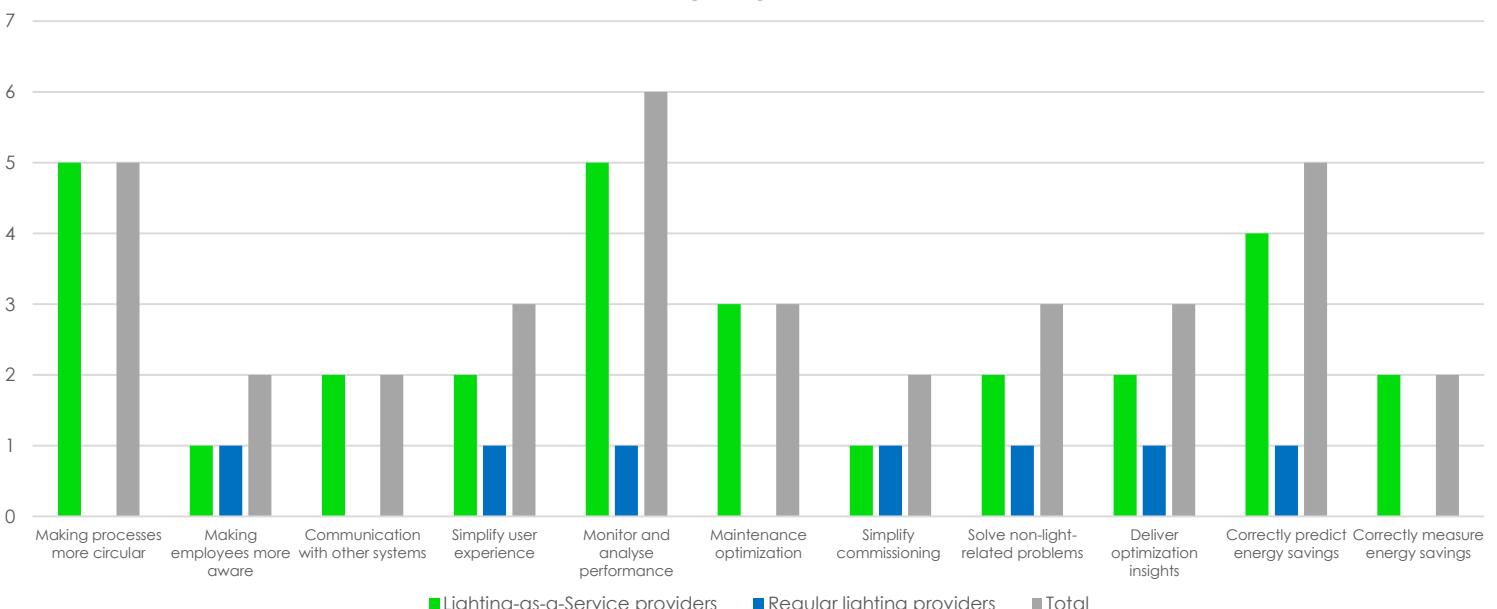


Figure 41: Chances in the Lighting-as-a-Service industry according to the interviewees

Making processes more circular (100% of LaaS providers, 70% of total interviewees)

As already discussed in section 4.4.3, circularity is a big theme in Lighting-as-a-Service. The providers mentioned that they are constantly trying to make their processes more circular in order to be ready for the future. Software that can help here is extremely valuable.

Making employees more aware of savings (20% LaaS providers, 50% regular, 28% of total interviewees)
Mentioned as one of the problems that companies face today. Employees aren't aware and do not care about energy and cost savings. They simply use the light and couldn't care less about the costs as it isn't their money they are spending. Using software to make the employees more aware would thus be a very valuable.

Communication with other systems (40% of LaaS providers, 28% of total interviewees)

Building Management Systems (BMS) are an upcoming technology that will be more and more used in the future. BMS manages not only the lighting installation, but the building as a whole. Heating, ventilation, water etc. Lighting is a part of this. Preparing a light management system in such a way that it is ready to be connected with other systems if necessary is thus a valuable chance.

Simplify user experience (40% of LaaS providers, 50% regular providers, 42% of total interviewees)

Light management is a complex thing and users might feel scared by all the possibilities that are handed to them when first using it. Making the interfaces simple and easy to understand will thus always be a valuable investment. People must be able to pick it up and start using it.

Monitor and analyse performance (100% Laas providers, 50% regular providers, 85% total interviewees)

Named by almost every interviewee, being able to monitor and analyse the performance of a lighting installation is very important, if not, the most important necessary development. Right now, customers can already check the performance of their own system, but there is no way for providers to simply check whether they have met their service level. They have to individually track their performance per customer, often without the use of software. Making that simple for them helps them to fully unburden their customers as they can then actively check whether they're fully unburdening their customers.

Maintenance optimization (60% Laas providers, 42% total interviewees)

Being able to automatize/optimize the maintenance process would further help Laas providers to unburden their customers. Where it is now necessary for the customer himself to call the installer and make an appointment, it would be very valuable and an extra step in the unburdening if the customer almost doesn't notice that maintenance is being performed.

Simplify commissioning (20% LaaS providers, 50% regular providers, 28% total interviewees)

Commissioning right now is a time-consuming task. On top of that, it looks quite silly. The provider has to walk around the hall, searching for a single light and then has to program them one-by-one in a grid. Being able to simplify this would be valuable.

Solve non-related lighting problems (40% LaaS providers, 50% regular providers, 42% total interviewees)

To provide extra service to the customer, the lighting installation could be used to help customers with problem in their day-to-day business. Task or processes that do not have anything to do with lighting could nevertheless be solved with the lighting system. These problems will mostly be optimization problems. Solving them would help the customer a lot and would thus be very valuable.

Deliver optimization insights (40% LaaS providers, 50% regular providers, 42% total interviewees)

The lighting installation collects every relevant data there is to find. By using this data, it might be possible to more efficiently commission the lighting installation so that the customers saves even more money and can enjoy his light even longer. Being able to deliver them these insights would increase the customer relationship as well as add some extra service.

Correctly predict energy savings (80% LaaS providers, 50% regular providers, 70% of total interviewees)

Together with the monitoring of the performance, this is one of the most valuable chances and crucial for LaaS providers. When determining the recurring fee that customers have to pay for the service, it is very hard to accurately predict what the exact savings will be when moving from the old to the new installation. Making the customer pay too much might result in an unhappy customer or might even

cancel the deal. Making the customer pay too less and the provider himself will suffer great losses. Software that can accurately perform this task is thus extremely valuable.

Correctly measure savings (40% LaaS, 28% of total interviewees)

It is sometimes still hard to accurately measure what the savings for the customer really are. Gaining and providing the correct insights to the customer is valuable for the customer, but also for the provider as they will then know if they perform like they promised. The ability to do this will also help prevent a problem that was mentioned earlier (the unrealistic expectations of customers).

5.4 Target group of the new functionalities

With Lighting-as-a-Service correctly defined and its characteristics well determined, an important conclusion can be drawn. What was found, was that the final customer indeed has very little to do with the responsibilities of a lighting system. The literature already indicated that this would probably happen, but the market also specified that the final customers are fully unburdened and that they (despite the infancy of the LaaS model) already have very little to do with the managing of the lighting. This also implicates that the final customer will definitely not spend much more time in a light management system when compared to the old model. If anything, they will spend less time. This means that adding functionalities for this customer group, will probably not be of much value. But where the final customer will interact less with the system, the LaaS provider has to interact with it even more. With LaaS, they have to be able to control their lighting system and deliver on their promises of full unburdening. A light management system like Luxon, can help them a lot here. That is why, it would be a valuable investment to create functionalities for the Lighting-as-a-Service provider. This would create a Lighting-as-a-Service management system. When looking at the research question specified in chapter 2, this means that functionalities will now be created for another party that indirectly have value for the final customers in the form of better services). There will not be any direct value added to the Luxon of the final customer. The functionalities will have direct value to the other party: the LaaS provider. This way, the Lighting-as-a-Service provider will also become customers of Nedap (more on this in Chapter 7).

5.5 Validity of findings

A good measure that can be used to see whether the conclusions drawn from the data can be seen as valid is looking at the extent to which the interviewees agree with one another. If certain statements are contradicted very often, it could mean that the statement could be false, exaggerated etc. In any event, the statement cannot be recognized as true. In this research however, there were surprisingly little contradictions. In fact, there were no contradictions at all about what the service is and what it implies.

Some of the statements made by others were unfortunately not checked with other interviewees as it wasn't brought up during the interview or the statement was made after a certain amount of interviews and couldn't be verified with previous interviewees. This means that the opinions of the people who did not mention the same statement weren't measured and it cannot be assessed whether they agree or disagree with the statement. However, based on their other statements, it is safe to assume that they will not disagree on these statements as they do agree with statements that are closely related. Besides, these unmeasured statements represent a fairly small group (as often only one interviewee's viewpoint is missing from a statement). The conclusions drawn from the data can thus be seen as valid.

6. Reference Architecture

With the market and literature thoroughly analysed, an opportunity arises. Before applying the valuable themes to the Luxon case, an important artefact can be created that has value for the entire market. Although this artefact does not contribute much to answering the research question, it is a valuable output of this research as it provides important insights for the future and the market as a whole. The artefact that can now be created is a reference architecture which proposes a blue print for a Lighting-as-a-Service management system. In this chapter, this reference architecture is discussed. First, the term will be introduced. In the following sections, the different layers of this architecture is discussed.

6.1 Definition of reference architecture

A reference architecture belongs to the field of enterprise architecture. The field of enterprise architecture has already been thoroughly discussed in section 3.2. A reference architecture merges the essence of all the existing architectures on a certain subjects and provides insights into future needs and offers guidance in developing new architectures (Cloutier et al., 2010). The reason for creating a reference architecture could be to develop a blue print for future architectures. In this research, this is exactly why it has value. Being that Lighting-as-a-Service is a fairly new business model, reference architectures are needed in order to indicate what is needed to accurately manage, control and offer Lighting-as-a-Service. This reference architecture could serve as a blue print for how a Lighting-as-a-Service management system should look like. Besides that it is valuable for the entire market, it is also of relevance to Luxon. As will be seen in appendix 11.4, not all the services included in the reference architecture are integrated in the new Luxon. This is due to the fact that these services do not have value for Luxon at this particular time or that they are not relevant for Luxon at this particular time. On top of that, this reference architecture designs a purely Lighting-as-a-Service oriented management system. The only users in this architecture are the Lighting-as-a-Service provider buyer and the Lighting-as-a-Service buyer. Nedap on the contrary, is not solely Lighting-as-a-Service oriented. They also have other 'regular' customers. That is why their architecture will not look the same as the reference architecture. The not included services could however be of value somewhere in the future and this reference architecture shows a way to integrate these services. The architecture focusses on the services that every layer has to deliver in order to manage the LaaS offering. Furthermore, it looks at the applications that are needed, the data that needs to be collected and the interplay between the different dashboard (of the customer and the Lighting-as-a-Service provider). Again, the Archimate language is used to design the architecture.

6.2 Reference Architecture

In this section, the reference architecture will be discussed. This reference architecture provides a basis for future research in which the reference architecture can be used as a starting point upon which others can incorporate their findings. The architecture is discussed layer by layer.

6.2.1 Business layer

In the business layer, there are two main users: the Lighting-as-a-Service provider and the Lighting-as-a-Service buyer. The Lighting-as-a-Service provider will interact the most with the system and thus, his dashboard offers more services than that of the customer (who doesn't want to be bothered with unnecessary information). The business layer thus offers two dashboards as indicated in figure 42.

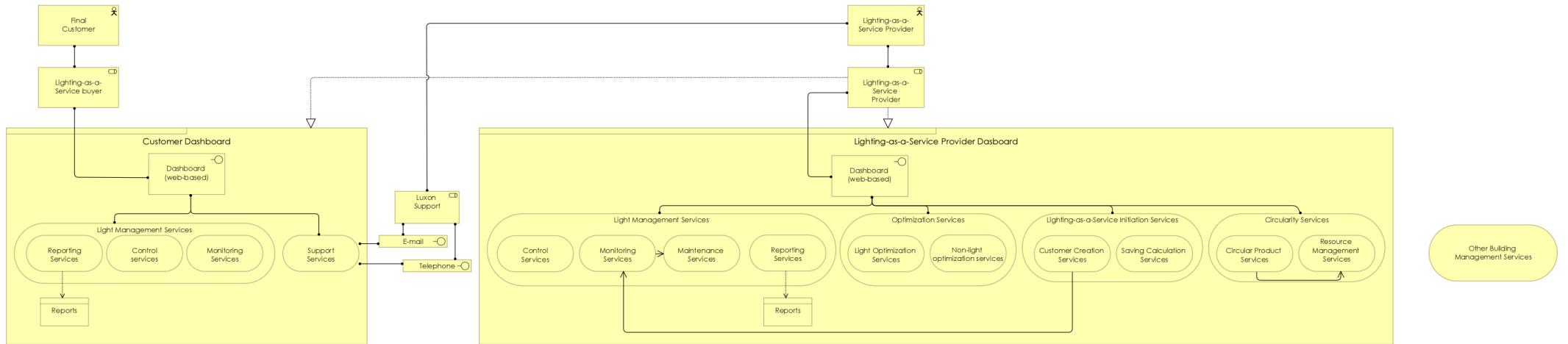


Figure 42: The business layer of the reference architecture

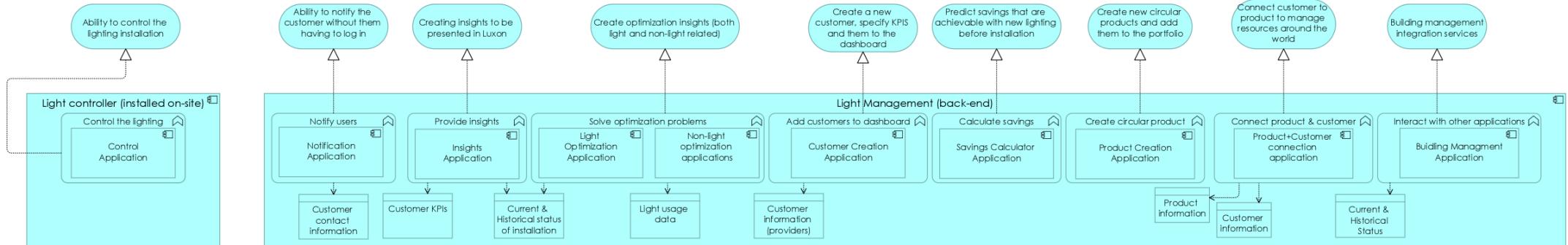


Figure 43: The application layer of the reference architecture

Business actors and their roles

There are two business actors in the business layer: the Lighting-as-a-Service provider and the Lighting-as-a-Service buyer. Their business roles are the same: the LaaS provider fulfils the role of LaaS provider and the Laas buyer fulfils the role of Laas buyer. The LaaS provider and buyer both interact with the dashboard. These dashboard are logically separated and although they sometimes present the same data (maybe presented in a different way even) the customer (LaaS buyer) does not have access to the LaaS dashboard. The other way around might be possible. In this architecture, the assumption is made that the LaaS provider creates and develops these dashboards. However, it doesn't have to be like this (with for instance Nedap).

The products

As already mentioned before, there are two product offerings in the business layer. One being the Customer dashboard and one being the Lighting-as-a-Service provider dashboard. The LaaS provider dashboard contains many services that help him to deliver, manage and control his offering to the customer. The customer dashboard is a minimized version in which only the key services are delivered that are needed to control the lighting and check whether the LaaS provider is doing his job correctly. The next section focusses in detail on these dashboards.

The Lighting-as-a-Service provider dashboard

The services delivered in this dashboard help the provider to perfectly deliver Lighting-as-a-Service. The services contribute to one of these four goals:

- Control, manage and analyse a contract. Here, the provider can control, manage and analyse the lighting installation of the customer. He can see when he does not live up to his promises and he can perform actions that help him to do deliver on his promises. These services are called Light Management Services.
 - Control services give the LaaS provider the ability to control the lighting installation from anywhere in the world (in real time or using a planning for the future).
 - Monitoring services display the current and historical status of the lighting installation of the customer. It must at least display the key performance indicators (KPIs) that are used to determine the performance. Using these KPIs, the performance can be measured and actions can be taken if the performance is low.
 - Maintenance services fix a problem when there is one. Or at least, optimize the process in such a way that the customer is involved as little as possible. An example of this is the replacement of a lamp for instance. The ability to know if there is a problem comes from the monitoring services.
 - Reporting services provide the ability to turn numbers into coherent reports that can be used for internal (the provider) or external use (the buyer).
- Initiate a Lighting-as-a-Service offering. These services help at the very beginning of a Lighting-as-a-Service offering (sometimes even before the contract is signed). These services are called Lighting-as-a-Service Initiation Services.
 - Customer creation services provide the LaaS provider with the tools to create a new customer profile when a contract is signed. Here, LaaS providers should be able to indicate the KPIs that they use to measure performance. This service, thus provides input for the monitoring services (as it specifies what it needs to measure).
 - Savings calculation services deliver the ability to accurately predict the savings that will be achieved when the new lighting installation is installed.
- Provide extra service. These services help to build an even stronger customer relationship as they deliver the ability to help the customer by solving problems or optimize processes in his

day-to-day work. These problems can be light related or non-light related. In the market, more and more services are introduced that solve problems that are not light related. The logistics within a storage, the place of machinery, the routing through a store can all be optimized using a light management system. These services all have one thing in common, they solve optimization problems. That is why these services are called Optimization services.

- Light optimization services delivers insights into how the user can better use his lighting. Indicating possible changes that can increase the monthly savings for instance.
- Non-light optimizations services deliver insights into how the user can better organise other process in his day-to-day work. Most of these optimizations are optimizations for routing problems, but these services will probably continue to grow in the future and will also optimize other processes (although at this point in time, the problems that these services are going to solve are unknown).
- Manage resources. The services help with the management of all the resources of the LaaS provider. They present an overview of the location of these resources (around the world or in a product) and indicate the flow of these resources throughout the year. Given the complexity of the circular economy, these services help to manage such an economy.
 - Circular product services provide the LaaS provider with the ability to create circular products. For every circular product, a product profile can be created which indicates the resources that it is made out off, the reusability of these resources and the processes that are used to reuse these resources.
 - Resource management services provide the LaaS provider with the ability to connect circular products to his customers. Given that the system already knows how many products of a certain category are present on site (for instance 300 lamps), the provider can connect a circular product to that customer to indicate that all the lamps installed at that site are circular. From then on, the system can accurately track the place, status and flow of these resources. The LaaS provider then knows where his resources and products are, when these resources and products will return and how many resources and products he has in ownership.

The customer dashboard

There are less services available in the customer dashboard. The simple reason for this is that the Lighting-as-a-Service provider takes care of everything and the customer only needs to be able to check if he actually does so. The services delivered in the customer dashboard are:

- Control services
- Monitoring services
- Reporting services
- Support services. If the customer has any questions, these services provide easy ways to get in touch with the provider.

There is one service that is detached from the two dashboards: other building management services. These services are not really part of the system (as indicated by the dashed line in figure 48), but does need to be modelled to indicate that there could be other systems with which it needs to talk to.

6.2.2 Application layer

To be able to deliver the services of the business layer to the provider and the customer, numerous applications must run in the back-end of the system. Figure 43 shows the applications that are needed to support the business layer.

The two main application components

In the back-end of the system, there are two major application components that support the business layer. One being the light controller and the other being the light management back-end. These two components are separated due to their location. The light controller is installed on-site as this is the application is directly in contact with the installation and can for instance turn the lighting on and off in real time. The light management back-end is placed somewhere in the cloud in a virtual environment. The applications that these major application components run are discussed in detail in the following two sections.

The light controller

The light controller runs one application: the control application. This application makes sure that the actions performed in the business layer are transformed into commands that can change the current or future on and off status of the lighting installation. This application has direct access to the light controller (in the technology layer).

The light management back-end

Nine different applications run in the back-end of the management system (connections to the business layer and technology layer are discussed in section 6.2.4):

- The notification application: created the ability to notify customers or providers without them having to log into the system. That way, they do not constantly have to check in the system if something is wrong, but important messages are received through more conventional communication methods (e.g. e-mail or telephone). To do this, it needs the customer contact information.
- The insights application: creates insights based on the raw data of the lighting installation (provided by the technology layer). It transforms the raw data into numbers that have meaning and can help the provider and customer to analyse the status of the lighting system. KPIs that are used to measure the performance are created here. To do this, it needs the KPIs that are attached to a customer and the current and historical status of that lighting installation.
- Light optimization application: transforms the raw data of the lighting installation into valuable insights that can help in optimizing the use of the lighting installation. To do this, it needs the light usage data.
- Non-light optimization application: transforms the raw data of the lighting installation into valuable insights that can help the customer with optimizing process that are not light related. To do this, it needs the light usage data.
- Customer creation applications: create and saves the customer profile. It ensures that the input from the business layer (where the user has created a new customer) is transformed into a profile that is readable for the insights application (so that it knows what KPIs need to be measured and how they need to be calculated) and ensures that the profile is saved correctly. To do this, it needs to know which providers are attached to the customer.
- Savings calculator application: contains the mathematical model with which the savings can be accurately predicted before the installation.
- Product creation application: enables the input from the business layer (the creation of a new circular product) to be transformed into a product profile that can be used by other applications. It also ensures that it is saved in the correct way.
- Product + customer connection application: ensures that a circular product can be coupled to a customer. It presents the product information (resources and reusability of the

product) and customer information (number of product installed on-site) in the business layer and once a connection is made, it stores this in the right location.

- Building management application: allows the system to talk to other building management systems. If needed, it passes along relevant information about the current and historical status of the lighting installation.

6.2.3 Technology layer

In this reference architecture, the specific organisation of the technology layer is not designed. However, the data artefacts that need to be present in order to support the application layer are identified (as seen in figure 44).

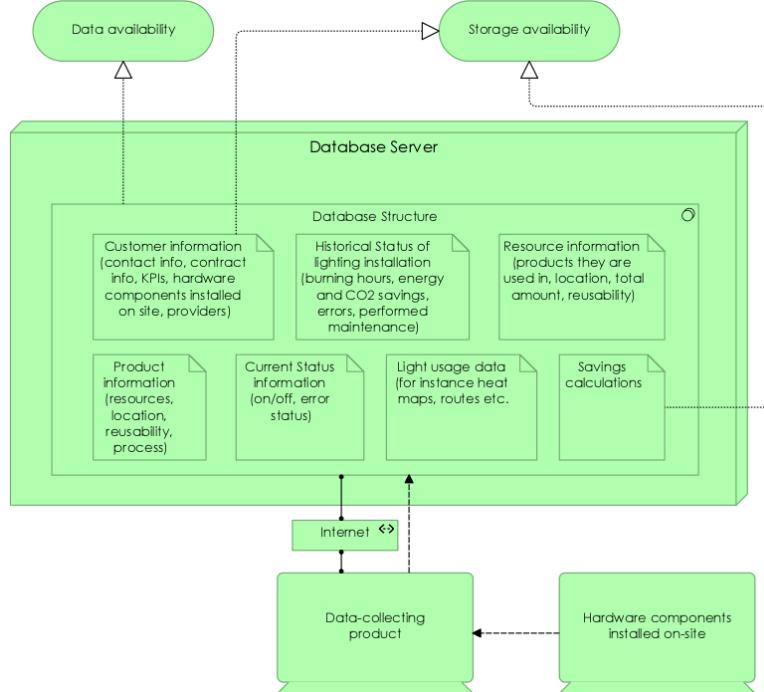


Figure 44: The technology layer of the reference architecture

The following artefacts need to be collected:

- Current status of the lighting installation including on/off status and error status.
- Historical status of the lighting installation including burning hours, energy savings, CO₂ savings, error statuses and performed maintenance.
- Light usage data. This type of data could be anything depending on the type of optimization problems that the system can solve.
- Customer information including contact info, contract info, KPIs, hardware components installed on-site and providers.
- Product information including the resource that are in it, their location, their usability, their circular process and general info (like name etc.)
- Resource information including the products in which they are used, their location, the total volume, their reusability.
- Savings calculations.

The first three artefacts need to be gathered by some product that is able to extract raw data from the lighting installation. The other artefacts are created by the Lighting-as-a-Service provider.

6.2.4 Cross-layer dependencies and total view

To indicate the cross-layer dependencies of the reference architecture, a summarizing table is used to indicate the relationship that the applications in the application layer have regarding the business and technology layer. Being that the application layer is the middle layer, it is the logical point from which all relationships can be described. In this table the services that truly connect to the business layer are not mentioned due to space constraints (since every application, apart from one, has a unique service it presents).

Application	Used by (business layer)	Service used (technology layer)	Has access to (artefact view)	Can alter (database)
Control application	Control services (buyer) Control services (provider)	Data availability	/	Light controller
Notification application	Monitoring service (buyer) Monitoring service (provider) Maintenance services (provider)	Data availability	Customer contract info	/
Insights application	Monitoring service (buyer) Monitoring service (provider)	Data availability	Current and historical status	/
Light optimization application	Light optimization services	Data availability	Light usage data	/
Non-light optimization application	Non-light optimization services	Data availability	Light usage data	/
Customer creation application	Customer creation services	Storage availability Data availability	Customer provider info	Customer information
Savings calculator application	Saving calculation services	Storage availability	/	Savings calculations
Product creation application	Circular product services	Storage availability	/	Product and resource info
Product + customer connection application	Resource management services	Data availability	Product info Customer info	/
Building management application	Other building management services	Data availability	Current and historical status	/

Table 12: Cross-layer dependencies in the reference architecture

The total view of the reference architecture can be seen in figure 45.

6.2.5 Evaluation of reference architecture

The reference architecture is not evaluated yet. Due to time constraints, this simply wasn't possible. The architecture as it is now provides a basis upon which further research can build. The reference architecture at this point in time does represent all the key elements of a Lighting-as-a-Service offering. But it still needs to be evaluated as it probably is not completely accurate yet.

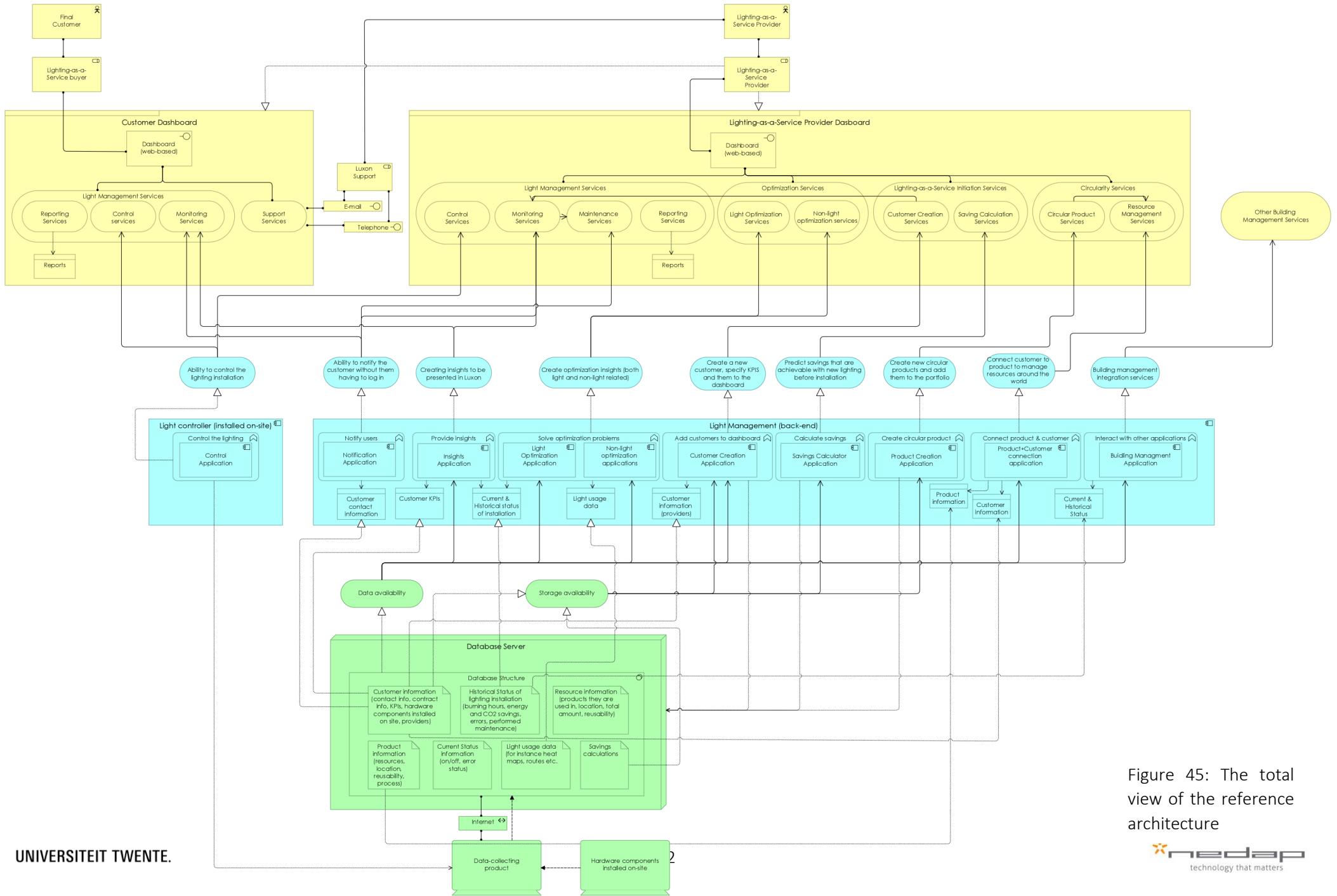


Figure 45: The total view of the reference architecture

7. New Situation

Now that the most valuable themes in the LaaS concept are clear and described, new functionalities for Luxon can be designed. To do this in a focussed and well defined matter, the chances are each evaluated on their ability to be transformed into software and their value. This will limit the list of chances and creates the opportunity to only use the most valuable chances. Using the findings from the interviews, a list with requirements for the new Luxon will be specified. Furthermore, the enterprise architecture that was developed in chapter 3 will be updated so that the interaction and relationship between the new and the current components can be described.

7.1 Valuable chances for Luxon

As mentioned in the introduction of the chapter, the chances specified in the previous chapter will be assessed on their ability to be transformed into software and on their value for Nedap, the customer and/or the market as a whole. A number of criteria have been developed to help assess the value of the chance. Each chance gets a score using a Likert scale of 1-5 (one being not valuable at all and five being extremely valuable) on each of the criteria and each criteria has a certain weight. Using the scores, the weighted score can be determined to rank the chances on their value. The chances will be discussed one by one using the following six criteria:

Criteria	Weight	Meaning	Measurement
Value according to the Lighting-as-a-Service market (VL)	5	Assesses the relevance and value of the chance according to the market (as a clear indication of what the market thinks of the chance)	The frequency of mentioning the chance by the Lighting-as-a-Service providers
Value according to the rest of the market (VR)	1	Assesses the relevance and value of the chance according to the market (as a clear indication of what the market thinks of the chance). Note: this criteria has less weight than the others.	The frequency of mentioning the chance by the regular lighting providers
Value for the customer (VC)	4	Assesses the value the chance has for the customer (as they are the ones for which the software, in the end, has to have value for)	Measuring are based on the literature and the interviews.
Relevance for Luxon (RL)	3	Assesses the compatibility of the chance with Luxon and the ability of it to be transformed into software (necessary due to the scope set in section 1.7)	Measured using the current functionalities of Luxon and comparing it with the chance if it will be implemented and by using the opinion of Nedap,
Relevance for this research (Lighting-as-a-Service) (RR)	5	Assesses the extent to which the chance answers the main research question (as this is the main goal of this research)	Measured by looking at the value it specifically has for the Lighting-as-a-Service market.
Time of value (TV)	2	Assesses when the chance will have value (immediately or in the future with a score of 5 being immediate value)	Measured by looking at the developments in the market.

Table 13: Criteria used to evaluate the emerged chances

7.1.1 Assessment of chances

In this section the chances will be assessed and their total score will be given in table 14. Some of the scores that need some further explanation will be discussed in the rest of this section.

Chance	VL	VR	VC	RL	RR	TV	Score	Rank
Monitor and analyse performance	5	4	4	5	5	5	95	1
Correctly predict energy savings	4	3	4	4	5	5	86	2
Making processes more circular	5	1	3	4	5	2	79	3
Maintenance optimization	3	2	4	5	4	5	78	4
Correctly measure savings	2	2	4	5	4	5	73	5
Deliver optimization insights	2	3	4	4	3	5	66	6
Solve non-light related problems	2	3	3	3	3	5	59	7
Communication with other systems	2	3	4	4	2	3	57	8
Making employees more aware of savings	1	2	3	2	2	5	45	9
Simplify user experience	2	4	4	4	1	5	57	10
Simplify commissioning	1	3	2	2	2	5	42	11

Table 14: The value of the emerged chances (ranked from the highest to the lowest score)

Making processes more circular

Given that the circular economy is on the rise and is likely to grow in popularity given the continuing loss of resources, this chance is very valuable. Software can certainly help, if it helps the companies to create or support circular processes. It's relevant to Luxon as it will help companies to manage a lighting system and that is exactly what Luxon does. Customer value lies in the fact that if customers still want to enjoy the richness of having lots of products (with lots of resources), the circular economy is the way to go. When the waste of materials keeps growing and the volume of materials left keeps decreasing, soon there will be no products to enjoy at all (at least not in this form). Important note however, is that the circular economy is something for the future and does not have much value at this very moment.

Making employees aware of savings

Making employees more aware hasn't been mentioned much by the interviewees. Besides that, it isn't that relevant for Luxon (as it hasn't got much to do with light management) and it isn't relevant for this research (as it hasn't got much to do with Lighting-as-a-Service).

Communication with other systems

This a very valuable chance and almost a must-have for light management systems in the future. However, it does not have much relevance in this research or for Lighting-as-a-Service. It is a development in the market that has to be taken serious and Nedap should definitely organise Luxon in such a way that is ready for these communication when the time comes. It is just not relevant for this research.

Simplify user experience

The reason for the low score of this chance is that it is simply not relevant for this research or for Lighting-as-a-Service specifically. It is however, extremely important for Nedap to pay attention to this statement. Usability is a very important criteria for customers when buying light management as it is a complex technology and they do not have the time or energy to invest in such a system.

Monitor and analyse performance

Ranked number one in the table due to its extreme relevance and value for the Lighting-as-a-Service market. They have to be able to check whether they've met their service level and to check whether they truly unburden their customers (one of the key elements of LaaS). Besides, it'll also have value for regular providers in the market, as monitoring of your lighting system is always valuable.

Maintenance optimization

Valuable for the same reason as the chance above. Being able to further optimize the maintenance process will greatly help companies in further unburdening their customers and it will be of great value for the customers because they are no longer burdened with organising maintenance when this is necessary.

Simply commissioning

Has been mentioned by some of the interviewees, but there is a problem with this chance. Besides the fact that it has little relevance to the research or to Lighting-as-a-Service and that it has no value for the customer. Nedap also asks money for this service. Making this service unnecessary or very simple would result in a loss of revenue.

Solve non-related lighting problems

This again could be a valuable chance, however, it does not have much relevance for Lighting-as-a-Service. It is simply another service that is being added. It doesn't help customers to reduce risks or unburden them.

Deliver optimization insights

The ability to deliver optimization insights is already incorporated in Luxon. Although limited, it is not valuable to further develop this chance as Nedap is already working on incorporating it in the software.

Correctly predict savings

Together with the "monitor and analyse performance"-chance, this is the most valuable chance. Companies are looking for ways to accurately predict the savings they will achieve once they have installed a new lighting installation. Making software that can do this for them, is valuable for the companies but also for the customer. They will get a better price for their lighting installation as the companies do not longer have to build some risk into the fee.

Correctly measure savings

Is mentioned by some of the interviewees as they probably do not have a good light management system yet. When they use Luxon, they'll probably greatly increase their savings measuring as Luxon has already grabbed this chance. Improvements can always be made but for this research it is not relevant.

7.1.2 Chances used for software

Given the scores and statements of the previous section and the limited time at hand, the following chances will be used in the software solution:

- Monitor and analyse performance
- Correctly predict energy savings
- Making processes more circular
- Maintenance optimization

7.2 Software specification of the new Luxon

The research so far has delivered numerous outputs: the enterprise architecture of the current Luxon environment has been designed, the meaning of Lighting-as-a-Service and servitization has been examined and the developments in the market have been analysed, the market has been interviewed, a reference architecture is proposed and potential chances have been identified and evaluated. Now it is time to combine all these elements together to take it one step further and become creative: the development of new software modules in Luxon. In this section, the requirements for the new software modules are presented together with a recommendation for a way to implement them.

7.2.1 User requirements

One by one, the different chances will be transformed into user requirements in this section. As mentioned in section 4.4.6, user stories will be used to design the requirements for the new software and these user stories have to specify which requirement is relevant for who (user class) and why it is relevant. There are two user classes involved with the new Luxon. These are the Lighting-as-a-Service provider (new class) and the final customer (already existing class). Remember from section 5.4 that the IaaS providers are now customers as well.

6.2.1.1 Monitor and analyse performance

- 1.1) As a Lighting-as-a-Service provider, I want to be able to quickly see if I'm honouring my existing commitments to all my customers as otherwise, Lighting-as-a-Service will lose lots of its value. Full unburdening cannot be achieved if commitments aren't being honoured. When they aren't being honoured and I know that before the customer, calling him in advance will make the customer feel like you're really trying to help him.
- 1.2) As a Lighting-as-a-Service provider, I want to be able to see what the current performance is of the lighting installations for all my customers. As, even if I'm honouring my commitments, I still want to see how well the system performs in detail.
- 1.3) As a Lighting-as-a-Service provider, when something is wrong, I want to immediately see that in Luxon so that I can quickly react to the problem.
- 1.4) As a Lighting-as-a-Service provider, when something is wrong, I want to immediately get a notification on my mail or phone so that I can quickly react to the problem without constantly having to log into Luxon.
- 1.5) As a Lighting-as-a-Service provider, when something is wrong, I want to immediately see what is wrong so that I can react to it in an efficient manner.
- 1.6) As a Lighting-as-a-Service provider, if absolutely necessary, I want to be able to control the installation of the customer. This might be valuable when the customer doesn't have the time to change something in the system, doesn't understand the system or simply isn't interested in the system.
- 1.7) As a Lighting-as-a-Service provider, the contracts I make are all very different. The service level agreement is different and the KPIs chosen to assess the performance of the system might differ. In Luxon, to correctly assess the performance as mentioned in requirement 1, I have to be able to create and adjust the way in which performance is measured.
- 1.8) As a Lighting-as-a-Service provider, building on requirement 7, when a new customer receives Lighting-as-a-Service, I have to be able to create this new client into Luxon and create the way in which performance is measured.

- 1.9) As a Lighting-as-a-Service provider, when something is wrong or something can go better for a customer, I would like to have the ability to advise changes or optimization based on suggestions made by Luxon.
- 1.10) As a Lighting-as-a-Service provider, I want to be able to create reports for my customers so that I can accurately show that they are getting the best service there is. This creates trust from the customers and an opportunity to get in touch with the customers more often.
- 1.11) As a final customer, I want the Lighting-as-a-Service to be proactive when something is wrong. I do not want to have to worry that the commitments are being honoured and when something is wrong, I want the LaaS provider to contact me, instead of me contacting them.

6.2.1.2 Correctly predict savings

- 2.1) As a Lighting-as-a-Service provider, I want to be able to accurately predict the total costs of a contract before the installation is installed. This will result in less risk for me and a better price for the customer.
- 2.2) As a Lighting-as-a-Service provider, I want to provide my customer with a comprehensive analysis of the calculation I've made so that I can help him understand how much he will be saving.
- 2.3) As a Lighting-as-a-Service provider, I want to be able to look back at previous calculations so that I can see why I've made certain choices or to finish a calculation that wasn't finished.

6.2.1.3 Making processes more circular

- 3.1) As a Lighting-as-a-Service provider, I want to see how many resources I have and where they are placed in my hardware.
- 3.2) As a Lighting-as-a-Service provider, I want to see where my resources are around the world.
- 3.3) As a Lighting-as-a-Service provider, I want to see when, how and what resources will be returned.
- 3.4) As a Lighting-as-a-Service provider, I want to be able to create a new product and indicate which resources are used in that product.

6.2.1.4 Maintenance optimization

- 4.1) As a final customer, when there is an error in my lighting, I do not want to be burdened with the responsibility to get it fixed.
- 4.2) As a Lighting-as-a-Service provider, I want to be able to unburden my customer of having to organise the maintenance themselves.
- 4.3) As a final customer, when there is an error and the LaaS provider is going to take care of it, I want to be able to monitor the overall progress of the maintenance task so that I know when maintenance will be performed and by who.
- 4.4) As a Lighting-as-a-Service provider, I want to be able to easily initiate the maintenance process.
- 4.5) As a Lighting-as-a-Service provider, I want to be able to add the contact info of the installer to the profile of the customer so that I can better reach the goal specified in requirement 4.

7.2.2 The new Luxon

Due to the confidential information in this section, it has been removed in the public version of the thesis. With the right authorization, the section can be found in confidential appendix 11.3. Readers with the right authorization are advised to continue reading from this appendix in order to follow the chronological flow of the research.

7.3 Enterprise architecture of the new Luxon

Due to the confidential information in this section, it has been removed in the public version of the thesis. With the right authorization, the section can be found in confidential appendix 11.4. Readers with the right authorization are advised to continue reading from this appendix in order to follow the chronological flow of the research.

8. Conclusion and Discussion

In this research, numerous important and valuable findings have been made. Now that the research has been completed, this chapter will provide an answer to the research questions stated in section 2.5.

8.1 Conclusion

This research was aimed to answer the following question:

Which functionalities have to be added to the light management system of Nedap to create more value per light fixture in a market where light is sold as a service?

To answer this question, a number of steps have been taken. The current offering of Luxon was examined and an enterprise architecture was designed. Then, the literature was researched in order to create a theoretical framework in which the different product-service offerings (including Product-as-a-Service) in the manufacturing industry were identified. Furthermore, the relevance of Product-as-a-Service in the lighting industry was examined by creating a maturity model. This model was used to assess the level of servitization in the lighting industry and it was stated that the lighting industry is a level three industry (product plus differentiating services) with some pioneering companies entering the highest level of servitization (Lighting-as-a-Service). Lighting-as-a-Service is thus a relevant development. Next, five Lighting-as-a-Service providers were interviewed together with two regular lighting providers in order to identify valuable chances for Nedap in the Lighting-as-a-Service industry. Together with other valuable findings on the characteristics, financial organisation, target group and problems of Lighting-as-a-Service, eleven valuable chances in the Lighting-as-a-Service industry were identified. With the findings from the interviews and the literature, a reference architecture was proposed that could serve as a blue print for future Lighting-as-a-Service management systems. Of the chances identified in the review, four were identified as most valuable and these chances were transformed into four functionalities that provide an answer to the primary research question:

- The ability to monitor and analyse the performance of the lighting installation by the provider
- The ability to accurately predict the savings achieved by new lighting
- The ability to support companies in creating or delivering a circular economy
- The ability to optimize maintenance so that the customer will not be burdened

In the last phase of the research, the functionalities were transformed into three modules that gave a recommendation on how to implement the new functionalities. The Performance Manager, Savings Insights and the Circularity Manager were proposed as valuable modules for Luxon. Using the functionalities and then newly proposed modules, the enterprise architecture was expanded and altered in order to indicate what components were necessary before these modules could be delivered to the customers. With the, in this research, proposed functionalities implemented in Luxon, the light management system will be of more value.

8.2 Discussion

This section elaborates further on the conclusion of this research. Where the conclusion is a short summary of the findings, this discussion aims to dive deeper into the findings of the research. The different phases of this research and their outcome are discussed in greater detail in this section.

Firstly, the current offering the light management system Luxon was investigated. When adding functionality to an already existing software offering, it is important to know what that offering is in the present time. To do this, a software specification was made and an enterprise architecture was designed. As this enterprise architecture wasn't available and didn't exist yet, the architecture was designed from scratch. Thus providing Nedap with a valuable abstract architecture that models their current offering.

Secondly, a theoretical framework was designed. Here, the literature was researched to find out what servitization in the manufacturing industry was and what kind of offerings are made in such a market. In total, eight different product-service combinations were identified using the IPS cube and they were visualised using the Extended Product concept. One of these product-service offerings was the Product-as-a-Service offering and using the framework, it was possible to indicate what the characteristics of such an offering were:

- It is an IPS in which the provider of the IPS is the owner of the IPS.
- The offering has a compound nature which means that the product cannot be detached from the service.
- There is no technology involved in delivering or combining the IPS.

By visualising this offering using the Extended Product concept, it was stated that in this offering, the product itself has no value (figure 46). The framework was furthermore used to develop a maturity model that could be used to assess the position of the lighting industry and Nedap in terms of level of servitization (figure 47). It was concluded that the lighting industry was placed in stage three (product & differentiating services) and that some companies were pioneering in stage four (Lighting-as-a-Service).



Figure 46: Configuration of the Extended Product concept for the Product-as-a-Service offering

Product Product & Supporting Services Product & Differentiating Services Product-as-a-Service

Figure 47: Representation of the maturity of servitization in the lighting industry

In the third phase of this research, the lighting industry was interviewed to find out how relevant Lighting-as-a-Service is, how it is organised, how it will grow and where opportunities for Nedap can be identified in this new business model. From the small population (of about 15 LaaS providers), five have been interviewed. To critically assess their statements, two regular lighting providers were interviewed. Their statements were used to check whether the LaaS providers didn't have tunnel vision. From these interviews, the definition of Lighting-as-a-Service could be created.

Lighting-as-a-Service is a service in which companies work side-by-side to offer a service that fully unburdens and removes all the risks for the customers whilst providing a light solution that is adjusted to the customer's needs. Where ownership lies with the provider of the solution, for which the customer doesn't have to invest but instead just pays a recurring fee for the use of the service.

Numerous valuable findings emerged from the interviews including characteristics, financial organisation, target group and problems, but the most valuable findings were the identification of the chances in the Lighting-as-a-Service industry. In total, eleven chances were identified. By determining their value using their weighted score on six criteria's, the following four chances were identified as most valuable and relevant for Luxon:

- Monitor and analyse performance of the lighting installation. LaaS providers can use this to monitor if they are honouring their commitments and truly unburden their customer.
- Correctly predict energy savings. Used by the LaaS providers to accurately predict the savings that will be achieved by the new lighting installation in order to limit risk and deliver a better price for the service.
- Making processes more circular. Circular economy is one of the most important implications of Lighting-as-a-Service and with the mismatch between the growing economy and the limiting resources, it will grow in value over the next few years. Software that can help companies in supporting their circular processes is thus very valuable.
- Maintenance optimization. Organising maintenance is now something that the customer must do, but if full unburdening wants to be achieved, this process should be optimized in such a way that the customer will not be bothered.

In the fourth phase, an opportunity arose due to the findings in the literature and the market. A reference architecture was proposed which indicate how a Lighting-as-a-Service management system should look like and what services it had to provide. This architecture can be used for the development of future systems and also helps Luxon as it indicates what it needs to be able to do in the future.

In the fifth phase, these chances were transformed into functionalities that have to be added to Luxon. These functionalities provide an answer to the primary research question. The following functionalities have to be added to Luxon to create more value per light fixture in the Lighting-as-a-Service industry:

Chance	Functionality
Monitor and analyse performance	The ability to monitor and analyse the performance of the lighting installation
Correctly predict energy savings	The ability to accurately predict the savings achieved by new lighting
Making processes more circular	The ability to support companies in creating or delivering a circular economy
Maintenance optimization	The ability to optimize maintenance so that the customer will not be burdened

Table 15: Summarizing table in which the valuable new functionalities of Luxon are described

The sixth and last phase of the research took these functionalities one step further and created a recommendation for the implementation of them. Three new modules were introduced:



Performance Manager



Savings Insights



Circularity Manager

Figure 48: The new Luxon modules: Performance Manager, Savings Insights, Circularity Manager

The enterprise architecture was then altered to show how the new functionalities would change the architecture. In this way, it was made clear what was necessary for these functionalities to be added to the current Luxon.

Conclusively, the research has succeeded in answering all the research questions. Lighting-as-a-Service has been extensively researched, the lighting industry has been analysed, an enterprise architecture and reference architecture has been designed and most importantly, four valuable functionalities have been identified that could help Nedap to attain a great and strong position in the lighting industry of tomorrow.

8.3 Limitations of the research

There is one important limitation to this research that needs to be explicitly mentioned and that is the investigated population size. It has been mentioned a lot that Lighting-as-a-Service is still standing in its infancy and this means that there aren't that many companies who are providing this service. Many people talk about it, but only a few actually have the knowledge of what it takes to deliver Lighting-as-a-Service. These people are the ones that were interviewed for this research and the findings are rather unanimous (and could thus be seen as true). It should however be kept in mind that the population size was small and the findings could have had a bigger support if Lighting-as-a-Service was an already more commonly business model.

9. Recommendations

With the valuable functionalities identified, a recommendation can be given on the implementation of them. Furthermore, recommendations for valuable further research can be stated. These will be discussed in this section.

9.1 Recommendations for the implementation of functionalities

The identified functionalities could all have an enormous impact on the value of Luxon in the industry of tomorrow. However, implementing those takes time and money and it is critical to assess what is most valuable and what can be achieved in the near future. That is why some recommendations will be made on how this can be done best (in my opinion). The first recommendation is easy to come up with:

Recommendation 1: Implement all four of the functionalities proposed in this research. The industry have confirmed these functionalities are valuable and they are a logical valuable addition to Luxon.

In my opinion, the monitoring and analysing of the performance of a lighting installation together with the optimization of the maintenance process are functionalities that can be easily added into Luxon. The monitoring and analysis of performance is already available for the customer and the only thing that needs to be done, is creating a separate dashboard for the providers in which they get the same functionalities as their customers. The only difference is that the provider sees the performance of every lighting installation for which he is responsible. The creation of such a dashboard isn't that hard and it doesn't take much time to make a basic version of the Performance Manager. The same goes for the maintenance optimization. This functionality is easily implemented with the Maintenance Assist already available in the current Luxon.

Recommendation 2: Implement the monitoring and analysis of performance and the maintenance optimization first. They are easily created and do not take much time and money.

Furthermore, I would like to recommend to first build a basic version for each of the functionalities. All functionalities (except the predicting of savings) can be seen as having certain level of implementation. For instance, I think it would be a good idea to first provide a basic version of the performance manager. In this basic version, things like KPI and actual measurement of performance in one number can be left out as it is already extremely valuable for them to just get the raw data. When the module is a success and it is better known which KPIs are used, the module can be expanded.

Recommendation 3: Start small and make the modules bigger when they are a success. Create a minimum viable product (MVP) and deliver that to the customer so that you can quickly get feedback.

Although it has been shown in this research that Lighting-as-a-Service is a very real and valuable development, it is still standing in its infancy. Lighting-as-a-Service will grow a lot and it is valuable to invest in it, but the Circularity Manager module might not have relevance for some time. It is does wise to keep checking the developments in the market. This is specifically relevant for the Circularity Manager. The other functionalities can already be added as they are certainly valuable in today's market (but to prevent overkill, follow recommendation 2).

Recommendation 4: Keep checking the developments in the market. Lighting-as-a-Service is standing in its infancy and although it will grow a lot, it is wise to develop software for the near future (a year) instead of the distance future (10 years). This is specifically relevant for the Circularity Manager.

A last recommendation concerns the way in which Nedap will get paid. Now that the Lighting-as-a-Service provider will also become a customer, the pricing strategy should be critically evaluated. It should be clear who pays for what functionality. For instance, Maintenance Assist is now offered to the customer and he needs to pay for it. With the Performance Manager in place (where Maintenance Assist is a critical functionality), it should be examined who pays for the Maintenance Assist module.

Recommendation 5: Investigate what the best pricing strategy is now that the LaaS providers are becoming customers and users of Luxon. Determine who will pay for what and in what form.

9.2 Recommendations for further research

These recommendations have partly been discussed when the new Luxon was presented (appendix 11.3), but they will be further elaborated in this section.

In order to be able to implement the functionalities, some further research has to be done so that they actually work and have value.

Further research 1: Investigate what KPIs the LaaS providers use to assess and calculate the performance. Some of the KPIs are already identified, but these are probably not all of them and the connection between them is still unknown.

Further research 2: Develop a mathematical model that can accurately predict the savings that will be achieved with a new lighting installation. Some companies are working on this, but most companies lack the data necessary to validate their model.

Further research 3: Evaluate the proposed new functionalities and find out how much the Lighting-as-a-Service providers are willing to pay for the new software. The benefits will probably outweigh the costs of building the new modules (as they are easy to build and the industry did indicate that it would be valuable), but an exact evaluation needs to be performed before actually starting the development of the new software.

Important note on further research 2 is that in one of my interviews, the interviewee claimed to have developed a mathematical model that can accurately predict savings. He told me that he has hundreds of references for which it worked and that it has been fine-tuned over many years. This interviewee was Person E of Company E and it would be very valuable to talk to him (one of the sales people of Nedap is already investigating this lead).

Furthermore, the reference architecture that was designed needs to be validated.

Further research 3: Validate the reference architecture proposed in this research. The reference architecture as it is now has not been validated and probably needs altering if it were to be viewed as a fully developed reference architecture.

10. Reference List

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Appendices

Appendix A: Background info on Nedap

This appendix gives some more information on Nedap, what they sell and how they sell it. This is discussed in three segments: Nedap, Luxon and Implementation of light management”.

A.1 Nedap

Nedap was founded in 1929. The company focusses on the development and production of electronic systems. Nedap was formerly most famous for their voting machines. In the present, they are known as being the largest implementer of the NFC technology. Nedap is divided into different market groups, each with their own specialisation and products. The market groups are: Light Controls, Identification Systems, Healthcare, Library Solutions, Lifestock Management, Security Management, Nedap Pep, Energy Systems and Retail.

A.2 Luxon

As now known, Luxon is the light management system of Nedap. As its functions are extensively discussed in the thesis, this appendix will focus on the necessary hardware.

The hardware that Nedap sells is used to support and enable the use of Luxon. Without it, Luxon cannot be operated and it has no to little value for the customer. The hardware is used as a means for the software to work. Hardware exists in three different categories:

- Activators. These boxes are placed on the armature and are used to connect it to the Internet. This way, the different armatures can communicate with each other and with Luxon. This activator makes the armatures “Luxon-ready”. The activator is brand and type independent and can thus be attached to any armature. There are activators that are placed inside the armature and ones that connect it from a distance (either a single armature or a whole line).
- Controllers. The data that is being generated in all the armatures is collected on a controller called the LLC (Luxon Light Controller). This is where the lights are controlled and where the user can interact with their lighting system using the Luxon dashboard. The controller is installed locally and can control up to 200 light fixtures.
- Sensors. Sensors are used to generate data. Sensors come in two categories: motion sensors and daylight sensors. The motion sensors measure if a person is present in the room (and thus needs light) and the daylight sensor measures whether there is enough light coming from outside (so that the light can be dimmed). They then send that information to the LLC and the LLC then “decides” whether lights need to be turned on or off.

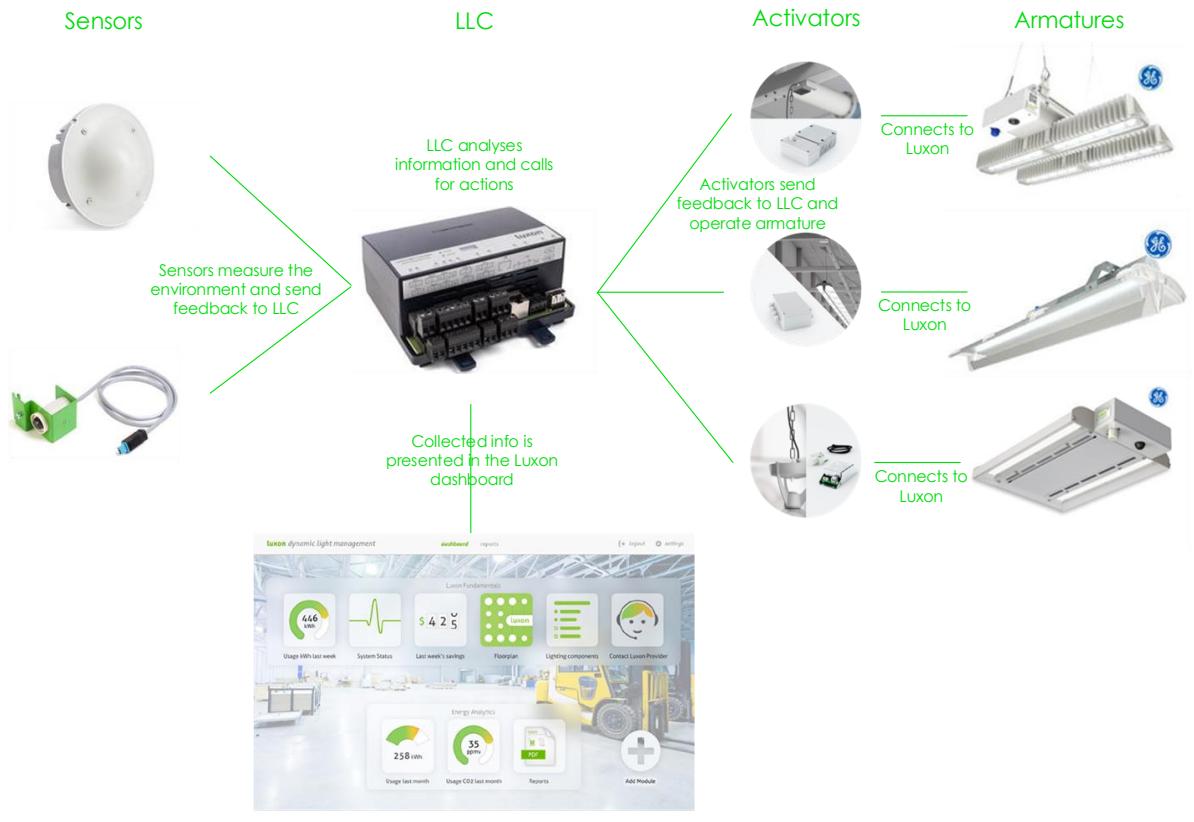


Figure 49: Visual representation of the interaction between hardware and software in Luxon

A.3 Implementation of light management

When a customer wants to buy a smart lighting installation in their new building or if they want to replace their current lighting with smart lighting in order to achieve great energy savings (a process called retrofitting), a process is started to make this happen. Multiple parties here have to work together in order to be able to deliver the wanted solution. The way this is done is described in this segment.

The supply chain

Starting off with the different supply chain configurations. As every project is different, there are multiple configurations for the supply chain that fabricates the outcome of the project. The following parties are involved:

- Nedap: deliverer of intelligence in the form of software.
- OEM (Original Equipment Manufacturer): deliverer of armatures
- Channel partner: sellers of the solution as a whole. They have the most contact with the customer.
- Installer: installs the light and performs maintenance.

Configurations differ on two aspects: 1) the place where the armature is made Luxon-ready and 2) the need and presence of a channel partner (as the OEM or Nedap can also take over that role).

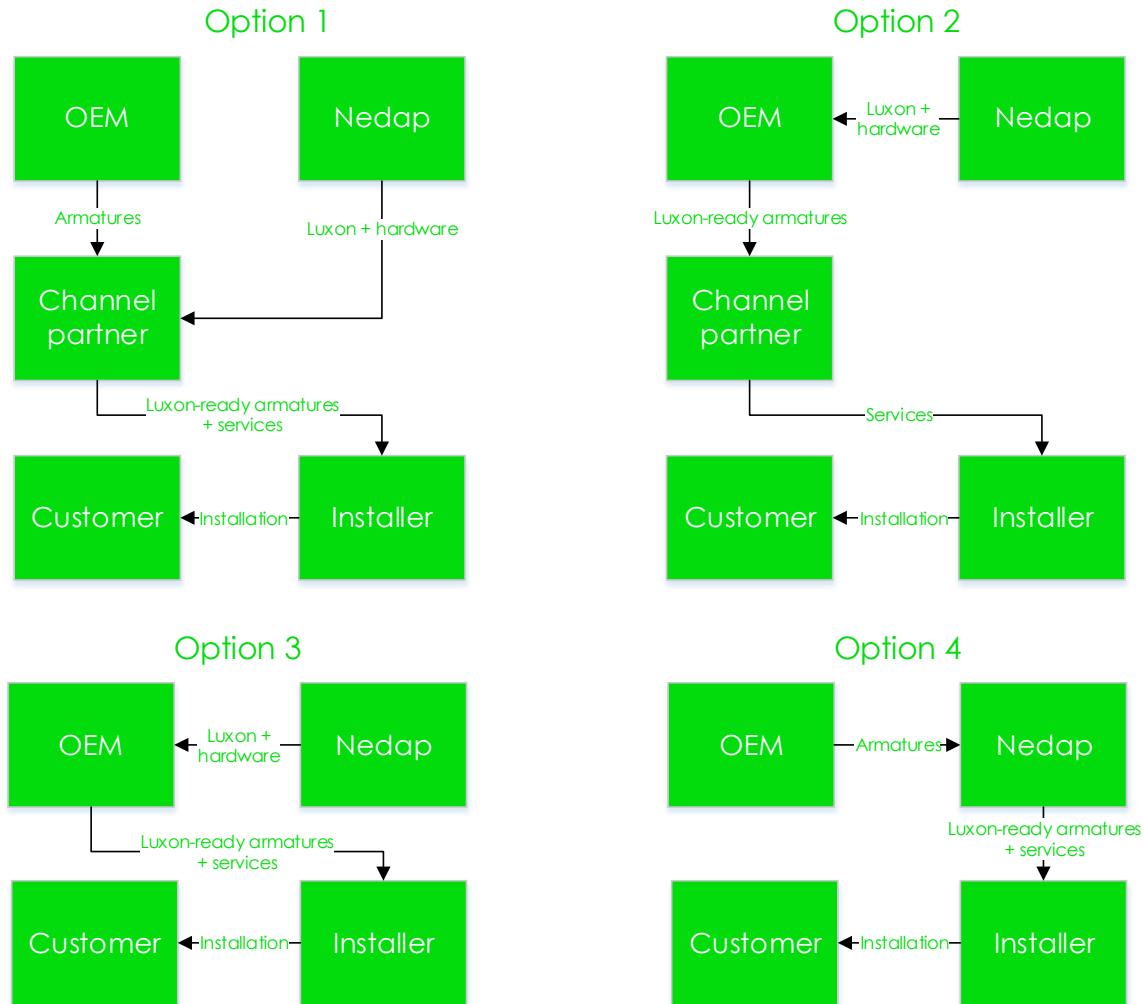


Figure 50: Configurations of the supply chain used to deliver light management to the customer

Appendix B: Metamodels and concept definition of ArchiMate

B.1 Business Layer

The business layer metamodel is described in figure 51.

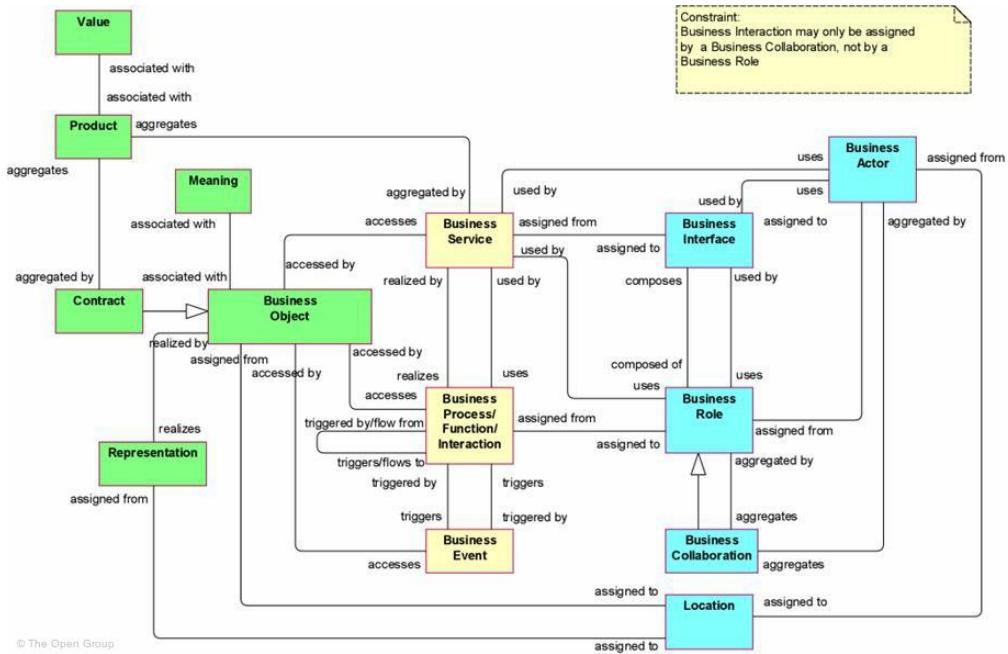


Figure 51: Metamodel of the business layer in the ArchiMate language

The relevant concepts in this layer are described in table 16. In this table, the name of the concept, their meaning, their aspect (active, behaviour or passive) and their symbol used in the model are stated.

Concept	Aspect	Description	Notation
Business actor	Active Structure	An organizational entity that is capable of performing behaviour.	
Business role	Active Structure	The responsibility for performing specific behavior, to which an actor can be assigned.	
Business interface	Active Structure	A point of access where a business service is made available to the environment.	
Business process	Behaviour	A behavior element that groups behavior based on an ordering of activities. It is intended to produce a defined set of products or business services.	
Business function	Behaviour	A behavior element that groups behavior based on a chosen set of criteria (typically required business resources and/or competences).	
Business event	Behaviour	Something that happens (internally or externally) and influences behaviour.	
Business service	Behaviour	A service that fulfills a business need for a customer (internal or external to the organization).	

Business object	Passive Structure	A passive element that has relevance from a business perspective.	
Representation	Passive Structure	A perceptible form of the information carried by a business object.	
Meaning	Passive Structure	The knowledge or expertise present in a business object or its representation, given a particular context.	
Value	Passive Structure	The relative worth, utility, or importance of a business service or product.	
Product	Passive Structure	A coherent collection of services, accompanied by a contract/set of agreements, which is offered as a whole to (internal or external) customers.	
Contract	Passive Structure	A formal or informal specification of agreement that specifies the rights and obligations associated with a product.	

Table 16: Business layer concepts used to design the enterprise architecture of Luxon

B.2 Application Layer

The application layer metamodel is described in figure 52.

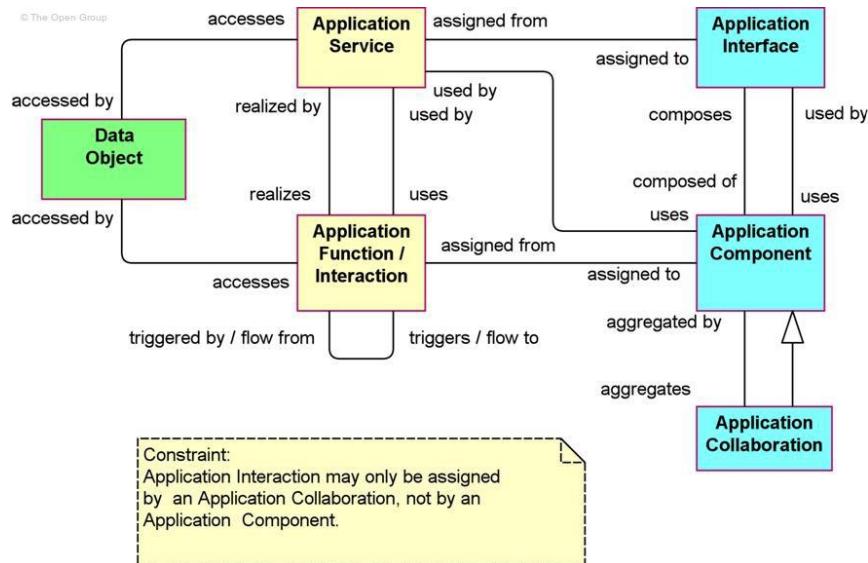


Figure 52: Metamodel of the applications layer in the Archimate language

The relevant concepts in this layer are described in table 17. In this table, the name of the concept, their meaning, their aspect (active, behaviour or passive) and their symbol used in the model are stated.

Concept	Aspect	Definition	Notation
Application component	Active Structure	A modular, deployable, and replaceable part of a software system that encapsulates its behavior and data and exposes these through a set of interfaces.	

Concept	Aspect	Definition	Notation
Application function	Behaviour	A behavior element that groups automated behavior that can be performed by an application component.	
Application service	Behaviour	A service that exposes automated behaviour.	
Data object	Passive Structure	A passive element suitable for automated processing.	

Table 17: The application layer concepts used to design the enterprise architecture of Luxon

B.3 Technology Layer

The technology layer metamodel is described in figure 53.

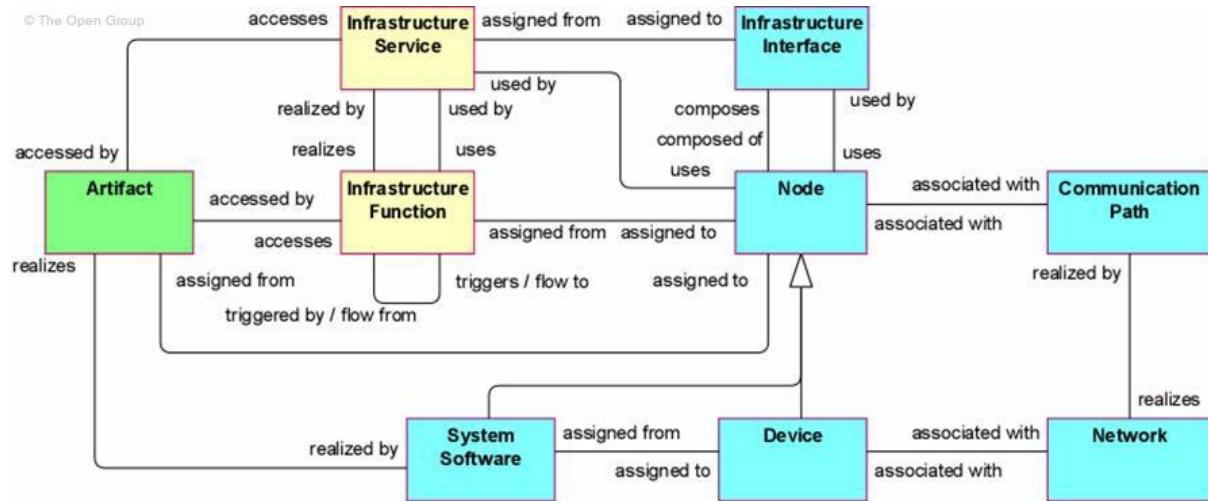


Figure 53: Metamodel of the technology layer in the Archimate language

The relevant concepts in this layer are described in table 18. In this table, the name of the concept, their meaning, their aspect (active, behaviour or passive) and their symbol used in the model.

Concept	Aspect	Definition	Notation
Node	Active Structure	A computational resource upon which artifacts may be stored or deployed for execution.	
Device	Active Structure	A hardware resource upon which artifacts may be stored or deployed for execution.	
Communication path	Active Structure	A link between two or more nodes, through which these nodes can exchange data.	
Infrastructure function	Behaviour	A behavior element that groups infrastructural behaviour that can be performed by a node.	

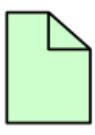
Concept	Aspect	Definition	Notation
Infrastructure service	Behaviour	An externally visible unit of functionality, provided by one or more nodes, exposed through well-defined interfaces, and meaningful to the environment.	 
Artifact	Passive Structure	A physical piece of data that is used or produced in a software development process, or by deployment and operation of a system.	 

Table 18: Technology layer concepts used to design of the enterprise architecture of Luxon

B.4 Relationships

In order to be able to indicate the different relationships between the concepts, the symbols stated in table 19 are used. Each symbol indicates a different relationship between the concepts. The relationships are classified in the following three categories:

- Structural, which model the structural coherence of concepts of the same or different types.
- Dynamic, which are used to model (temporal) dependencies between behavioural concepts.
- Other, which do not fall in one of the two categories above.

Structural Relationships		Notation
Association	Association models a relationship between objects that is not covered by another, more specific relationship.	
Access	The access relationship models the access of behavioral concepts to business or data objects.	 
Used by	The used by relationship models the use of services by processes, functions, or interactions and the access to interfaces by roles, components, or collaborations.	
Realization	The realization relationship links a logical entity with a more concrete entity that realizes it.	
Assignment	The assignment relationship links units of behavior with active elements (e.g., roles, components) that perform them, or roles with actors that fulfill them.	
Composition	The composition relationship indicates that an object is composed of one or more other objects.	
Dynamic Relationships		Notation
Flow	The flow relationship describes the exchange or transfer of, for example, information or value between processes, function, interactions, and events.	
Triggering	The triggering relationship describes the temporal or causal relationships between processes, functions, interactions, and events.	

Table 19: Relationships used to design the connection between concepts in the architecture

Appendix C: Research process of literature review

The coming about of the literature review is based upon the research process that is stated in this section. Here, the different steps taken in order to design the literature review are discussed in a chronological order.

C.1 Search words

The following search strings were used to acquire literature:

“Servitization” AND “Manufacturing”

AND “Lighting”

AND “Literature Review”

AND “Maturity Model” OR “Stages” OR “Phases”

AND “Service Creation”

AND “Problems” OR “Issues” OR “Difficulties” OR “Obstacles” OR “Barriers” OR “Challenges”

AND “Requirements engineering”

AND “Perceived customer value”

“Requirements engineering” AND “Software”

AND “Methodology” OR “Framework” OR “Standards”

AND “Software requirements specification” OR “SRS”

These search strings will be used in the following databases:

- Scopus
- Web of Science (WoS)
- Business Source Elite (BSE)

The search strings will also be used in Google Scholar. Here, the first two/three pages of search results will be checked to verify that no useful references were missed.

C.2 Inclusion and exclusion criteria

Once the search assignments have been carried out and a large list of references has been established, the inclusion and exclusion criteria determine whether a reference is relevant for the literature review or not. In table 20, the inclusion and exclusion criteria used in this review are stated. When a reference meets one of the inclusion criteria, it will be kept. When it doesn’t (and thus meets an exclusion criteria) it will be deleted.

Inclusion criteria	Exclusion criteria
Articles that describe the definition and characteristics of servitization in the manufacturing sector.	Articles that only describe servitization in other industries and thus are irrelevant.
Articles that describe problems in servitization that could be relevant for new software requirements	Articles that describe implications of servitization for one firm. Thus looking at for instance management implications or strategical changes.
Articles that describe ways in which service is created and delivered to the customer in a servitized market.	Articles in which the main goal is to explain what happens when requirements have already been stated.
Articles in which is specified what requirements engineering is, what forms exist and how it can be used to write down new software specification.	Articles that talk about requirements engineering for hardware or is irrelevant for front-end web-based software applications
Articles that combine criteria mentioned above. Even if the main subject isn't one of the main topics of research.	Articles that mainly discuss the origin, rise, drivers and validation of servitization.
	Articles that sketch problems that cannot be overcome using software or do not add value to the final customer.

Table 20: Inclusion and exclusion criteria used to assess the value of an article

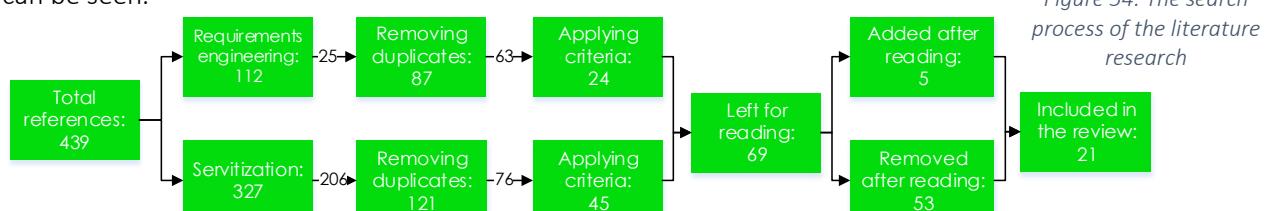
C.3 Search results

Using the search strings defined in section C.1, 439 references were found. The results of the different search strings in the different databases are as shown in table 21.

Search strings	Scopus	WoS	BSE	Scholar
"Servitization" AND "Manufacturing"				
AND "Lighting"	0	0	0	3
AND "Literature Review"	43	22	20	0
AND "Maturity Model" OR "Stages" OR "Phases"	16	8	7	0
AND "Service Creation"	7	17	13	5
AND "Problems" OR "Issues" OR "Difficulties"	67	34	24	34
OR "Obstacles" OR "Barriers" OR "Challenges"				
AND "Requirements engineering"	0	0	1	8
AND "Perceived customer value"	5	0	7	5
"Requirements engineering" AND "Software"				
AND "Methodology" OR "Framework" OR "Standards"	17	1	50	6
AND "Software requirements specification"	23	5	1	2

Table 21: Search results of the search strings in the literature databases

The total amount of references found was 641 (346 for servitization and 138 for requirements engineering). When the duplicates were removed and the inclusion and exclusion criteria were used to further decrease the amount of references, 21 references remained. In figure 54, the research process can be seen.



Appendix D: Qualitative Research Design

This appendix gives detailed information about the research design used in the interviews. In figure 55, the qualitative research process suggested by Cooper and Schindler is shown.

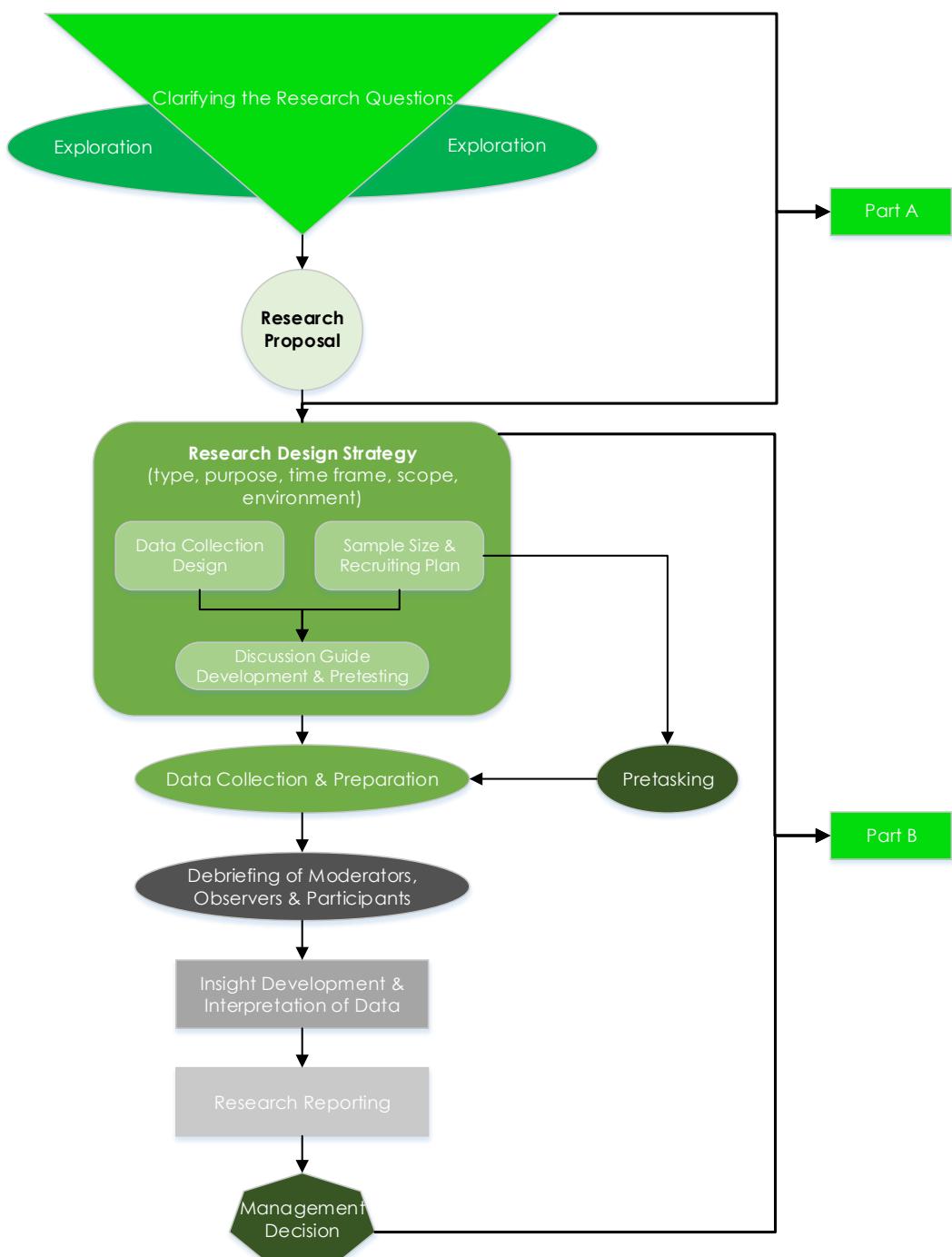


Figure 55: The qualitative research process

The research design itself specifies every aspect of the way in which the data will be gathered. This part is divided into seven segments. Each segment specifies a certain aspect of the way in which the data will be gathered and together they form the research design. The segments are: purpose (why is this necessary and what is the goal?), type (which method will be used?), time frame (when will the data be gathered?), environment (where will the data be gathered?), sampling (from whom will the data be gathered?), questions (what will be asked?) and measurement (how are the answers measured?) (Cooper and Schindler, 2011).

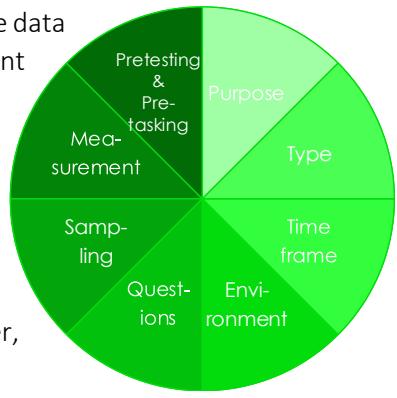


Figure 56: Topics that need to be correctly specified to carry out a good qualitative research

D.1 Purpose & Goal

To start off, it is first stated what the acquired data should look like. Indicating a goal and purpose as to why this is done and what is it that this research is ultimately looking for. As this research is looking to describe new software functionalities for the lighting industry, the best outcome of the data gathering phase will be clear opportunities that might lead to valuable software functionalities. The fact that these functionalities must be valuable for the market, makes it necessary to inquire information from this market. That is why this data needs to be gathered. Given these statements above, the following is the main subject of analysis:

Opportunities in the servitized market that may lead to new software functionalities in Luxon that are valuable for the services provided to the final customer.

D.2 Type

Now that the ultimate goal of the data gathering phase has been stated, the method used will be specified. As stated in the purpose of the data gathering phase, the market needs to be analysed to come up with valuable functionalities. That is why a descriptive qualitative research will be carried out to acquire the data (Bhattacherjee, 2012). More specifically, Individual Depth Interviews (IDI) will be carried out (Cooper and Schindler, 2011). This method calls for an interaction between one interviewer and one interviewee. The interview will be carried out over the phone (with a duration of about 20 minutes) or face-to-face (with a duration of up to two hours). Using IDI's, topics can be discussed in great detail and follow-up questions can be asked immediately when interesting things come up.

D.3 Time frame

The interviews are carried out over a time span of approximately three weeks. This gives flexibility to the interviewees as to when they have time to sit down and talk.

D.4 Environment

In order to get the most valuable and honest data, interviewees must feel safe and comfortable (Cooper and Schindler, 2011). That is why the interviews will take place in the offices of the interviewees. The interview will, if possible, start off with a small tour and an introduction to the company. This way the interviewer will get used to the vocabulary of the interviewee (everyone's vocabulary is different) and this might result in better understanding of the answers of the interviewee (Becker and Geer, 1957).

D.5 Questions

The most important part of the research design is of course the interview itself. Here, the questions that will be asked are being stated as well as the reasons why they are being asked. Every question has a purpose. In this research, questions are placed into different categories that label them. Here we use the following categories:

- Introduction. These questions will be asked in the beginning of the interview. Their answers give a description of who the interviewee is and they can be used to evaluate the value of the interviewee. It shows whether the interviewee is a strong or a weak source.
- Description. These questions search to describe certain concepts or developments. It allows the interviewee to show his viewpoints on the market and where it is headed. These descriptive questions might give rise to unstated needs or unknown problems. This because the interviewee will talk freely about different concepts without specifically paying attention to opportunities for software. Afterwards or during the interview, their story might imply problems or unstated needs that were not seen by the interviewee.
- Opportunities. These questions expect the interviewee to point blank state opportunities that they think is valuable. These opportunities do not necessarily have to be able to lead to new functionalities. It thus seeks states needs and known problems.
- Customer value. These questions ask the interviewee to talk about what he thinks the customers find valuable. It seeks to state the stated or even unstated needs.
- Solution. These questions seek to understand how the interviewee thinks software can help to support services, thus guiding towards a solution.

With these categories of questions, the questions used in the interview are displayed in table 27, they are displayed in chronological order and divided into main subjects.

<i>Subject</i>	<i>Category</i>	<i>Question</i>
Introduction	Introduction	Can you give a description of what your company exactly does?
	Introduction	What is the goal of your company?
	Introduction	What is your role in the company?
	Introduction	How actively do you investigate and develop products and services for the future?
	Introduction	What is your part in this innovation?
Market of today	Description	What services are most valuable in the market of today?
	Opportunities	Are there problems with the current services that need to be solved?
	Description	Why aren't they solved yet? What is needed to solve them?
	Solutions	How can software help here?
	Opportunities	Are there any valuable chances in the market of today that are waiting to be grabbed?
	Customer value	What do customers think is most valuable in today's market?
	Solution	How can software help in delivering or increasing this value?
	Description	What developments/innovations are you noticing in the market?
	Description	What implications do they have for the market? What is going to change?
	Opportunities	What problems do they take with them?
Market of tomorrow	Solution	How can they be solved?
	Description	What, in your eyes, is the future of the lighting industry?
	Description	What services will be the most valuable in the market of tomorrow and why?
	Description	Why isn't everybody providing this service?
	Description	What is Lighting-as-a-Service in your eyes?
	Description	What does it take for a company to be able to deliver Lighting-as-a-Service? Do the different forms extremely influence the things a company need?
	Description	How does a company manage the supply chain in a LaaS market?
	Description	How is maintenance and replacement organized?
	Description	How is financing organized?
	Description	How often do you see it implemented in the lighting industry?
	Description	Why isn't everybody doing it?
	Opportunities	What do customers find most valuable in the LaaS concept? Contact with supplier? Financing options?
	Opportunities	What are clear problems that need to be solved in order to make it attractive for a customer?
Light management	Solution	Are there obvious applications for software that have value today?
	Description	What will customers think is the most valuable in the market of tomorrow?
	Solution	Can software be used to deliver this value?
General feeling about the interview	Description	What will be the role of light management in the future?
	Description	What parts of light management need to be improved or further developed?
	Description	Is there anything that you would like to add?
General feeling about the interview	Description	What were your thoughts about the interview?
	Description	Do you have any tips for my next interview?

Table 22: List of questions used as guidance in the interviews

D.6 Sampling

Now that is stated what is going to be asked, attention needs to be directed to the group of people that will be interviewed. It is necessary to be able to give verdicts about the entire market. However, it is impossible to ask every single individual in the market what they would like to see in their software. That's why a sample of the entire population will be drawn. This sample will be interviewed and used to give verdicts about the market in general (the population). A good sample is accurate (no bias) and precise (the amount of randomness in the findings) (Cooper and Schindler, 2011).

To acquire opportunities for software development, a number of samples were considered. The different considerations can be found below:

- The final customer. Although the final customer is the person for whom the software must have value, it is not valuable to interview them. Most of the final customers do not think about their lighting system and they probably won't come up with valuable opportunities. Also, they have no knowledge of Lighting-as-a-Service.
- The Lighting-as-a-Service providers. Although these providers do represent the group for which the software also has value, the research wants to look into the future of the lighting industry. Albeit that the focus lies on Lighting-as-a-Service, other opportunities must be indicated and Lighting-as-a-Service itself must be critically analysed. As Lighting-as-a-Service providers are biased, they do not form a good sample.
- The service providers in the lighting industry (a mixture of Lighting-as-a-Service providers and other service providers). This is the sample that will be used for the research. By interviewing both companies that offer Lighting-as-a-Service and those who don't, it is possible to obtain information about the future of the lighting industry in general. The sample is accurate as the different parties will all have different views, but together will give a relatively objective vision about the future of the lighting industry. Precision is hard to measure as there is no data to which the findings can be compared. When talking about the future (which is somewhat random in itself) it is hard to talk about randomness.

D.7 Measurement

To measure the chances that the interviewees indicated, they were asked how valuable they thought the chance was on a scale from 1-10. Unfortunately, not many chances were clean cut and sometimes, due to time constraints, this question wasn't asked.

D.8 Pretesting & pretasking

To fine-tune the interview, it was tested on three people of Nedap. Using their feedback, the final question list was specified.

The interviewees were given an e-mail in which the goal of the interview was stated. This e-mail was sent one day before the interview. In this way, given the open character of the interview, the interviewee was given a chance to already think about opportunities and the future of the lighting industry one day in advance. When the interview started, they were made aware of the limitations of this type of interview so that, hopefully, they would take these into account and thus minimize them.

Appendix E: Transcripts of the interviews

The transcripts of the conducted interviews are specified in the following appendix. Some of these transcripts are Dutch as the interview was conducted in this language. They are ordered in a chronological order.

E.1 Interview with Person A

Company (location):	A (England)
Position:	Sales Director Europe
Relationship with LaaS (company):	None
Relationship with LaaS (personal):	Aware of its existence and implications
Level of LaaS knowledge:	3
Date of interview:	29-04-2016
Location of interview:	Nedap Headquarters
Medium used (duration):	Skype (70 minutes)

Partij A: Antonie Berkel

Partij B: Person A

A: Wat is jouw functie en wat doet Company A?

B: Ik heb in veel gebieden gewerkt. Supply chain, marketing, sales. Ook in verschillende marktgroepen. Special lighting, automotive, outdoor, retail en op dit moment breder. Op dit moment ben ik verantwoordelijk voor de internationale sales. En dat doe ik in Europa en in het Midden-Oosten.

Company A is onderdeel van partij X. Partij X is toch wel één van de grootste armaturen ontwikkelaar ter wereld. Ze zitten vooral in Noord-Amerika. Zelf zijn we redelijk klein. Daardoor zijn we flexibel, maar hebben we wel de technologie en buying power van een groot bedrijf. We zijn vooral goed in een aantal segmenten: industrie, rails, straatverlichting en buitenverlichting. Dingen die we niet doen is thuis en kantoor verlichting.

A: Verkopen jullie dan complete oplossingen of alleen armaturen?

B: Eigenlijk beide. Onze strategie heeft een aantal verschillende tiers: tier 1, tier 2, tier 3 en tier 4. 1 is domme armaturen zonder intelligentie. 2 is met een lokale controller. 3 zijn networked controllers (Luxon) en 4 zijn echt services waarbij financing en recurring revenues worden aangeboden. De focus voor Company A is vooral 2 en 3. Tier 4 zal waarschijnlijk in de toekomst meer gedaan worden.

A: Is Company A een innoverend bedrijf?

B: Ja, toch wel. Company A is een middelgroot bedrijf. We hebben eigen armaturen. 80% is LED gebaseerd. We halen ook producten van partij X. We verkopen veel jonge producten (jonger dan drie jaar) en ik denk dat die op dit moment voor 70% van de omzet zorgen.

A: We hebben het net al over jullie diensten gehad en ik benieuwd naar wat de klant op dit moment de meest waardevolle diensten vindt.

B: Dat is wel een interessant punt. Ik zie bij veel van die diensten dat er meer over gepraat wordt dan dat het ook echt gedaan wordt. Bijvoorbeeld financing. Dat was punt omdat klanten een project afkapte omdat wij geen financing hadden. Toen zijn we met een partner in zee gegaan die ons kon financieren. Dat hebben we toen aangeboden, maar uiteindelijk merk je dan dat er toch gewoon over wordt gegaan tot koop van de installatie.

A: Waarom is dat dan? Dat mensen nog steeds kopen?

B: Ik weet het niet. Naar mijn idee wordt het af en toe gebruikt om dingen buiten de deur te houden. Een excus om de beslissing nog even niet te maken. Je komt er dan achter dat geld eigenlijk nooit het probleem is geweest, maar dat het als excus wordt gebruikt. Toch zijn de lease opties wel dusdanig interessant. Wanneer we spreken over een lease contract van vijf jaar dan zie je dat je maandelijks minder betaalt dan dat je bespaart. Het is dus een redelijke no-brainer. Na vijf jaar kun je dan beslissen of je het langer wilt leasen of dat je wat anders wilt. Wanneer we kijken naar licht als dienst dan wordt daar denk ik ook nog vooral veel over gepraat. Philips heeft het geïmplementeerd op Schiphol. Daar betalen zij voor licht, niet voor de lampen zelf. Wanneer Philips denkt dat ze de dingen efficiënter kunnen inregelen, dan is dat in principe winst voor hen omdat zij betalen voor de lampen. Echter zie je dat er nog maar weinig van die contracten zijn.

A: En de andere services. Licht management, controls, onderhoud, wat is daar het waardevolst?

B: Ik denk dat er bij complexe control systemen nog wel een stukje te gaan is. Veel klanten vinden het mooi, maar ze kijken naar wat het onder de streep doet en wat er verder bij komt kijken en besluiten dan vaak om het niet te doen. Simpele control systemen zijn heel belangrijk daarom. Wij hebben bijvoorbeeld een klant waar controls zijn geïnstalleerd maar waarbij het nooit is gebruikt. Zelfs niet gecommissioned. En ik vraag me dan wel eens af, hoeveel control systemen worden nou echt gebruikt? Ik denk dat dat er weinig zijn. En waarom is dat? Waarschijnlijk omdat er ergens op management niveau die beslissing is gemaakt (omdat ze dan groener o.i.d. zijn), maar dat het uitvoerend personeel er niets mee te maken wil hebben.

A: Dus de systemen zijn lastig te begrijpen. Zijn de interfaces dan te lastig?

B: Ja en nee. Sommige zijn inderdaad lastig, maar het is vooral belangrijk dat er iemand achter gaat zitten en de tijd neemt om het te leren. Dat is vaak niet. Veel mensen denken, verlichting is maar verlichting en het valt alleen op wanneer het heel slecht is. Nooit wanneer het heel goed is. Licht is er gewoon. Daarom hebben wij de filosofie dat die systemen allemaal heel intuïtief en simpel moeten zijn. En eigenlijk dat het allemaal automatisch gaat.

A: Is Luxon dan zo'n systeem die dat goed doet?

B: Ja, ik denk dat Luxon in de basis doet wat het moet doen. Echter kan Luxon meer dan alleen één keer gecommissioned worden en ik ben benieuwd hoe vaak dat gebeurd. Dat mensen ook echt hun schedule gaan aanpassen wanneer er een holiday is.

A: En wanneer er op de een of andere manier een mogelijkheid is waardoor mensen dat wel doen of waardoor het op zo'n dag automatisch uit gaat, heeft dat dan veel waarde?

B: Ik denk dat je het grootste gedeelte van de behoefte daarmee bevredigt. Veel mensen zullen er niet bij stil staan dat dat ook nog eens heel waardevol is. En daarnaast, hoeveel bespaar je dan nog extra. Zoveel holidays zijn er bijvoorbeeld niet. Kijkend naar Nedap zeggen zij dat ze het licht willen optimaliseren door er vaker naartoe te gaan en te kijken of het beter kan. Voor veel klanten zal dat nog een stap te ver zijn. Voor hen is het belangrijk dat het gewoon werkt.

A: Dus het belangrijkste in een lichtmanagement systeem is het groen zijn voor het management, de besparing en het feit dat het gewoon werkt.

B: Dat klopt. Mensen moeten er niet over na moeten denken.

A: En doet Luxon dat goed?

B: Ja, Luxon levert zeker de basis functionaliteit. Echter is wel goed om te noemen dat het ook veel licht aan de manier waarop zo'n installatie wordt gecommissioned. Het systeem kan veel, maar zonder goede commissioning is het niets waard. Van tevoren is het dus belangrijk om te snappen wat de klant wilt en dat kun je meestal lastig vragen (zij weten niet wat ze willen). Basis functionaliteit is dus belangrijk, maar eigenlijk wordt er bij control systemen nooit de eerste keer goed gecommissioned en dat zie je in een paar problemen terug. 80% van de problemen komen van de installateur. Simpelweg dat het licht niet goed is opgehangen. Het tweede is dat de verwachting van de klant vaak toch nog anders is dan wat er is ontwikkeld. Het derde is dat het systeem simpelweg niet doet wat het moet doen. Dat is de belangrijkste reden om met Nedap samen te werken, het doet het.

A: Waarom wordt dat slecht opgehangen door die installateurs?

B: Ja meestal zit het in de installatie. Installateurs maken gewoon fouten en dan kun je het als leverancier oplossen omdat jouw systeem dan niet werkt. Ook krijgen ze het niet goed gecommissioned soms.

A: Waar kan software in de huidige markt nog zaken verbeteren/optimaliseren?

B: Nou, waar ik mij nog over verbaas is dat je bij het commissionen nog echt alle lampen handmatig op een grid moet zetten terwijl je toch eigenlijk zou verwachten dat daar wel intelligentie voor is. Dat ze zichzelf in een netwerk kunnen zetten. Ze zouden op basis van signaalsterkte prima moeten kunnen weten hoever elk armatuur bij je verwijderd is. Tweede manier waarop dat opgelost kan worden is door gebruik te maken van VLC (Visual Light Communication). Acuity is hier mee bezig. Het is een soort gps voor binnen waar elk armatuur een satelliet is. Dan zou de camera van je telefoon het licht zien binnenkomen en op basis daarvan kan het je positie bepalen. Dat kan in de retail veelal worden gebruikt om je route te bepalen. Maar je zou het ook andersom kunnen doen. Dat op basis van je eigen locatie de locatie van de lampen kan worden bepaald. En dan kan je simpelweg met je telefoon door de locatie lopen en alle lampen op een grid zetten. Nu moet je namelijk een lamp aantikken, die gaat knipperen en vervolgens moet je die gaan zoeken. In grote hallen is dat dan nog een hele klus.

A: Maar dan maak je het dus voor jezelf makkelijker. Zou een Company A bijvoorbeeld Nedap een waardevollere partner vinden wanneer dit automatisch kan?

B: Ja, voor ons is dat belangrijk. Wij commissionen zelf en we zijn hier in de huidige situatie veel geld aan kwijt.

A: En als je die functionaliteit een cijfer zou geven, hoe waardevol is die dan?

B: Nou toch wel een 8, want je bent er echt wel 3 a 4 dagen mee bezig.

A: En als dat commissionen nou automatisch zou gaan? Dat de armaturen op basis van machine learning o.i.d. het zelf inregelen en dat commissionen dus eigenlijk ook niet meer nodig is. Zou dat waardevol zijn?

B: Ja op het moment dat je een control systeem verkoopt, maakt hij een afweging hoeveel hij gaat besparen en hoelang hij ertover doet om het terug te betalen. Met intelligentie is het heel lastig om hard te maken hoeveel je nu daadwerkelijk bespaard. Net zoals met bewegingssensoren is het lastig om te meten wat de impact is. Wanneer je dat wel kan zou het interessant zijn om dat in een dienst aan te bieden. Dan moet je wel echt in je concept geloven, maar het kan wel werken. Dan geeft je een besparingsgarantie. En die contracten zijn er al wel.

A: Dan hebben we het echt over Lighting-as-a-Service dus?

B: Dat klopt. Maar het is heel lastig om dat te implementeren. Wat als de kantoor uren veranderen? Hoeveel brandt het überhaupt? Dat soort dingen zijn heel lastig om in te schatten en daarom is het lastig om dat aan te bieden.

A: Is dat wel de toekomst? Lighting-as-a-Service.

B: Ik denk deels wel, veel voor grote projecten denk ik. Heel belangrijk is dat het moet simpel gehouden worden. Je moet op een heel ander niveau met klanten gaan praten en eigenlijk beginnen bij de CEO en wanneer hij overtuigt is volgt de rest ook wel. Maar het is echt belangrijk om het simpel te houden. Op een lager niveau zijn ze daar niet echt mee bezig.

A: En waarom is dat? Is het te moeilijk?

B: Het gaat boven hun niveau, boven hun paycheck. Het is niet hun verantwoordelijkheid.

A: En dat is dan alleen voor grote projecten? En dan in de nieuwbouw of ook retrofit?

B: Ik denk beide wel, misschien retrofit nog wel meer. Daar gaat het echt om besparing en bij nieuwbouw is verlichting maar 2% van de gehele kosten.

A: Waar zitten de pijnpunten bij de aanbieder van Lighting-as-a-Service? Het vraagt namelijk een flinke verandering in de manier van aanbieden van licht.

B: Ja je gaat een hele shake down in de markt krijgen eigenlijk maar een paar partijen die dit serieus kunnen aanbieden. Het vergt namelijk veel kennis, kapitaal en goede partners en dat hebben veel mensen niet. Daarnaast is financiering ook pas echt interessant vanaf projecten van een ton. Het gaat wel een strijd worden wie nu echt die LaaS provider wordt en wie dat klant contact heeft. Daar vallen namelijk de beslissingen en iedereen wil dus dat klantcontact. Er komen ook anderen nieuwe spelers op de markt zoals Cisco, Google en Apple die veel met automated homes aan de slag gaan.

A: Wat zou naast LaaS een waardevolle innovatie zijn in de toekomst?

B: Ja, dat is de gouden vraag. Als we dat toch eens wisten... Ja, de buzz words: Internet of Things, Big Data etc. Er komen standaard netwerken/protocollen. Kennis wordt daarom heel belangrijk. Het is dan goed om in een niche te zitten. Veel control systemen voor kantoren en thuis gebruik, maar weinig industrieën. Daar moet je je in specialiseren.

A: Zie jij daarnaast zelf nog interessante ontwikkelingen die we nog niet hebben besproken?

B: Nee ik denk dat we wel aardig alles hebben gehad. Voor licht management is het belangrijk om gemakkelijk en simpel te zijn, denk dat dat het belangrijkst is.

A: Dan wil ik je graag bedanken voor je tijd en openheid!

B: Graag gedaan en veel succes met je onderzoek.

E.2 Interview with Person B

Company (location):	Company B (The Netherlands, operates worldwide)
Position:	Managing Director
Relationship with LaaS (company):	Provider of LaaS
Relationship with LaaS (personal):	Actively researching and promoting the LaaS concept
Level of LaaS knowledge:	5
Date of interview:	13-05-2016
Location of interview:	/
Medium used (duration):	Face-to-face (90 minutes)

Partij A: Antonie Berkel

Partij B: Person B

B: Company B is een Duitse, internationaal opererende fabrikant van armaturen. Een hele historie in licht en hebben bijna alle technieken wel meegemaakt. We hebben de lichtbronnen nooit zelf gemaakt. Wij passen de lichtbronnen toe en zorgen dat het gebruikt kan worden. Dat doen we nu 100 jaar. Wij zijn een volledige dochteronderneming, de Benelux organisatie, en van hieruit marketen wij de Company B producten. Dat is wat we doen en we hebben bij elkaar zo'n 6000 medewerkers. Actief in alle landen van Europa. In Nederland zijn we al meer dan 20 jaar actief. We zijn met name gericht op professionele verlichting, binnen en buiten. Grote gebouwen, utiliteit, overheidsgebouwen. En dat doen we zeer succesvol.

A: En de rol van diensten daarin?

B: De rol van diensten was tot voor kort niet heel erg groot. We zijn begonnen met montage diensten. Dus niet alleen het leveren van de armaturen maar ook het monteren ervan. Dat was de afgelopen jaren eigenlijk de hoofdzaak van de diensten. Maar we doen ook lichtberekeningen maken, visualisatie. Dus adviesdiensten aan de ene kant en werkzaamheden, zoals montage, aan de andere kant. En sinds kort is daar ook financiering bijgekomen. Zo langzaam bouwen we de diensten op.

A: En LiveLink zag ik ook als dienst...

B: Ja, LiveLink is een lichtmanagement systeem en ja, dat zou eigenlijk een basis voorwaarde (voor elk lichtsysteem) moeten zijn. Het licht beter en efficiënter gebruiken en dat is een heel intuïtief systeem.

A: En uw rol hierin is managing director?

B: Ja dat klopt, ik ben nu 14 jaar in dienst en ik ben langzaam aan het afbouwen en ik heb een opvolger al gevonden en die doet de operationele taken. Ik doe nog een aantal zaken eromheen zoals het ontwikkelen van nieuwe producten, het aangaan van partnerships en Lighting-as-a-Managed-Service. Dus dat is een beetje de taakverdeling.

A: Dus innovatie is wel echt onderdeel van uw dagelijkse taakomschrijving?

B: Ja, ik heb meerdere achtergronden. Ik heb in de ICT en Telemarketing gezeten en ik denk dat ik die kennis goed kan toepassen op de ontwikkelingen in de lichtindustrie.

A: En als we het over innovatie hebben. Hoeveel procent van de omzet wordt gemaakt op basis van oude producten en hoeveel op nieuwe. Dus wordt er veel verdiend aan de oude armaturen of veel door de nieuwe diensten en services.

B: Nou, meer dan 90% is eigenlijk van de oude armaturen. Waarbij wij armaturen leveren aan de eindgebruiker of de installateur en die monteert dat en zorgt dat de verlichting werkt. Maar je ziet een kanteling in de markt waarbij steeds meer klanten ontzorgd willen worden. En daar ontstaan eigenlijk het vervolg op die eerdergenoemde diensten die wij in de markt hebben gebracht.

A: En als we kijken naar die markt zoals die er hedendaags uitziet, om meteen maar met de deur in huis te vallen, wat vindt u dan de meest waardevolle dienst die een klant kan krijgen?

B: Ja, dat hangt volledig van de klant af. De klant ziet altijd in een heel verschillende stadium van tijd. De een wil gewoon heel traditioneel een armatuur kopen. Anderen die zeggen: "ik wil helemaal geen armatuur kopen, ik wil gewoon licht." Er zit een heel groot verschil tussen. Je ziet dat de overheid en veel klanten die zich richten op core businesses langzaam aan het nadenken zijn over "moeten wij wel eigenaar zijn van het gebouw. We zijn al geen eigenaar van de auto, moeten we dan nog wel eigenaar zijn van onze installatie." Nog licht is dan weer een voorloop product op de overige installatie producten. WKO installaties kunnen al wel geleased worden. Bij de meeste anderen zie je dat niet. Komt ook door Philips die het in de markt heeft gezegd. Beetje gelijk met ons alleen zij hebben er iets meer marketing aan besteed. Het gaat er steeds meer om dat mensen zeggen: "het gaat me erom dat het het doet en dat ik bijvoorbeeld gewoon les kan geven".

A: Dus er is echt een scheiding tussen de conventionele klanten die gewoon armaturen willen betalen en de klanten die licht als dienst willen?

B: Nou het is niet echt een scheiding. Het is meer een stadium van volwassenheid. Er zijn al klanten die veel meer weg zijn van de techniek. Thomas Rau is dan een bekende die het niet heeft over eigendom, maar eigenslim. Hij loopt voorop.

A: En als je er nu een percentage op zou moeten plakken?

B: Dan denk ik dat ongeveer 5% klaar is voor licht als dienst op dit moment. En dan praat je eigenlijk over de meest uitgebreide vorm van diensten (licht als dienst). Voor de andere diensten (montage diensten, adviesdiensten) zie je dat de markt een stuk ontvankelijker is. Heel veel installateurs willen bijvoorbeeld al niet alleen maar het werk uitvoeren maar willen ook betrokken zijn in het management (bij het aansturen en het ontwikkelen van een licht management systeem).

A: Als je nu kijkt naar wat klanten op dit moment zelf het meest waardevol vinden. Wat is dat dan? Is dat het financiële plaatje, is dat de relatie met de leverancier, is dat de kwaliteit van het licht?

B: Die klant die vindt goed verlichting en comfort erg belangrijk. Dan vindt hij denk ik belangrijk wat de kosten zijn. Veel klanten zijn bezig met energiebesparing. En wij hebben een programma waarin je zoveel energie bespaard, dat het eigenlijk de investering zelf terug verdient. Klanten hebben dus over het algemeen meerdere dingen die ze belangrijk vinden. Energiebesparing is dan wel iets wat de afgelopen jaren zwaar heeft gewogen. Maar toch zie je ook hier dat er een verschuiving komt. Energiebesparing wordt steeds meer gezien als iets dat er gewoon is. Zeker nu met de opkomst van LED. Nou dan wil je meer licht, beter licht, ondersteunend licht, dynamisch licht. Waarmee mensen beter gaan werken, productiever worden. Dus voor iedereen zit er weer wat anders aan. Over het algemeen dus energiebesparing en comfort verbetering.

A: En daar zit Company B ook op in? Het energie besparen en het comfort leveren.

B: Ja, dat zijn marktgegevens waar wij ook mee te maken hebben. Daar houden we dus zeker rekening mee.

A: En wat is dan precies het verschil tussen Lighting-as-a-Managed-Service (LaaS), zoals jullie het noemen, en het Lighting-as-a-Service concept?

B: Nou je had natuurlijk LaaS. En wij hebben toen gezegd dat LaaS niet helemaal de lading dekt. Het is namelijk eigenlijk een managed service. Service is heel breed en daarom hebben we gezegd dat deze service beheert en gemanaged wordt geleverd, om zo de betrokkenheid van de leverancier te benadrukken.

A: En wat houdt dat dan precies in?

B: Het is een service die inspeelt op het volledig ontzorgen van de klant. Een klant zegt: "we willen eigenlijk die installatie helemaal niet hebben, we willen eigenlijk helemaal niks meer we hebben. We hebben een ruimte nodig waarin we bijvoorbeeld kunnen werken en iemand anders moet er maar voor zorgen dat daar goed en voldoende licht is." En dat biedt dus LaaMS. LaaMS biedt de mogelijkheid om geen investering te hoeven doen in armaturen, maar te betalen op basis van het gebruik van licht. En dan wordt dat gemanaged. LED is een complexe technologie, licht management is iets complex, en daar willen ze eigenlijk niet zoveel mee te maken hebben. Ze willen gewoon dat het het doet en dat het naar hun wensen wordt aangepast. Dat is wat geboden moet worden en daar betalen ze dan een x bedrag per maand voor. En dat is wat we doen. En dat kunnen ze dan 5, 10, 15 jaar huren.

A: Company B is dan degene die dan ook echt het klantcontact heeft?

B: Ja

A: Oke. Een van de dingen die deze manier van licht verkopen kenmerkt, is die reconfiguratie van alle partijen die bij zo'n verkoop betrokken zijn. Zoals u ook al zei, Company B heeft ook wel ooit alleen de armaturen geleverd en de rest aan iemand anders overgelaten. Hoe ziet dat er nu uit in jullie geval?

B: De traditionele lineaire weg naar de markt waarbij de aannemer een gebouw heeft, die vervolgens de installateur vraagt om een lichtinstallatie en de installateur zegt dat weer tegen Company B dat zij licht moeten leveren. Nou, dat zie je langzaam doorbroken worden. Fabrikanten met name die kennis hebben van hun producten en de toepassingen daarvan, komen naar boven want die nemen die verantwoordelijkheid (voor de installatie) over. Je ziet dus veel meer parallelisatie. Partijen werken samen met andere partijen met daarboven maar een partij die daarin de regie neemt. Het kan het geval van zo'n gebouw zijn dat dus meerdere partijen allemaal samenwerken om luchtdiensten, maar ook luchtdiensten of telecommunicatiediensten op te leveren. En daar zit een regisseur tussen die ervoor zorgt dat het voor de klant allemaal netjes op elkaar afgestemd wordt. Die partij kan een adviesbureau zijn of de aannemer zelf etc. Het lineaire model waarbij de ene schakel de bovenliggende schakel een beetje uitperst. Het netto resultaat daarvan namelijk is niet duurzaam en er wordt niet gekeken naar de lange termijn. Dat kan in een parallel systeem wel.

A: En in uw verhaal hoor ik veel nieuwbouw projecten waarbij ook compleet andere diensten worden geleverd? Is het ook toepasbaar op renovaties?

B: Ja, dat kan zeker.

A: Inzoomend op het licht onderdeel van zo'n project. Daar wordt ook op een andere manier samengewerkt en dit is waar ik meer op doelde. Hoe organiseren jullie dat? Heb je een eigen installateur of zoek je voor elk project een nieuwe partner.

B: Wij zullen dat niet zelf doen. We werken met partners. In de toekomst zal je een networked organisatie krijgen waarin allemaal gespecialiseerde bedrijven die elkaar goed kennen zullen samenwerken om tot een oplossing te komen. Waar dat vroeger nog wel echt losse schakels waren, worden die samenwerkingsverbanden steeds belangrijker aangezien Company B de verantwoordelijkheid voor het resultaat op zich neemt.

A: Hoe gaat die samenwerking dan in de praktijk? Zijn er problemen of verbeterpunten?

B: Dat moet allemaal nog een beetje wennen, maar dat gaat eigenlijk steeds beter. Je leert met elkaar omgaan. Het is alleen wat moeilijk om een traditionele installateur die vroeger gewoon zei dat iets geleverd moet worden, nu moet vragen hoe ze samen dingen kunnen doen. Wat doe jij en wat doe ik. Die cultuuromslag is soms nog lastig. Je ziet echter wel veel bedrijven die dit al goed doen.

A: Ik heb inderdaad al wel eerder gehoord dat installateurs het lastig vinden om soms ook het klantcontact eigenlijk te verliezen, aangezien maar één partij LaaS aanbiedt. Het gaat in één pakket naar de klant. Hoe ervaart u dat?

B: Wij willen graag samenwerken. Hij hoeft het contact niet te verliezen. Wat wij willen is een probleem oplossen. Iemand komt naar ons toe met een probleem. Dat kan een eigenaar van een gebouw zijn, een financier, een installateur etc. Hetgeen wat zij nodig hebben is een oplossing op de manier zoals zij dat willen. Dat kan betekenen dat de installateur nog heel veel contact heeft met zo'n klant, soms ook niet. Het gaat erom dat zo'n partij kennis nodig heeft. Company B is bereid om in elke soort

samenwerking te opereren. Wij kunnen de regie voeren, we kunnen onderaannemer zijn. Het is net maar wat de klant verwacht. Maar het is zeker zo dat we het, in het verleden achtergestelde, klanten contact steeds beter moeten gaan uitdiepen.

A: Nog heel even over die installateur. We hadden het over die samenwerking waar hij nog moet aan wennen. Is het dat de tijd ervoor zal zorgen dat hij eraan went of zitten er nog kinken in de kabel die er nog uitgehaald moeten worden?

B: Nee, ik denk dat het een kwestie is van een soort van volwassen worden van de traditionele installateurs. Daarnaast vraagt de klant steeds meer aan de installateur waardoor de installateur ook dingen wil uitbesteden en geen verantwoordelijkheid wil hebben (hij is namelijk in dit model niet verantwoordelijk voor de installatie zelf).

A: En de financiering van zulke projecten? Dat gaat nu ook op een hele andere manier. Er wordt nu gewerkt met recurring revenues. Wat voor impact heeft dat?

B: Nou, als bedrijf moet je als eerst in staat zijn om dit model aan te kunnen bieden. Voor je eigen cashflow heeft dit namelijk nog wel impact. Waar je vroeger voor 1 miljoen licht verkocht en een jaar kon teren op die miljoen, moet je het nu uitsmeren over 10 jaar. Ja hoe ga je dat financieren? Want je hebt wel je kosten. Dat vraagt een omslag in het financieringsmodel van de aanbieder. Bedrijven die een goede financiering of financieringspartner hebben, die kunnen dat doen. Een sterke financier komt dan het licht van de leverancier en levert dat dan weer naar de klant. Net als een hypotheek als het ware.

A: En die financier, staan die daar welwillend tegenover?

B: Nou dat is voor veel van hen nog wennen. Met auto's is het al heel lang gebruikelijk om te leasen. Voor installaties is het wel gek nog om te huren. Juridisch is dat ook nog lastig aangezien je wanneer je iets aan een gebouw vastmaakt, het eigenlijk onderdeel van het gebouw is. Dat is allemaal op te lossen. Maar het blijft gewoon wennen voor zulke financiers.

A: Wanneer we de aandacht verschuiven naar de klant. Hoe welwillend staan zij tegenover deze manier van licht verkopen? Wat vinden zij van deze manier van financieren?

B: Heel veel klanten zeggen, ik heb er nu geen geld voor, maar ik wil het wel hebben. Nou, met verlichting zit er eigenlijk direct een energie besparing aan vast. Zo'n 70% besparing. Verlichting is een vrij grote post in de kosten van een kantoorgebouw. Het is vaak heel erg prettig als je die kosten naar beneden kan brengen, maar wel hetzelfde betaalt. Door de verlichting dan te huren en maandelijks te betalen gaat je energie naar beneden en betaalt de installatie zichzelf als het ware terug.

A: En toch hoor ik veel mensen zeggen dat klanten het wel interessant vinden, maar dat wanneer ze met een uitgewerkt lease plan komen, ze toch zeggen dat ze het willen kopen.

B: Ja, dat kan. Er zit toch een stukje onzekerheid in. Wat je ook ziet is dat de partij soms een eigen partij vindt die het finanziert. Dat is vaak net wat goedkoper. Maar het heeft gewoon wat tijd nodig. Kijk maar wederom naar de auto industrie. Klanten zijn soms gewoon nog een beetje huiverig.

A: En nemen jullie ook de energierekening over?

B: Nou we hebben een constructie in de vorm van een ESCo (een Energy Services Company, een bedrijf die berekeningen maken over energiebesparingen). Die hebben we opgericht met een aantal bedrijven en heet ManESCo (Managed Energy Services Company). Daar zitten een aantal bedrijven in en wij werken samen om vanuit die ManESCo, waar de specialistische kennis zit over energiebesparing en garantie daarvan, die garanties aan de klant te kunnen leveren. Zo kunnen we ook gegarandeerde energiebesparingsdiensten aanbieden.

A: En zo kunnen jullie de energierekening ook overnemen?

B: Ja, de ManESCo verzamelt alle gegevens van zo'n gebouw en berekent de totale besparing van alle installaties (verwarming, licht, isolatie etc.) die geleverd gaan worden. Door naar de performance van de oude installatie en de gegevens van de nieuwe installatie te analyseren kunnen zij die berekening uitvoeren. Op basis daarvan wordt een SLA opgesteld waarin wij garanderen wat de totale besparing zal zijn en zo nemen wij als het ware de energierekening over. Wij garanderen namelijk dat het nooit hoger zal zijn dan een bepaalde waarde en wanneer dat wel is wordt de SLA niet nageleefd en wordt de klant gecompenseerd. Het is aan de ManESCo om deze besparing te monitoren en te beheren.

A: En houdt je in de berekening dan ook al rekening met licht management of controls? Het is al een hele vooruitgang van conventionele verlichting naar LED, maar door controls en licht management toevoegen kan die besparing nog groter worden. Echter is het voorspellen hiervan lastig. Houden jullie hier rekening mee?

B: Het is inderdaad lastig te meten. Maar we gebruiken daar oude cijfers voor en wanneer we een nieuwe project hebben wordt simpelweg, wanneer er licht management wordt toegevoegd, een fictief percentage (ontstaan uit oude data) toegevoegd aan het energiebesparingspercentage.

A: Zijn die cijfers betrouwbaar gebleken? Gaat het meten goed?

B: Het is lastig om dit soort dingen na te meten. Het gebouw kan veranderen, werkcondities kunnen veranderen etc. Wanneer je dit goed wilt meten moet alles gedurende een hele periode hetzelfde zijn. Helaas gebeurd dit bijna niet. Wel kun je de individuele lichtpunten meten. Als antwoord op de vraag: het is heel lastig, maar wel heel waardevol om het te meten.

A: Stel dat dat er zou zijn? Is dat waardevol?

B: Om dit te kunnen meten is heel lastig aangezien je veel verschillende variabelen zou moeten meenemen, maar het zou er ongetwijfeld komen. Meten is weten, dus het is waardevol.

A: En stel dat je dat allemaal zou kunnen presenteren voor key accounts, zal dat dan ook niet de awareness voor andere klanten groter maken?

B: Op zich gelooft iedereen wel dat het werkt. Iedereen ziet dat de besparing er wel zou komen, dus wat dat betreft is het niet per se nodig.

A: Hoe bepalen jullie wat jullie maandelijks vragen voor de oplossing?

B: In eerste instantie kijken we naar de investering (de installatie) zelf en dat smeren we uit over de contractduur. Dat geld krijgen wij. Vervolgens kijken we naar de berekeningen van ManESCO en die worden erboven op gegooid. Dat is wat de klant in totaal betaald. Het kan ook zijn, en dat is weer een andere vorm van LaaMS, dat de klant pas wilt betalen wanneer hij het gebruikt. Hij betaalt dan een variabel bedrag voor de hoeveelheid gebruik en daarin verrekent zit ook de installatie en het onderhoudt (pay-per-lux).

A: Dus dan heb je een flexibel abonnement.

B: Dat klopt, het tarief per uur staat vast, maar het maandelijkse bedrag wordt bepaald aan de hand van het aantal uren dat het brandt.

A: Wanneer er, kijkend naar mijn onderzoek, een module aan een lichtmanagement systeem zal worden toegevoegd die dit voor een klant in de gaten houdt en een prognose geeft en dat hij wanneer hij het nog beter inregelt, er wordt gedeeld in de besparing, zou dit dan waardevol zijn?

B: Ja dat is zeker waardevol. Al denk ik dat vele lichtmanagement systemen dit al wel kunnen.

A: Is zo'n flexibel abonnement een extra motief voor een klant om LaaMS toe te gaan passen.

B: Dat hangt ervan af wat de klant wil. Op dit moment wordt het nog niet veel gedaan. We hebben wel een klant in de logistiek die een gebouw verhuurd aan een aantal andere partijen. Die partijen hebben allemaal verschillende behoeften en verschillende goederen opgeslagen. Het licht in dat gebouw moet dus gemanaged worden wanneer er nieuwe klanten in dat gebouw komen. Voor klanten die zelf in een flexibel gebouw zitten en een flexibel lichtsysteem nodig hebben, is dit erg handig.

A: Wat vindt de klant het meest waardevol aan LaaMS?

B: De ontzorging. Je bent nergens meer verantwoordelijk voor. Wanneer iets fout gaat is het niet jouw probleem.

A: Kan die ontzorging nog beter?

B: Dat zal zich zeker ontwikkelen over tijd. Ik denk dat de ontzorging eerst is dat je zelf een fout moet constateren en dat je dan belt of dat iemand al ziet dat het fout gaat.

A: Nu zijn er nog maar ongeveer 5% van de klanten die dit concept omarmen. Zijn dit alleen grote of ook kleine projecten.

B: Beiden. Voornamelijk de grote projecten (multi-site of één groot gebouw) zijn geïnteresseerd maar er zijn ook zeker kleine projecten waarbij klanten zeggen dat ze ontzorgd willen worden. De volwassenheid van de klant en de afstand die hij heeft tot de installatie (focus op zijn core business, de randzaken moeten er gewoon zijn) drijft tot LaaMS. Wel is het voor veel kleine projecten te complex om LaaMS op toe te passen.

A: En hoe en waarom zal dit in de toekomst gaan groeien?

B: Ik denk dat het puur tijd nodig heeft. Dit heeft gewenning nodig. Net als in alle andere industrieën waarin het al normaal is dat niemand meer eigendom is, heeft dat ook gewoon tijd gekost. Ik denk dat alle functionaliteiten in de gebouwen een commodity worden. Mensen verwachten dat die functionaliteiten erin zitten en dat ze er niet naar hoeven omkijken en dan worden deze diensten het meest interessant.

A: Wat is iets wat de klant nog graag wil zien in dit model?

B: De finetuning van het hele model. Bijvoorbeeld het goed inregelen van het pay-per-lux principe, betere tariefstelling, nauwkeuriger meten. Nu doet iedereen het nog voor hele specifieke opdrachten. Straks komen er steeds meer algemene modellen.

A: Dan zal dus de prijsverfijning en flexibiliteit er nog voor zorgen dat zo'n klant eerder gaat overstappen?

B: Ja zeker.

A: En aan de organisatie kant. Wat moet hier nog gebeuren om alles beter te laten werken.

B: Ook hier moet veel worden gefinetuned. Ik denk dat wij al onze modellen heel goed op elkaar moeten afstemmen en met elkaar moeten verbinden zodat we eigenlijk een netwerk creëren van alle verschillende diensten. Op die manier zou het licht kunnen praten met de verwarming of kan een vertraging bij de NS ervoor zorgen dat de agenda van een persoon wordt omgegooid (omdat hij te laat was). Die connecties moeten allemaal gemaakt worden zodat wederom het individu volledig ontzorgd wordt.

A: Dus je gebruikt dan een licht management systeem om op basis van andere systemen het lichtniveau aan te passen.

B: Ja en nee. Ja, het licht management systeem dimt uiteindelijk het licht bijvoorbeeld, maar ik denk dat de beslissing op een hoger niveau wordt gemaakt. Waarschijnlijk door het gebouw beheer systeem. Dit systeem zal alle data interpreteren en op basis daarvan keuzes maken. Dat zal de toekomst zijn. Een licht management systeem hoeft van mij echter niet die beslissing te maken.

A: Wat zou nog, heel breed, een software applicatie zijn wat heel waardevol zou zijn voor LaaS?

B: Het is meer de flexibiliteit van de user interface die nog moet worden verbeterd. Het is een complex systeem, maar wanneer je het op een intuïtieve manier vormgeeft en weergeeft, dan helpt dit de klant begrijpen wat er gebeurd. Het gemak waarmee die systemen kunnen worden gebruikt, moet nog groter worden. Zoals je je iPhone meteen kan oppakken en kan gebruiken, moet dat ook met deze user interfaces kunnen. Het zal straks zijn dat er een aantal standaard platforms komen waarop je je applicatie kan bouwen. Hierdoor zal alles ongeveer hetzelfde gaan werken en kan er makkelijk connectie worden gemaakt met andere systemen. Die connectie zal heel waardevol zijn om te maken. Daar moet nog veel gebeuren.

Daarnaast denken we ook veel aan circulariteit. Door onze processen circulair in te richten worden alle producten duurzamer en economischer.

A: Dat waren al mijn vragen. Heeft u zelf nog opmerkingen?

B: Nee, ik denk dat we alles hebben besproken.

A: Dan dank ik u voor uw tijd en openheid!

B: Graag gedaan en succes met je onderzoek.

E.3 Interview with Person C

Company (location):	Company C (The Netherlands)
Position:	Manager New Businesses
Relationship with LaaS (company):	Core Business
Relationship with LaaS (personal):	Creates partnerships and sells the LaaS concept
Level of LaaS knowledge:	5
Date of interview:	13-05-2016
Location of interview:	Dura Vermeer Office in Hoofddorp
Medium used (duration):	Face-to-face (75 minutes)

Partij A: Antonie Berkel

Partij B: Person C

A: Wat is Company C en wat doet het precies?

B: Company C is een financieel bedrijf. Gericht op het financieren van projecten met het in het bijzonder projecten die gebruik maken van LED verlichting. En dat is ook wel ons vertrekpunt geweest drie jaar geleden. Het is ontstaan uit een samenwerking tussen een lichtadvies bedrijf, een financieel adviseur van overheden en een energie leverancier. Het lichtadvies bedrijf zag dat er veel naar nieuwe besparende technologieën werd gezocht. Daar zijn mooie oplossingen voor te bedenken maar wanneer de offerte wordt gepresenteerd zie je dat veel bedrijven dan toch op de rem gaan. Dat is een grote hobbel om te nemen. Ofwel het bedrijf heeft geen geld of ze weten niet of het wel gaat doen wat we zeggen wat we doen en vaak is innovatie ook lastig om te verkopen. Uit dit probleem is het leasen ontstaan. Je neemt namelijk de investering weg en je neemt een deel van het risico weg. Toen we de kennis hadden vergaard om dit te doen, gingen we naar de klant en in mijn ogen hebben we zo een no-brainer gecreëerd.

A: Is de klant aan het eind van het contract eigenaar of nemen jullie het terug?

B: Wij leveren een operationele lease, ofwel verhuur van verlichting. Wij zijn eigenaar van de verlichting en wij blijven dat. Na de looptijd van het contract kunnen er een paar dingen gebeuren. Je neemt de verlichting over (je koopt het). Dat is interessant als de verlichting een levensduur langer dan de contractduur heeft. Of we gaan het refurbishen en stellen een nieuw contract op. Of we halen het weg en we zorgen dat het op een bewuste duurzame manier wordt hergebruikt.

A: En jullie gebruiken dan partners om de lampen en de installatie te doen lijkt me?

B: Wij zijn uiteindelijk alleen maar de financiële partner. Wij werken met iedereen samen om de oplossing te bieden.

A: En ziet dat lichtadviesbureau nu dan ook dat het inderdaad beter gaat? Zij zagen dat er niet veel werd verkocht. Is dat nu beter?

B: Nou ze hadden vooral veel frustratie. De techniek was er, maar het overtuigen was gewoon bijna onmogelijk. Inmiddels heeft die oplossing zich bewezen.

A: Noemen jullie de operationele lease dan ook Lighting-as-a-Service?

B: Ja, dat doen we inderdaad. Er zijn veel verschillende termen, maar wij zien dit inderdaad als LaaS. Het uiteindelijke doel wat wij voor ogen zijn is dat men van bezit naar gebruik gaat. Wij willen duurzaam zijn. Circulaire economie is voor ons erg belangrijk en we willen graag veel materialen hergebruiken. Leasen past daarin erg goed.

A: En jullie doen dat puur in deze vorm? Jullie moeten eigenaar blijven van de installatie?

B: Ja, en dat heeft voor drie zware jaren gezorgd. Het duurt gewoon lang voordat de markt voor dit soort deals klaar is. Het vergt een andere manier van denken. In 95% van de gevallen zijn mensen echt nog huiverig tegenover dit soort modellen. In mijn ogen is LaaS ook wel echt iets waarbij de eigenaar altijd de leverancier is. Het simpelweg kopen met SLA is geen LaaS. LaaS is zeggen: "Ik wil 500 lux op dit bureau hebben, altijd. En daar betaal ik voor. Niet voor die lamp."

A: Zeg je dan dat 5% van de markt echt klaar voor deze ontwikkeling is?

B: Ja, misschien iets meer. Maar het gaat echt niet zo snel.

A: Wat vindt die andere 95% dan op dit moment de meest waardevolle dienst?

B: Dat zijn vooral de laagdrempelige diensten. De onderhoudscontracten en dergelijke. Bij ons wordt het pas interessant wanneer er totaal geen geld is om de lichtinstallatie aan te schaffen. Dan heb je namelijk een keuze: of je blijft veel geld uitgeven, of je investeert niets maar bespaard wel. Bij innovatieve bedrijven die aan veel criteria moeten voldoen begint dat nu langzaamaan door te sijpelen.

A: Nemen jullie de energie ook voor jullie rekening?

B: Ja, dat kan. In sommige gevallen doen we dat wel, in anderen niet. Wanneer we dat wel doen, dan leveren we een garantie op de besparing. Dat is niet echt de energierekening overnemen maar het komt wel op hetzelfde neer.

A: We hadden het net al even over de klanten van vandaag. Wat vinden zij op dit moment het belangrijkst in een lichtinstallatie?

B: Dat hangt van de klant af. In alle gevallen geldt wel dat de besparing heel belangrijk is (kosten drukken). Industrie vindt dan kwaliteit, veiligheid en intelligentie heel belangrijk. Kantoren, scholen en zorg verwachten een hele hoge kwaliteit. Arbeitsomstandigheden verbeteren, concentratie problemen oplossen, dag/nachtritmes beïnvloeden. Gemeentes en parkeergarages vinden dan weer alleen de besparing heel belangrijk.

A: Kijkend naar de manier waarop LaaS wordt georganiseerd. Jullie werken al veel met partners. Maar hoe betrekken jullie die partijen in jullie visie?

B: Wij zeggen altijd dat we niet boven of onder, maar naast de partner staan. We worden in 90% van de gevallen ingeschakeld door een andere partij (een installateur, een lichtleverancier etc.) en die is al binnen bij de klant. Wij zorgen dan alleen voor een financiële optie. Dan gaan we een partnership aan. En dat vergt vertrouwen en dat moet gedurende de tijd groeien.

A: Dus jullie dragen wel verantwoordelijkheid voor alles wat jullie in het contract zetten, maar het dagelijks beheer en het klantencontact ligt vaak nog bij een andere partij?

B: Dat verschilt. Meestal inderdaad niet, maar elk project is maatwerk.

A: En kijkend naar de reconfiguratie van de supply chain, zie jij dan nog duidelijk aspecten die nog beter moeten?

B: Ik zie niet echt problemen, maar ik denk wel dat veel dingen nog geautomatiseerd gaan worden. Bijvoorbeeld het melden van foutmeldingen vraagt nu nog een belletje, maar dit moet eigenlijk automatisch gaan.

A: Het beheer van zo'n lease, daar kan software dus veel in betekenen?

B: Cruciaal. Wij willen alle gegevens hebben. Wij willen alles weten over onze verlichting. Wij geven een prijs af op basis van branduren, gebruiksomstandigheden. Want die hebben invloed op de levensduur van de lamp. Dat soort gegevens willen wij real-time beschikbaar hebben om nacalculatie mee te doen.

A: Hoe kom je nu dan tot je verkoopprijs? Hoe wordt zo'n abonnement bepaald?

B: Je hebt allereerst te maken met aanschaf. Dan komt rente daaroverheen. Onderhoud is ook wel te bepalen. En dan heb je te maken met uitval. De lamp, de driver kan uitvallen. Ze hebben allemaal een andere levensduur. Dat is lastig te bepalen aangezien het aantal branduren waarschijnlijk zal verschillen met wat er vooraf is afgesproken. Daar zit de onzekere factor. Alle systemen die dit kunnen doen (risico voorspellen en beperken) zijn zeer waardevol. Op dit moment wordt dit namelijk nog maar slecht gedaan. Hoe beter onze informatie, hoe lager we onze prijs kunnen stellen, hoe eerder een klant het aantrekkelijk zal vinden.

A: Stel je kan dat berekenen, hoe waardevol zou dat dan voor jullie zijn op een schaal van 1 tot 10?

B: een 10

A: Houd je dan ook al rekening met hetgeen wat licht management doet?

B: Ja

A: En dat is een vast bedrag per maand?

B: Ja

A: En stel dat de klant krimpt of groeit? Wat gebeurd er dan met het abonnement?

B: Groei is niet lastig. Dat kan er zo bij op. Een klant die krimpt is een ander verhaal. Dan is hij wel verplicht om een oplossing van het contract te vinden. En zo werkt dat altijd.

A: Wat denk je wat nodig is om meer klanten over te laten stappen op LaaS?

B: Ik denk dat dat tijd is. Dat is wennen aan nieuwe financieringsmodellen en dat is een proces. En dat zie je in meerdere branches. Dat is voorlopig een natuurlijk proces. Met die groei komt meteen ook de vraag naar veel nieuwe technologie op het gebied van ICT die zorgt voor meer zekerheid.

A: Moet ICT nog een andere rol vervullen?

B: Ik denk dat betrouwbaarheid de belangrijkste is.

A: Wat denk je dat nog aan LaaS moet worden toegevoegd om het nog beter te maken. Naast de lage prijs en manier van investeren, zijn er nog andere dingen die het mooier gaan maken?

B: Nou, we zijn daar inderdaad wel over aan het nadenken en wij zijn nu ook bezig met het kijken naar manieren waarop we het systeem kunnen integreren in een compleet gebouw. Dat verschillende systemen met elkaar gaan praten en gaan samen werken om een gebouw te beheren. De regeltechnologie moet dan niet alleen gelden voor licht, maar ook voor de andere systemen.

A: Toch nog even naar het voorspellen van risico. Zou het waardevol zijn wanneer het mogelijk is om een flexibel abonnement aan te bieden. Die daadwerkelijk meet wat er gebruikt is en op basis daarvan aan het eind van de maand een bedrag gevraagd om zo de klant ook een incentive te geven om hun licht goed te gebruiken?

B: Dat doen we al. Wanneer er een hogere besparing wordt gehaald, wordt er inderdaad al gedeeld in de winst. Dat kunnen we ook wel aardig goed meten. Wel heel basis, maar het wordt gemeten.

A: Wijken de voorspellingen niet heel erg af van wat er gerealiseerd wordt?

B: Dat moet nog blijken. Daar hebben we nog niet veel data van. Wat wel belangrijk is en waar we tegen aan lopen in de openbare verlichting is dat gedurende de contractduur mensen graag willen dat hun systeem ook ge-update wordt. Veel mensen zijn bang dat ze zich nu 10 jaar vastleggen en dat er over een jaar iets beters is. We willen graag dat gedurende de contractduur op meerdere moment de lichtinstallatie ge-update kan worden.

A: En vervang je dat alleen als je met modulaire lampen werkt waar makkelijk dingen in en uit gehaald kunnen worden of kunnen er ook compleet nieuwe lampen in?

B: Modulair is daarin wel erg belangrijk. Daar selecteren we onze armaturen ook op.

A: Nu even wat breder dan LaaS, hoe ziet de toekomst er in de lichtindustrie er verder uit?

B: Dat moet de toekomst leren. Op hardware gebied zal er nog veel vernieuwd worden. Intelligentie zal ook steeds belangrijker worden. Je kan met verlichting namelijk veel meer dan alleen verlichten. Je kan navigeren etc.

A: En wat denk je dat lichtmanagement nog moet kunnen? Naast het betrouwbaar kunnen meten?

B: Ja, betrouwbaarheid is denk ik echt het belangrijkst. Ook het kunnen integreren met andere systemen is heel belangrijk.

A: Wat zullen klanten in de toekomst het belangrijkst vinden?

B: Nog steeds kwaliteit en energiebesparing. Klantcontact is vooral belangrijk voor de leverancier.

A: Toen we het over het flexibele abonnement hadden, toen hadden we het over het feit dat de klant door zelf goed op te letten, minder hoeft te betalen. Licht management kan hierin enorm helpen. Doen ze dit ook echt?

B: Vaak wordt gewerkt met licht dat reageert op beweging. Routing aanpassen zou kunnen helpen, maar dat vergt wel een stuk bewustwording. Daar moet je ze mee helpen. Het helpt wel om het ze inzichtelijk te maken. Als je ze bewust wil maken is dat heel belangrijk. Je bent namelijk aan het praten met de directie en de afdeling duurzaamheid die het heel belangrijk vinden, maar de rest van de werknemers interesseert het niet. Als je die mensen bewust wilt maken, dan moet je het ze inzichtelijk maken. Dat kan simpelweg door een monitor op te hangen.

A: Maar is dan puur het laten zien van wat er bespaard wordt genoeg om ze bewust te laten worden? Is dat genoeg om ze dusdanig te overtuigen dat ze ook beter gaan werken?

B: Ik denk dat het een hele belangrijke stap is.

A: En is er dan ook nog een hele slag te winnen in het intuïiever maken van de licht management applicatie zelf? Wordt die soms als lastig ervaren?

B: Nou waar ik het over heb zijn de werknemers die niet direct in contact staan met de applicatie. De meeste gebruiken de app namelijk niet, maar moeten wel bewust worden gemaakt om nog meer besparing door te voeren. De app wordt maar uitgelezen door een handjevol mensen. Die zijn vaak handig genoeg om de app te kunnen begrijpen. En ik denk dat dat wat je biedt aan gebruikers die niet de hele dag met verlichting bezig zijn die moet je heel simpel kunnen tonen wat er allemaal gebeurd met het licht.

A: Dus eigenlijk moet je ergens buiten de applicatie maken wat voor iedereen inzichtelijk is en wat makkelijk te begrijpen is voor iedereen?

B: Ja, dat klopt. Ik heb namelijk niet veel aan awareness bij een CFO. Als ik hem wil overtuigen moet hij er ook in geloven dat zijn medewerkers gaan opletten.

A: En als je dat kwantificeert. Hoeveel bedrijven ken jij waarvoor dit interessant?

B: Het speelt overall wel. Iedereen is bezig met awareness. En als ze er nog niet aan denken, dan brengen wij het wel op tafel. Daar begint het eigenlijk allemaal. Energiebesparing. Echter zijn we ook een keer te ver gegaan. Toen hebben we dat op tafel gebracht bij het ziekenhuis in Hoofddorp en zij werden daardoor bewust van het feit dat het geen zin had om dit te doen aangezien de medewerkers het niet

uitmaakte of het licht nu brandde of niet. Omdat ze nu eerst de medewerkers bewust willen maken, is het project uitgesteld. Tot 2017 is voor hen puur het doel om de medewerkers bewust te maken.

A: Ooh, dat is erg interessant. Maar ik hoor ook verhalen waarbij het, bijvoorbeeld in The Edge in Amsterdam, wel gebeurd (bewustwording), maar dat niemand het echt doet.

B: Dat klopt. Ik zat daar laatst en één iemand van het helemaal super en één iemand vond het allemaal maar ingewikkeld en deed er niet aan mee. Wat dus betekent dat ook daar de missie nog niet geslaagd is. Bewustwording moet parallel lopen met uitvoering. Door feedback te verzamelen kan de bewustwording beter worden gemaakt. Of je moet alle belemmeringen helemaal weghalen en ervoor zorgen dat het helemaal niet nodig is om je werknemers bewust te maken. Dan moeten ze alleen maar wennen aan LED verlichting. Dat vraagt ook zeker wennen.

A: Dus stel je regelt het zo in dat de lampen op basis van machine learning o.i.d. na het ophangen continu kijken of ze beter kunnen worden ingeregeerd, dan heb je de beslommeringen weggehaald en is bewustwording een minder belangrijk issue?

B: Ja dat klopt. Daar waar de medewerker er invloed op heeft, daar is bewustwording voor nodig.

A: Scheelt dat nog veel dan? Wanneer je er bijvoorbeeld met z'n allen op let dat je niet onnodig kamers binnen loopt, zal je dan nog veel besparen?

B: Ja, dat is best veel nog. In bepaalde omstandigheden zeker.

A: Ter conclusie, zie jij in de markt nog dingen waar software heel belangrijk voor zou kunnen zijn?

B: Nou ik denk wel dat we de koe bij de hoorns hebben gevat. Software is vooral belangrijk voor de achterkant, voor ons. Alles wat wij kunnen uitlezen, sturen en monitoren, dat is van belang en dat wordt steeds belangrijker. Systemen moeten vereenvoudigd worden. En voor eind gebruikers moet het simpel blijven. Simplicity is key.

A: Dus het kunnen voorspellen en regelen van licht gebruik is in het LaaS concept misschien nog wel belangrijk dan dat het is in het huidige business model?

B: Ja, absoluut.

A: Hoe kan Nedap een nog betere partner worden?

B: Nedap is al een goede partner voor ons. Zij zijn voor ons de weg naar de klant en ze blijven innoveren in hun systeem en dat is belangrijk voor ons. Blijven innoveren is dus de key.

A: Dan dank ik je voor je tijd en openheid!

B: Graag gedaan, en veel succes met je onderzoek!

E.4 Interview with Person D

Company (location):

Company D (The Netherlands)

Position:

Owner and Managing Director

<i>Relationship with LaaS (company):</i>	Does research into the subject (doesn't provide it)
<i>Relationship with LaaS (personal):</i>	Actively discusses new innovations with customers
<i>Level of LaaS knowledge:</i>	2
<i>Date of interview:</i>	13-05-2016
<i>Location of interview:</i>	SciSports Office in Enschede
<i>Medium used (duration):</i>	Face-to-Face (60 minutes)

Partij A: Antonie Berkel
 Partij B: Person D

A: Wat doet Company D en wie ben jij?

B: Nou wij zijn een vrij jonge club. Wij zijn ontstaan in begin 2009. Ik kom uit de buitenverlichting & openbare verlichting. Was toen accountmanager bij een fabrikant. Ik kwam daar vaak architectonische verlichting tegen. Hoe ga je om met de openbare ruimte en hoe beschouw je dat als een soort toneel? Dus toen liep ik al snel tegen het verhaal aan dat je dan moet adviseren en in mijn rol kon dat niet. Toen ben ik dus begonnen met licht adviezen verkopen. Puur voor de openbare ruimte buiten. Wat je vaak ziet is dat de binnenverlichting vaak verder is dan de buitenverlichting. Management systemen hebben bijvoorbeeld pas de laatste tijd hun weg gevonden naar de buitenverlichting. Nu de gemeenten steeds meer bezig zijn met energiebesparing en CO2 uitstoot, vragen ze zich steeds vaker af wanneer ze echt licht nodig hebben en wie nou de gebruikers zijn in het gebied. Daarom was ik ook benieuwd naar jouw verhaal over Luxon, aangezien Luxon, zo te horen, in ieder geval het systeem goed kan managen. Dus ik was benieuwd of we misschien wat voor elkaar kunnen betekenen. De markt is gewoon enorm en beweging en misschien gaan we wel naar Lighting-as-a-Service. Gemeenten zeggen, we hebben zoveel fabrikanten met het ene product nog mooier dan het andere, maar wat willen we nu. Een mooi beeld door een straat bijvoorbeeld. Kunnen we daar niet wat met die sfeerverlichting gaan doen. Kunnen we bijvoorbeeld emoties vertalen naar licht. Ook een nieuwe ontwikkeling. En circulaire economie wordt ook steeds crucieler. Wie heeft ooit bepaald dat een lichtmast maar een aantal jaren mee gaat? Die kan veel langer mee. Kleine updates zullen het al een langere levensduur kunnen geven.

A: Dus het is begonnen met een lichtadvies over de manier waarop licht mooi kan zijn en het verschuift nu ook deels naar het advies geven over hoe iets groen en duurzaam kan zijn?

B: Ja.

A: Praat je dan met overheidsinstanties en fabrikanten? Bij de fabrikanten in dat geval informatie winnen en dat aan de overheid verkopen?

B: Dat klopt. Ja, we zien dat fabrikanten van alles bieden en dat ze allemaal zeggen het beste aan te bieden, maar iedereen biedt gewoon LED aan. Het is eigenlijk allemaal hetzelfde.

A: Oke en hoe onderscheid je je dan?

B: Ja dat is modulariteit, dat is management dat is licht ook op andere manier gebruiken (bijvoorbeeld je licht mast als antenne gebruiken), dat is je licht kunnen aanpassen aan de behoeften van je verschillende gebruikers (wanneer een oud vrouwtje veel licht op straat nodig heeft dan kan dat, maar wanneer iemand anders er is, dan wordt dat licht weer gedimd) en dat laatste vind ik heel interessant. Dat is echt toekomst.

A: En bedrijven zijn daar ook echt mee bezig?

B: Al die dingen: circulaire economie, management systemen, sensor technieken (maar gebruiken als antenne) wordt ontwikkelt, maar het is soms nog lastig om dit echt goed in te zetten. Het is nog een “kleine” groep mensen die hier mee bezig is en het vergt samenwerking van veel partijen om dit voor elkaar te krijgen.

A: Dus jullie zijn eigenlijk de schakel tussen de overheid en de fabrikanten. Adviseren jullie alleen of doen jullie ook het aansturen van die projecten?

B: Soms inderdaad beide. Overheden zien door de bomen het bos niet meer. Niet alleen door het aanbod, maar vooral ook door wetgeving en wij kunnen hen daar bij helpen. Soms ook inderdaad door ook te controleren of alles ook in de uitvoering goed verloopt.

A: Hoe reageren die overheden op de veranderingen in de licht industrie?

B: Ze hebben veel vragen daarover, maar ook veel vragen over de markt. En die hebben wij ook. Hoe ziet het er precies uit en hoe werkt het nu? Bijvoorbeeld circulaire economie. Hoe organiser ik dat? Als ik een luminaire modulair opbouw, werkt dat dan? Ik denk dat het wel de toekomst is en dat licht als dienst wel erg belangrijk gaat worden. En wat dan ook nog lastig is, is er achter komen hoeveel componenten kapot gaan en hoeveel technische mensen je weer nodig hebt om dat op te lossen.

A: Zoeken jullie dan ook partijen die dit kunnen en werken jullie dan ook het liefst met dat soort bedrijven samen (die licht als dienst verkopen)? Of hoor je het vooral veel, maar zie je het nog niet?

B: Dat laatste. Wij hebben nog nooit samengewerkt met bedrijven die het aanbieden. Bij één kleine gemeente zijn we er wel mee bezig. Die vragen om een bepaalde hoeveelheid licht voor een bepaalde periode. Dus we zijn er wel mee aan het spelen, maar een echte samenwerking is nog niet tot stand gekomen.

A: En op jullie website zag ik dat jullie ook een innovatieplatform hebben waarin jullie het over circulaire economie hebben. Hoe ziet dat eruit?

B: Het is eigenlijk door mij een keer bedacht in een commerciële bui. Ik had problemen met onze naam. Eerst heette we namelijk JOB en ik was eerst 7 minuten bezig met het uitleggen van onze naam. Company D klonk echter veel beter en in de toekomst is ons plan om inderdaad zo'n platform te creëren. Echter zijn we nu met een klein clubje en kunnen we onze krachten beter ergens anders voor gebruiken. Op dit moment stelt het dus niet veel voor maar in de toekomst willen we wel met partijen gaan zitten om het hier over te hebben. Voor ons is het een stip aan de horizon.

A: En als we die analogie aanhouden. De stip aan de horizon. Als die stip nou het Lighting-as-a-Service concept is, komt die steeds dichterbij of is die nog lang niet te zien?

B: Die komt zeker dichterbij. Absoluut.

A: Waar ik nu naar op zoek ben in mijn onderzoek, zijn thema's die belangrijker zijn in het LaaS concept

dan in de originele markt. Wat zal in het LaaS concept heel waardevol zijn voor bedrijven die het aanbieden (welke thema's)? Wat is nodig om het LaaS concept meer waardevol te maken?

B: Dat is denk ik een combinatie van technologieën. Voor buiten is het belangrijk dat de gebruikers moeten kunnen worden geïdentificeerd en dat op basis daarvan het lichtniveau en dergelijke kan worden aangepast. Dat door middel van een app gebruikers aan kunnen geven wie ze zijn en wat ze fijn vinden en dat ze op basis daarvan licht krijgen. Dat het licht inspeelt op hun emotie.

A: Maar dan hebben we het meer over licht met diensten en niet licht als dienst toch? Wat is in jouw ogen precies licht als dienst?

B: Ten eerste zichtbaarheid en dat het altijd aanwezig is wanneer ik wil. Ooit heeft de overheid bedacht dat ze 3,1 miljoen lichtmasten in Nederland gingen plaatsen om voldoende licht overal te genereren. Maar lang niet iedereen is daar blij mee. Sommige mensen willen ook donkerte hebben. Die houden daarvan. Nou, wanneer je dus licht als een dienst kan leveren zou je dus kunnen zeggen dat overal wanneer jij licht nodig denkt te hebben is er licht en anders niet.

A: In de literatuur wordt het anders beschreven. Het hele product-as-a-service is een concept wat meerdere malen daar wordt genoemd. Ik denk dat jij het vooral hebt over licht met dienst en niet over licht als dienst. Lighting-as-a-Service in mijn ogen is het verkopen van licht op een compleet andere manier. Je verkoopt geen lamp, maar licht. Waarin jij betaalt voor het licht wat je krijgt. Jij bent geen eigenaar van de installatie, hoeft je geen zorgen te maken over onderhoud of vervanging, jij betaalt een maandelijks abonnement voor licht. In zulke onderhandelingen ga jij aan tafel zitten en zeg je simpelweg, ik wil 300 Lux op dit bureau, 7 dagen per week. Hoe jij dat voor elkaar krijgt, maakt niet uit. Als jij het maar voor elkaar krijgt en daar betaal ik jou voor. Je hebt dus geen enkel risico meer en je wordt volledig ontzorgd. Daar komt circulaire economie weer bij kijken, want de eigenaren van de installatie (de fabrikant) gaan nu kritisch naar de producten kijken en zorgt dat er zo min mogelijk uitval is. Dit wordt geleverd naast de diensten waar we het net over hadden. Daar zit een duidelijke scheiding tussen. Licht als dienst en licht met dienst.

B: Maar waar ik dan een beetje tegenaan loopt. Ik heb ooit ook met de jongens van Philips hierover gesproken en waar ik dan tegenaan loop is de manier waarop er dan nog met innovatie wordt omgegaan. Wanneer beslis je dat iets dusdanig rendabel is, dat je die hele installatie gaat vervangen. Hoelang moeten die contracten ook duren? En wie is dan verantwoordelijk voor wanneer bijvoorbeeld de stroom is uitgevallen? Niemand gaat zeggen dat zij daar schuld in hebben. Voor binnen is het makkelijker om zo iets af te kaderen.

A: Maar Philips is zelf ook bezig met City-as-a-Service. Alle lampen in een stad in eigendom van het bedrijf. Hoe moeten zij daarmee omgaan doen? Moeten zij alle bedrijven die bijvoorbeeld verantwoordelijk zijn voor de stroom ook betrekken in het hele concept? Dat zij verantwoordelijk zijn voor het kunnen leveren van stroom.

B: Maar waarom zou het je dan nog zo doen?

A: Het uiteindelijke doel is de klant ontzorgen.

B: Maar kunnen zij nu al niet volledig ontzorgd worden. Dat een bedrijf alles voor ze regelt maar dat ze nog wel eigenaar zijn van het licht.

A: Nou, er zit natuurlijk ook een financiële kant aan het verhaal. Bedrijven verkopen het namelijk in abonnementsvorm en dat betekent dat je eigenlijk vanaf het moment dat je het contract aangaat, een positieve cashflow hebt (besparingen zijn hoger dan maandelijks abonnement). In de andere vorm moet je eerst enorm veel investeren en heb je eerst een enorme negatieve cashflow.

B: En hoe zit dat dan verzekeringstechnisch? Wanneer er geen licht is, het licht valt uit. En ik ga op m'n plaat. Wie is dan verantwoordelijk? Er zijn gemeenten waarin men schadevergoeding heeft gekregen voor een ongeluk dat is ontstaan door het uitvallen van het licht. Je neemt namelijk dan iets weg, wat er normaal gesproken wel is. Omhoog liggende stoeptegels zijn ook zo'n geval. Ik kan me voorstellen dat zo'n LaaS provider dat risico niet wilt lopen.

A: Hoe zijn die regels nu dan precies?

B: In principe is, bijvoorbeeld, een bestuurder, verantwoordelijk voor zijn eigen acties. Maar als je het als gemeente niet goed op papier hebt, dan hang je. Maar ik snap niet wat precies dan de meerwaarde is van zo'n LaaS concept.

A: Het zijn meerdere dingen. Het eerste is de financiering. LED zorgt al voor een enorme besparing van soms wel 70%. Met licht management wordt die besparing alleen maar hoger, maar soms zijn klanten nog huiverig voor investering. LaaS biedt dan een uitkomst met haar positieve cash flow vanaf dag één. Het tweede is dat klanten volledig worden ontzorgd. Het derde is dat klanten geen risico meer hebben.

B: Hmm, oke. Toch ben ik niet helemaal overtuigd van zo'n lang contract. Daar komt dan de emotionele kant van de mens bij kijken en die is dan huiverig naar de toekomst. Men weet namelijk niet waar hij dan voor betaald en kan dan nog wel eens bedrogen uitvallen.

A: Veel bedrijven werken wel met open calculaties, dus als het goed is weet de afnemer precies waar hij voor betaalt en als hij dan teveel betaalt achteraf dan is hij daar zelf bij geweest. Dat is net als bij het kopen van een normale installatie. Daar kun je ook later erachter komen dat je toch een betere deal had kunnen krijgen.

B: Maar is het dan niet in de basis alleen maar een financiële constructie?

A: Ja, het is financieel, maar ook ontzorging en risico verplaatsing.

B: Oke, maar kan ik dat zelf niet regelen? Dat ik een installateur regel die er een paar Japanse lampjes in zet en dan klaar is.

A: Dat kan, maar dan heb jij wel alle risico. Jij weet dan dat wanneer ze kapot gaan, dat jij moet betalen. Het zal in eerste instantie zeer waardevol zijn voor bedrijven met meerdere gebouwen en bedrijven die zich alleen willen focussen op core business. Die zich met niks anders willen bezig houden dan hun core business.

B: Ja dat klopt. Ik zie wel dat mensen niet in de gaten hebben hoeveel tijd zij onbewust in een probleem steken. Vooral voor verlichting. Als daar een probleem is, ben je stiekem best veel tijd kwijt om het op te lossen.

A: Heb ik nu wat van je twijfels weg kunnen halen? Geloof je er nu in of ben je nog steeds sceptisch? En zo ja, wat moet er nog gebeuren om het in jouw ogen wel te laten werken?

B: Voor de binnenverlichting zou het wel kunnen werken. Maar voor de buitenverlichting moet er nog wel veel gebeuren denk ik. Er zijn gewoon meer variabelen die allemaal moeten meewerken en een deel van het risico en de verantwoordelijkheid op zich willen nemen (denk aan bouwbedrijven die aan het netwerk werken, de energiemaatschappijen zelf). Daarnaast is het politieke spel wat gespeeld wordt een enorme variabele bij de gemeente. En dan hebben we het niet over wetgeving, maar over lokale politiek. Ze leveren elkaar allemaal gunsten en het is geven en nemen. En als een wethouder meer heeft gegeven dan de ander, kan het zomaar zijn dat hij een perfect plan gaat tegenhouden om een ander dwars te liggen (en dus zelf maar een keer neemt).

A: Oke! En als we het hebben over dingen waar we wel invloed over hebben. De verlichting. Wat vinden de gemeentes het meest belangrijk aan hun lichtinstallatie?

B: Belangrijkste is dat het het doet. Dat het brandt.

A: En denk je dan dat in het hele LaaS concept dit beter gaat.

B: Ja, dat moet wel.

A: Wat zijn naast LaaS de grootste ontwikkelingen voor de toekomst?

B: Ik denk dat het licht ook andere functies gaat krijgen dan alleen licht geven. Lichtmasten worden antennes waar je bijvoorbeeld je auto kan opladen. Daarnaast denk ik dat het licht zelf beter gaat worden. Meer emotie, meer persoonlijkheid. LaaS is lastiger toe te passen denk ik. Ik denk eigenlijk dat het niet gaat gebeuren. Als mens willen we niet graag dat één iemand alles controleert. Men wil het macht niet verliezen over de verlichting. Daarnaast denk ik dat software belangrijk is om het licht persoonlijker te maken en emotie mee te geven. Dat hij op basis van mijn gemoedstoestand het licht aanpast en zelfs bijvoorbeeld dingen op de muur kan projecteren.

A: Heb jij verder nog opmerkingen? Dingen die we nog niet hebben besproken?

B: Nee volgens mij hebben we alles wel besproken.

A: Dan wil ik je graag bedanken voor je tijd en openheid.

B: Graag gedaan en veel succes met je onderzoek.

A: Dankjewel!

E.5 Interview with Person E

Company (location):
Position:
Relationship with LaaS (company):
Relationship with LaaS (personal):
Level of LaaS knowledge:
Date of interview:

Company E (The Netherlands)
Owner and Managing Director
Core business
Creates partnerships and sells the LaaS concept
5
20-05-2016

Location of interview: Company E office
Medium used (duration): Face-to-face (45 minutes)

Partij A: Antonie Berkel
Partij B: Person E

A: Wat is Company E?

B: Ik ben al heel lang ondernemer. Ik ben meerdere malen een start-up begonnen en deze uitgebouwd totdat ik deze weer kon verkopen. Bij al deze start-ups begon het met een idee en dat idee is uitgewerkt tot een product of dienst. Zo ook met Company E. Company E is ontstaan vanuit het idee dat mensen wel graag wilde besparen en nieuwe verlichting wilden, maar het eigenlijk niet konden betalen (dit kwam vooral door de crisis). We hadden met een aantal jongens die verstand hadden van LED een nieuwe armaturen serie ontwikkelt die geschikt was voor de 24-uurs markt. Daar is de besparing namelijk het grootst en konden we echt het verschil maken. Echter kregen we het niet verkocht. Vooral wanneer er niet echt de noodzaak was of wanneer mensen met budgetten werkten (en een nieuwe lichtinstallatie pas over 5 jaar in het budget zat). Ook waren mensen bang voor nieuwe technologie. Degene die de beslissing maakte was bang voor z'n baantje, de financiële man vond het veel geld terwijl de commerciële man het heel graag wilde omdat een groen bedrijf beter verkoopt. Terwijl het eigenlijk slimmer is om wel te doen aangezien je dan een aantal jaren langer bespaard, kregen we het niet verkocht. Vervolgens is een nieuw business model ontwikkelt die dit probleem zou oplossen. Wij noemen dat het delen in de besparing concept, maar in de basis lijkt het erg op Lighting-as-a-Service. Het verschil zit hem in dat je bij operationele lease of financing veel te maken hebt met zware wetgeving.

A: Wat zegt die wetgeving dan?

B: Het is niet toegestaan om iets dat met spijker en nagel vastzit in een gebouw te financieren. Dit omdat het bij een calamiteit onmogelijk is om weg te halen. Bij auto's en machines is dat makkelijk.

Wij hebben toen dus gekozen voor deze constructie. Vervolgens zijn we gaan zoeken naar financiers die dit ook interessant leek. Het is namelijk een kapitaal intensief verhaal en je hebt dus financiers nodig. Tenzij je zelf genoeg geld hebt. In ons geval zijn dat geen banken, maar andere partijen. Wanneer de klant solvabel genoeg is bevonden door ons, kunnen ze dan in deze constructie licht ontvangen, zonder investering.

En om dit goed te kunnen verkopen heb je allereerst heel veel bewustwording nodig. Bewustwording van het feit dat dit werkt en dat het de beste oplossing is. Veel mensen denken dat het te mooi is om waar te zijn en het was in de eerste paar jaren vooral de zaak om dat goed in hun hoofden te krijgen. Om dat te kunnen doen heb je simpelweg veel referenties nodig. Zowel over je product als over je concept. Daarnaast moet je een hele service omgeving creëren waarmee je de klant volledig kunt ontzorgen. Van lichtplannen tot product keuze, maar ook bij hulp met de installateur en financiering. Bij de productkeuze is het belangrijk dat je modulair bent. Dat alle componenten individueel kunnen worden vervangen en verbeterd.

Company E is dit nu een paar jaar aan het doen en nu met succes. Door veel met de ondernemingen te praten kom je met de juiste mensen aan tafel en kun je de juiste mensen samen brengen (commercieel, financieel en technisch) om ervoor te zorgen dat ze bewust worden.

Op dit moment zijn we op zoek naar partnerships met grote bedrijven die zelf niet de flexibiliteit hadden om dit tot volwassendom te krijgen en die dit wel graag willen toepassen. Wij leren hen dan dit concept en krijgen de licentie om dit toe te passen. Die licentie bestaat dan uit: de armaturen die wij hebben ontwikkeld, onze energiebesparingscalculator software, onze kennis en expertise, en het delen uit de besparing concept.

A: Hoe werkt die energiebesparingscalculator?

B: Wij stellen in het begin van ons traject 5 vragen aan de klant. Wil je 65% besparen? Zonder investering? Zonder risico? Met een doorlopende garantie? En ook nog jaarlijks meer geld verdienen? Bijna iedereen vindt dat interessant. Dan zeggen wij: "Dat is mooi, dan gaan we u nu verder helpen". Dan beginnen we met de 5 stappen. Eerste maken we een inventarisatie (hoeveel lampen, hoeveel uren en welke soort). Die inventarisatie wordt gestopt in een energiebesparingscalculator en die berekent met 16 parameters welke besparingen te halen vallen (gebaseerd op wat gemiddelde Europese bedrijven zien als belangrijk wanneer ze een investering doen). Het mooie daaraan is, is dat dit soort onderwerpen vaak niet interessant zijn voor ondernemers. Of ze hebben er het geld (nog) niet voor over of ze vinden het niet interessant. Totdat er wordt gesproken over besparing en dan vinden mensen het wel interessant. Nou, zo'n calculator laat dat heel duidelijk zien. Die calculator hoeft niet per se Company E te heten, maar kan op elke onderneming worden geplakt. De derde stap is het kiezen van de producten. Ten vierde kijken we naar de solvabiliteit van de klant en ten slotte wordt het plan daadwerkelijk uitgevoerd (inclusief garanties en service levels (dat ligt aan de omgeving waarin ze hangen, want dat heeft daar een zeer groot effect op)). Dat hele concept heeft veel tijd nodig om fijn te slijpen en goed te ontwikkelen. Dan pas heb je een goed concept. En dan zie je dat je nog heel veel kan winnen. 10% van de markt is tot nu toe nog maar overgestapt op LED. Veel mensen gaan dus nu die overstap nog maken. En wat je daarnaast ziet is dat grote energiebedrijven en lampenproducenten op zoek zijn naar concepten (niet producten) die ze kunnen gebruiken om hun producten te verkopen.

A: Wat is het meest waardevol voor de klant in een Lighting-as-a-Service model?

B: Dat is het niet hoeven investeren en dus meer geld hebben voor andere dingen.

A: En ontzorging?

B: Dat is soms lastig, omdat je soms te maken hebt met een technisch iemand die jarenlang degene is geweest met de know-how van alles wat er in het gebouw gebeurde. Als je hem vertelt dat je hem volledig gaat ontzorgen is hij niet blij, want hij verliest een deel van zijn taken. Je gooit dan zijn waarde eigenlijk weg en daar moet je voor oppassen. Het is echter wel degelijk een grote drijfveer voor sommige klanten. Daarnaast is het niet hebben van de risico's ook erg belangrijk.

A: En hoe kunnen we ook zo'n technisch iemand in het concept te betrekken?

B: Ja eigenlijk precies wat je al zegt. Je moet hem betrekken in het zoeken naar een oplossing. Het vergt strategie en tact om dat goed te kunnen doen. De onderneming moet natuurlijk niet helemaal op z'n kop worden gegooid. Daarnaast moet je ook nog oppassen met hoe je het brengt, sommige ondernemingen vinden het soms beledigend als je binnenkomt wandelen met het verhaal dat ze ergens niet in hoeven te investeren omdat ze dan denken dat jij denkt dat ze geen geld hebben. Bedrijven willen graag als rijk worden gezien.

A: Wat is ervoor nodig om Lighting-as-a-Service nog groter te maken?

B: Wederom is dat het niet investeren (geld wordt alleen maar belangrijker), maar ook de tijd. Die geeft mensen de mogelijkheid om meer een meer te wennen aan het idee en in te zien dat het daadwerkelijk alleen maar voordelen heeft. Ten slotte gaat men steeds meer zien hoe het werkt. Door het bij klanten te implementeren zien andere klanten dat het werkt. Het is ook heel belangrijk om je verhaal goed te vertellen en dat zal ook door de jaren heen beter gaan. En omdat wij zo vroeg zijn begonnen merk je dat dat bij ons al wel aardig goed gaat. We zijn door een aantal grote bedrijven al benaderd die ons vroegen hoe we het voor elkaar kregen om met een kleine club toch de markt een beetje op de kop te zitten. Dan ben je blijkbaar toch nog best disruptive en dat is een lekker gevoel. Mond tot mond reclame is daarom ook een heel goed medium om dit concept groter te maken.

A: Waarom doet iedereen het niet?

B: Wij hebben best veel concurrenten gekend, maar de meeste van deze zijn geen concurrent meer. Zij zijn er niet meer. En hoe komt dat? Het valt of staat met referenties (wij hebben er zo'n 200 a 300). Wanneer men over contracting of leasing of operational lease spreekt vraag ik altijd hoeveel referenties ze hebben. En dan wordt het meestal angstvallig stil. Die hebben ze niet zoveel.

A: Oke. En nog heel even terug naar de energiebesparingscalculator. In ons telefoongesprek dacht ik te horen dat er geen rekening wordt gehouden met slim dimmen (light management). Is dat waar?

B: Nee, in onze software kun je ook die optie inschakelen. Dan wordt een verwachte besparing inclusief de verwachte besparing van licht management gegeven. Dat hebben we kunnen doen door het bij enorm veel klanten te testen (120 klanten, waaronder QPark). In die software zijn vaak de belangrijkste parameters de initiële aanschaf, de vervanging van componenten met een bepaalde levensduur en onderhoud.

A: Dus jullie kunnen met jullie software zowel de besparing die LED genereert als de besparing die licht management genereert van tevoren bepalen zodat de klant weet wat hij in totaal gaat besparen?

B: Ja, dat klopt.

A: Hebben jullie daar data van waaruit blijkt dat het klopt?

B: Ja, gelukkig wel. Anders hadden we nooit de goede garanties en SLA's kunnen opstellen. Meestal rekenen we aardig conservatief, waardoor de klant na het in gebruik nemen van de installatie nog aangenaam verrast is wanneer het nog meer bespaard.

A: Is dat veel meer?

B: Ja, dat is soms wel 20%.

A: Is dat dan soms niet veel? Dan kun je toch eigenlijk als je het beter berekent je maandelijkse abonnementsprijs naar beneden halen toch?

B: Ja, calculators kunnen altijd beter, maar dit model voldoet. Te complexe excel sheets kunnen nog wel eens de klant overrompelen. Echter, zal het voor ons abonnement niet veel uitmaken omdat het

maandelijkse bedrag dat betaalt wordt aan ons, de helft is van de besparing die zij realiseren. Het is niet een op voorhand afgesproken bedrag.

Je ziet gewoon dat die hele markt veranderd. Door de lange levensduur van al die lampen is het zo dat ze maar één keer in de 30 jaar hoeven te worden vervangen. Als je daar je geld uit moet halen dan ben je snel failliet. Veel grote lampenproducten (Philips, GE en Osram) doen steeds maar afstand van het fabriceren van lampen en focussen meer op andere manieren om geld te verdienen. De Lighting-as-a-Service modellen zullen daarom veel belangrijker worden, omdat ze zorgen voor recurring revenues bij de leveranciers. Dat zorgt ook voor andere spelers die de lichtmarkt gaan bedienen.

A: Hoe monitoren jullie de gerealiseerde besparingen bij al jullie klanten? Hoe zorgen jullie ervoor dat jullie ook daadwerkelijk ontzorgen en de risico's verplaatsen en de besparingen halen?

B: Op dit moment doet dat klant dat zelf. Maar dat zou ook heel goed kunnen met jullie systeem (Luxon).

A: Dus een verzameling van al je klanten in één overview zou een waardevolle toevoeging zijn?

B: Ja, absoluut. Absoluut.

A: En als er iets kapot is, hoe regelen jullie dan dat er wat nieuws komt? Moeten ze zelf bellen?

B: We leveren altijd een extra setje bij de installatie. Daarnaast hebben we een uitvalspercentage van maar 0.25 promille en lager. Dat is bijna niks. Dat heeft veel te maken met thermomanagement en een goede driver. Wanneer ze dus toch uitvallen heeft de klant nog altijd een setje liggen die ze kunnen gebruiken.

A: Dan denk ik dat ik al mijn vragen heb beantwoord en ik wil je bedanken voor je tijd en openheid!

B: Graag gedaan en heel veel succes met de afronding van je onderzoek!

E.6 Interview with Person F and Person G

Company (location):	Company F (The Netherlands)
Position:	Owner and Managing Director
Relationship with LaaS (company):	Core business
Relationship with LaaS (personal):	Creates partnerships and sells the LaaS concept
Level of LaaS knowledge:	5
Date of interview:	23-05-2016
Location of interview:	Company F office in Amsterdam
Medium used (duration):	Face-to-face (75 minutes)

Partij A:	Antonie Berkel
Partij B:	Person F
Partij C:	Person G

Kleine introductie: Company F is al voorafgaande aan dit gesprek op het kantoor van Nedap geweest. Nadat ik contact met ze had opgenomen, heeft Nedap een partnership met Company F afgesloten. Er

is dus voorafgaand aan dit interview al het een en ander besproken. Echter zal dat ook in dit interview weer de revue passeren.

Introductie/binnenkomstgesprek

A: Wat doet Company F en hoe bieden jullie LaaS aan?

B: Wij zijn, vinden wij, de enige partij in Nederland die echt Lighting-as-a-Service aanbieden. Omdat wij echt eigenaar blijven van de lichtinstallatie. Dat is anders dan bij een Philips die daar weer een lease maatschappij tussen zetten. Dat is eigenlijk dan meer een hele uitgebreide vorm van een SLA, maar dingen als circulariteit zitten daar naar mijn mening minder in. Wij zijn de partij in Nederland die dit ook volledig aanbiedt. Nou, naast die volledig operationele lease (want dat is het eigenlijk), bieden wij ook een financiële lease (kopen op afbetaling) en een gewone koop. Dat zijn de drie pakketten die wij leveren en daarin is Lighting-as-a-Service die meest servitized vorm van licht verkoop. We bedienen de 24-uurs markt, groot gebruikers van licht met grote oppervlakte. Dat is in de industrie veelal. We werken veel met sensors. Alles is DALI. Alles is meetbaar en bestuurbaar. Company F is begonnen met het idee om licht te leasen. Er waren toenertijd (6 jaar geleden) grote twijfels over de betrouwbaarheid van LED. In een koop of afbetaling konden we dan LED verkopen en dan geef je eigenlijk een garantie. Als het niet doet wat het moet doen, dan betaal je niet.

A: Met dan aan het eind van het contract de overdracht van het eigendom naar de klant?

C: Formeel is dat al aan het begin van het contract.

B: Op die manier konden we een garantie leveren voor onze lampen. Dat was het idee in het begin en later is dat naar een hoger plan getild door het in z'n geheel als dienst aan te bieden. Toen is de Lighting-as-a-Service ontwikkelt.

A: En hoe is dat idee tot stand gekomen?

C: Het is eigenlijk een soort van logische consequentie. Als je een financiële lease hebt, dan is de volgende "logische" stap het aanbieden van het gehele product als een dienst, waarbij het eigendom bij de leverancier blijft en de klant echt alleen maar betaalt voor wat hij gebruikt. Mensen willen alleen het licht hebben en willen het liefst aan het eind van het contract de lampen gewoon terug kunnen doen zonder kosten. De logische consequentie is dan, mensen willen licht en wij verkopen hen dat. Dat is één ontwikkeling. Een andere trend is die van outsourcing. Mensen willen zo veel mogelijk bezig zijn met wat ze leuk of belangrijk vinden of waar ze goed in zijn. Alle rompslomp eromheen zijn ze niet in geïnteresseerd. Daar past het licht als dienst concept natuurlijk ook heel goed aangezien het de klant volledig ontzorgd.

A: Samenvattend gaat het dus om het niet willen zijn van een eigenaar en het niet willen hebben van de sores.

B: Dat klopt.

A: En de koopoptie, hoe ziet die eruit?

C: Die is eigenlijk een beetje uit nood geboren. We zien nog vaak dat mensen ons een goede partij vinden en onze producten mooi vinden, maar dat ze toch nog graag willen kopen. En het blijft voor ons dan nog een interessant omdat we gewoon geld verdienen. Dan komt er gewoon een simpele garantie bij.

A: Wanneer jullie een licht als dienst contract verkopen, dan stellen jullie een maandelijkse prijs vast. Is die prijs gedurende het hele contract hetzelfde.

B: Ja.

A: Hoe komen jullie tot die prijs?

C: We beginnen met de marge die we willen maken over, laten we zeggen, 10 jaar. Dan gebruiken we de kosten van de producten, de kosten van de installatie, de kosten van het onderhoud, in sommige gevallen nemen we de energierekening over (theoretisch dan, letterlijk overnemen is heel lastig) en dat verspreiden we dan over de contractduur. Bij het abonnement spreken we een minimaal bedrag af. Dit moet de klant elke maand sowieso betalen. Wanneer hij meer bespaard dan betaalt hij minder, maar nooit minder dan het minimum. Wanneer hij heel weinig bespaard betaalt hij meer, maar nooit hoger dan een maximum.

A: Maar dan heb je het dus over een pay-per-use model en die is wel flexibel.

C: Dat klopt. Feit is alleen dat we nog niet letterlijk zover zijn. Om dat te doen moeten we zelf energie gaan inkopen. Dit kan alleen wanneer we genoeg klanten hebben zodat het voor ons voordelig gaat worden. Vervolgens kan zo'n klant gewoon twee energieleveranciers hebben en beide gebruiken om stroom te krijgen. Zo kun je dus echt het pay-per-use model implementeren. Technologisch zijn we alleen nog niet zover.

Met de prijsstelling is het gewoon belangrijk dat je wel wat garanties van de klant krijgt over bijvoorbeeld het aantal branduren. Anders is het heel lastig om tot een goede prijs te komen.

A: Maar ook in de huidige vorm waarin gewerkt wordt met een minimum is het dan een variabel bedrag toch? De installatie, kosten van de hardware en onderhoud staan redelijk vast en zorgen voor een minimum. Maar vervolgens komt het gebruik van de lampen erbij op als variabele binnen een bepaalde onder- en bovengrens.

B: Ja, daar heb je gelijk in.

A: Hoe berekenen jullie dan dat variabele deel?

C: We beginnen met het analyseren van de huidige installatie. We kijken hoeveel hij die gebruikt en hoeveel hij betaalt voor z'n energie. Dan bekijken we wat de lichtniveaus van de lampen zouden zijn wanneer hij slim dimmen zou gebruiken en op basis daarvan kunnen we de besparing bepalen. Dat doen we in Excel. We gebruiken de nulmeting (die we krijgen in overleg met de klant) en vervolgens kunnen we dat gebruiken voor de besparingscalculatie.

A: En hoe gaat de in de praktijk?

B: Dat gaat heel goed. Die nulmeting is daarin heel belangrijk. Zo kunnen we appels met appels vergelijken. Dat kan natuurlijk alleen bij renovaties. In nieuwbouw is dat lastiger, maar is het nog steeds mogelijk.

A: Hoe doen jullie dat dan in nieuwbouw?

B: Waar we bij renovaties eigenlijk rekenen in besparing. Kijken we daar gewoon naar de kosten van LED. Dan vragen we nog steeds hoeveel ze denken dat ze bepaalde ruimtes gaan gebruiken en op basis daarvan kunnen we alsnog de total cost of ownership berekenen.

A: Hoeveel klanten hebben jullie die het licht als dienst concept hebben afgenumen?

B: Ik denk zo'n 25 klanten in de afgelopen 1,5 – 2 jaar. Veel van die klanten zijn eigenlijk net iets te klein. We willen graag grote industriële klanten. Alleen is dat gewoon lastig om het aan hen te verkopen. Het is een conservatieve wereld daar en het valt of staat met referenties. Wanneer je die hebt, is het makkelijker verkopen aan andere klanten.

A: Zien jullie dan dat die grote klanten iets anders willen of kopen ze helemaal niet?

B: Ja, sommige kopen LaaS, anderen willen een gewone koop. Weer anderen zien ervan af. Maar we komen wel altijd binnen met het LaaS verhaal. Een gewone lampenverkoper heeft geen kans.

A: Waarom gebeurd het bij sommigen dan wel en bij anderen niet? Waar ligt dat aan?

B: Je ziet vaak dat het komt omdat het onbekend is. Laten we het dan maar niet doen. Laten we het gewoon kopen. Terwijl de partijen die het wel doen echt zeggen dat ze op het geld zitten en dat ze die investering niet willen doen. Daarvoor is LaaS echt een uitkomst. Als ze dan overgaan op koop hebben ze waarschijnlijk genoeg geld en is dat onbekende dan toch te eng om ervoor te gaan.

A: Is het dan ook lastig om bij de juiste persoon aan tafel te komen?

B: Ja soms wel. Facility management is eigenlijk altijd vervelend. Je moet op C-level beginnen (CEO/CTO/CFO). Echter is het dan nog lastig om hen te overtuigen.

A: Hoe komt dat dan? Als ik namelijk als CFO dit verhaal te horen zou krijgen zou ik denken, dit is geweldig. Ook al is die post klein, ik maak hem nog minder en ik hoef er nooit meer naar om te kijken.

B: Daar heb je gelijk in. Echter, zegt zo iemand dan nog vaak dat hij bang is dat alle processen worden verstoord wanneer zo'n nieuwe installatie wordt opgehangen. Daar heeft hij geen zin in. Het moet hen dus geen centje pijn doen en daar moet je ze van overtuigen. Door te werken met hun eigen mensen en de huisinstallateur bijvoorbeeld.

A: Goed dat we het nu over die installateur hebben. In ons vorige gesprek kwam naar boven dat daar nog wel eens problemen zitten. Wat zijn die problemen precies?

C: Installateurs hebben niet altijd behoefte aan zo'n overgang. Bij LaaS worden wij ten eerste de contract partij met die klant. De installateur verliest het contact met die klant. Het tweede is dat zij op dit moment aan iedere lamp verdienen. Elke keer als zij onderhoud plegen, maken ze niet alleen marge

op de uren die ze schrijven, maar ook op de producten die ze erin hangen. Die gooien daar rustig nog een percentage overheen en die raken ze nu kwijt.

A: Waar verdient hij dan aan in het LaaS model?

C: Simpelweg op de uren, niet meer op de hardware. Veelal weten de klanten niet eens dat ze daar nog op verdienen.

A: Maar wil zo'n klant dan per se met de oude installateur verder? Als hij niet wilt meewerken dan ga je toch gewoon naar een ander?

C: Dat verschilt. Je hebt klanten die vinden dat helemaal niet erg, omdat ze erachter komen dat ze extra betalen voor de hardware. Anderen vinden het heel fijn om met dezelfde installateur te werken omdat die bijvoorbeeld alle gebouwen van hem al doet. Je moet dan wel met hele goede reden komen om hem van gedachte te laten veranderen. Installateurs zijn gewoon niet de meest positieve krachten in dit concept.

B: We zitten nu echter wel samen met een installateur in een traject die zelf ook zegt dat hij van dat model wilt afstappen. Niet omdat hij dat wil, maar omdat het geen toekomst heeft. Vooral door de opkomst van LED.

A: Aan de ene kant snap ik hem ook wel. Als een groot deel van m'n omzet, hoe ik er dan ook aan kom, wegvalt, dan zou ik ook niet heel welwillend zijn tegenover zo'n concept.

B: Het voordeel voor hem is dat hij zich onderscheidt. Het is een van de partijen die dan LaaS aanbiedt. Hij wordt waarschijnlijk minder gebeld voor problemen (door LED). En wat je ziet is dat die huisinstallateurs vaak alles doen in een gebouw. Niet alleen licht. Ik weet het niet precies, maar volgens mij is 20% van hun werkzaamheden licht. De rest blijft gewoon staan. Hij levert dus een tevreden klant af en creëren een sterke band met hem. Daarnaast heeft hij ook nog gewoon dagelijks klantcontact (hij lost de problemen nog op).

A: Hoe denk je dat je zulke installateurs wel meetrekt in zo'n concept?

C: Ik denk dat installateurs wel gaan inzien dat het verdienen op onderhoud niet meer genoeg is. Los van LaaS komt LED er toch wel en daarom denk ik dat steeds meer installateurs het wel zullen aangrijpen.

A: Is Maintenance Assist een mogelijke steun in de rug dan? Om bijvoorbeeld hen iets meer klantcontact te geven?

C: Dat zouden wij niet per se willen. Wij willen juist wel dat klantcontact hebben. Ook omdat we niet altijd met dezelfde installateur werken. Ze werken dan waarschijnlijk één jaar wel mee, maar het tweede jaar beginnen ze je te naaien.

A: Jullie hebben dus geen contractuele installateur die jullie altijd gebruiken?

C: Nee, er is een grote kans dat we met de installateur die de installatie heeft gedaan, verder gaan. Maar dat hoeft niet. Dat staat niet in het contract.

A: Om de ontzorging even af te ronden. We hebben de installateurs nu gehad. Zijn er verder nog punten in het leveren van die ontzorging die lastig gaan of beter kunnen?

C: Je hebt nog wel eens een discussie met zo'n klant over het feit of de energiebesparingen nu wel of niet gehaald zijn. Meestal kijken ze dan verkeerd of interpreteren ze de data verkeerd. Als het systeem zijn commissioning nog niet heeft gehad, dan behaalt hij inderdaad nog niet de besparing die was afgesproken.

A: Hoe houden jullie op dit moment die cijfers zelf bij?

C: Dat is per klant verschillend. Bij sommige klanten kan het simpelweg niet. Wij zien dan bijvoorbeeld niet de energierekening. Bij anderen hebben we een apparaat in de meterkast die aangesloten is op de groep waar het licht is aangesloten. De volgende stap daarin is dat ons regelsysteem dat moet gaan meten en dat willen we ook via het internet kunnen bekijken.

A: Dus een dashboard met daarin alle contractgegevens van een klant en een simpele interface met daarin de performance van het systeem bij een klant zou een welkome toevoeging zijn?

C: Ja, absoluut. Daar moeten we naartoe.

A: Buiten het LaaS model, wat gaat in de toekomst nog meer gebeuren?

C: Ik denk dat het via het internet kunnen monitoren van de lampen heel waardevol is.

A: Heel concreet voor m'n onderzoek, wat zou een hele waardevolle software functionaliteit zijn in de lichtindustrie.

C: Het commissionen. Dat moet veel makkelijker kunnen.

A: En het monitoren, wat zijn dat de belangrijkste KPI's voor jullie om te zien of het goed gaat bij een locatie?

B: Foutmeldingen (kapotte lampen) & branduren is het aller belangrijkst. Daarnaast is het gewoon fijn om te weten hoe de installatie wordt gebruikt. En dat we zelfs misschien op basis van hun gebruik, uitspraken kunnen doen over andere zaken als bijvoorbeeld verwarming. Het zou ook super zijn als hij de SLA voor ons zou kunnen monitoren. Die verschilt per klant, dus het zou top zijn om dat te kunnen monitoren.

A: Wat denken jullie wat nodig is om LaaS groter te maken?

B: Dat is tijd, maar ook referenties. Laten zien dat het werkt, mond tot mond reclame. En wanneer dat gebeurd zullen mensen het niet meer eng vinden om zo'n model te gaan gebruiken.

A: Hebben jullie ooit problemen gehad met de prijsstelling in het feit dat jullie uiteindelijk de opdracht hebben gekregen omdat jullie te duur waren?

B: Volgens mij is dat nog nooit gebeurd. We werken met een open calculatie en ik denk niet dat als we worden teruggeduwd in die koop optie, dat dat komt door de prijs van het abonnement. Wij hebben gewoon best wel ervaring wat betreft de prijsstelling. Dus we weten best wel wat we ongeveer moeten vragen voor zo'n abonnement.

A: Hebben jullie verder nog opmerkingen?

C: Nee, volgens mij niet.

A: Top. Dan wil ik jullie enorm bedanken voor jullie tijd!

B: Graag gedaan en ik wil graag je bevindingen lezen wanneer dat mogelijk is!

E.7 Interview with Person H

Company (location):	Company G (The Netherlands)
Position:	Managing Director
Relationship with LaaS (company):	Core business but in a broader way (also with other products)
Relationship with LaaS (personal):	Creates partnerships and sells the LaaS concept
Level of LaaS knowledge:	5
Date of interview:	25-05-2016
Location of interview:	Nedap office in Groenlo
Medium used (duration):	Telephone (30 minutes)

Partij A: Antonie Berkel

Partij B: Person H

A: Wat doet Company G?

B: Company G is gestart in 2009 als projectontwikkelaar in energiebesparing. We zijn begonnen met zonnepanelen en focussen ons vooral op het energie efficiënter maken van de huidige situatie van de klanten. Hier bieden wij leasing aan. Company G is daarnaast sinds een aantal jaar breder gegaan en levert nu ook lampen. Wederom in een lease. Hier leveren we ook een aantal garanties plus monitoring en onderhoud. Wij blijven eigenaar van de installatie. Met dit model bespaart de klant meteen en kan hij dus vanuit de besparing het abonnement betalen.

A: Hoe stellen jullie dat bedrag vast?

B: Dat bedrag wordt bepaald aan de hand van de initiële investering, maar ook de besparing en de lengte van de overeenkomst. Besparing wordt allereerst berekend door hetzelfde aantal branduren als in de oude situatie te nemen en te kijken naar de besparing die je dan zou krijgen door het installeren van de nieuwe lampen. Daarna wordt gekeken naar hoeveel uren de lampen in de nieuwe situatie gaan branden (op basis van slim dimmen). Met die twee componenten kan de besparing worden berekend.

A: Doen jullie dat zelf? Gebruiken jullie hier software voor?

B: Wij doen zelf niet die besparing calculatie, wij doen de financiën. Wij doen dat met een partner die dat kan voorspellen. De klant gaat vervolgens zelf ook rekenen en wil graag garanties op de besparing. Daarom rekenen we niet te agressief. Doen we dat wel, dan wil de klant een hele lage prijs en hebben

we het risico dat we verlies draaien op de installatie als de besparing ook maar net niet wordt gehaald. Ze hebben daar tools voor, ze doen dat vooral Excel. Het model wordt bij elke klant verbeterd en is dus vooral gebaseerd op ervaring.

A: Wat is de rol van Company G precies in het leveren van LaaS?

B: We noemen het niet per se LaaS, meer ESCO, omdat we ook dit soort investeringen doen in andere onderdelen van de markt (denk aan zonnepanelen). Company G is daarin financier en eigenaar van de installatie. Tevens doen zij het contact met de klant. Wanneer iets kapot is komen ze naar ons. Aan de achterkant werken wij met partners.

A: Wat is het meest waardevol voor de klant in dit model?

B: Energiekostenreductie is heel belangrijk voor de klant. Kwaliteit en onderhoud is een tweede puntje. Wij zien dat hoe hoger de potentiële energiebesparing is, hoe hoger de kans is dat het project doorgaat. De meest mensen zijn wel enthousiast over deze vorm van verkoop, echter hangt bijna alles af van je energiekostenbesparing.

A: Aan wie verkoop je op dit moment het meest?

B: Het is erg belangrijk voor grote multinationals die zich willen focussen op hun core-business. Bij deze bedrijven kun je enorme kosten besparing realiseren. Vooral als je het breder trekt dan alleen verlichting. Voor kleinere bedrijven is het lastig, omdat we weinig zekerheid hebben over hun toekomst (5 jaar of langer) en dat heeft de klant zelf ook niet. De bank heeft ook vaak moeite met dit soort klanten.

A: Wat moet er gebeuren om LaaS/ESCo groter te maken in de toekomst?

B: Naarmate de complexiteit van een lichtinstallatie zal toenemen, is het lastiger voor de klant zelf om een goede oplossing te vinden. Wij kunnen dat beter voor hem. In dit model ontzorgen wij de klant volledig en kunnen ze volledig vertrouwen op onze expertise aangezien een slechte oplossing van onze kant, onszelf geld al gaan kosten. Zo'n klant koopt dan dus kennis en expertise.

A: In mijn onderzoek ben ik op zoek naar waardevolle software applicaties die zouden kunnen helpen bij het aanbieden van LaaS. Gezien het feit dat jullie de contact partij zijn, is het jullie taak om met veel verschillende partners bij verschillende klanten te werken. Dat kan lastig zijn om dat te managen lijkt me. Zou een platform waarop alle verschillende partijen zich zouden kunnen aansluiten om zo beter met elkaar te kunnen werken waardevol zijn?

B: Wij zijn vooral goed in projectmanagement. De kennis en expertise hebben we door de jaren heen opgebouwd en zo lukt het ons p, iedereen managen. Een platform creëren is lastig aangezien elk bedrijf anders werkt en het op een andere manier aan pakt. Voor sommige bedrijven is hun aanpak zelfs datgeen wat zich onderscheidt van hun concurrentie. Een platform met standaarden zou voor hen dus geen optie zijn. Er zijn namelijk geen standaarden. Er is dus denk ik geen markt voor.

A: En hoe houden jullie in de gaten of de door jullie verstrekte garanties en SLA's worden gehaald? Zou een dashboard waarop je in één overzicht zou kunnen zien welke klanten voldoen en voor welke klanten het mis gaat waardevol zijn?

B: Met Luxon kun je al deels zien wat je hebt gerealiseerd per lichtpunt. Zo kun je zien of je je SLA hebt gehaald. Echter moet je daarvoor bij elke klant op elke LLC inloggen. Leveranciers die tools in handen hebben om te monitoren zijn veel waard. Dit dashboard lijkt mij dan ook erg interessant. Het kan namelijk zorgen voor een makkelijke export van de data.

A: Zijn er daarnaast nog software applicaties die waardevol zouden zijn in de lichtmarkt?

B: Een inschatting maken van de savings is echt nog erg lastig. Je bent namelijk afhankelijk van de know-how van je partners en dat is soms wel erg risicovol. Wanneer daar software voor zou komen zou dat erg waardevol zijn.

A: Heb jij verder nog opmerkingen die waardevol zouden kunnen zijn voor mijn onderzoek?

B: In de software van Nedap is het lastig om te switchen tussen de verschillende locaties. Je moet namelijk voor elke LLC (200 lichtpunten opnieuw inloggen). Alle LLC's moeten dus samen op één dashboard komen.

A: Gezien de kosten naar het buitenland zou ik het dan graag daarbij willen laten! Enorm bedankt voor je tijd!

B: Graag gedaan en als je nog vragen hebt, laat maar weten!

Appendix F: Codebook

Theme	#	Codes
Performance Monitoring	6	<ul style="list-style-type: none"> CHANCE: Being able to monitor and analyse the lighting installation in real-time is very valuable for the LaaS provider.
Savings Measuring	2	<ul style="list-style-type: none"> PROBLEM: It is difficult to see whether the estimated savings are being met (as conditions constantly change)
	2	<ul style="list-style-type: none"> PROBLEM: Customers sometimes expect things that cannot be realised (or are realised but do not get interpreted as such)
	1	<ul style="list-style-type: none"> DEFINITION: Light management saving are measured using standard percentage (that originated from data at other projects)
	4	<ul style="list-style-type: none"> DEFINITION: In a LaaS model, energy savings can be measured beforehand (but not very well)
	4	<ul style="list-style-type: none"> DEFINITION: Energy savings calculations are done by an internal tool
	4	<ul style="list-style-type: none"> DEFINITION: Energy savings calculations are done by an ESCo
	5	<ul style="list-style-type: none"> CHANCE: Being able to correctly predict the usage of a lighting system is very valuable.
Creating Awareness	2	<ul style="list-style-type: none"> PROBLEM: People high in the company are mostly very interested, people lower in the company however are harder to convince.
	1	<ul style="list-style-type: none"> SOLUTION: You can make people aware about their lighting by simple showing to them how well they use it.
	1	<ul style="list-style-type: none"> DEFINITION: Companies are constantly trying to make their employees aware of the way they use the lighting.
	2	<ul style="list-style-type: none"> CHANCE: Making people aware about the fact that they have to use the lighting economically is very valuable.
Circularity	1	<ul style="list-style-type: none"> DEFINITION: Parallelisation results in durable, long term solution.
	2	<ul style="list-style-type: none"> DEFINITION: Companies work in a networked supply chain (parallelisation)
	5	

	5	<ul style="list-style-type: none"> ● DEFINITION: By implementing LaaS, you should create a more durable and circular economy ● CHANCE: Making processes more circular will be very valuable.
Integrability	2	<ul style="list-style-type: none"> ● CHANCE: Being able to communicate with installation other than lighting (heating, airco etc.) is very valuable
Readiness	1	<ul style="list-style-type: none"> ● SOLUTION: People lower in the company (who might feel threatened) can be convinced by involving them in the process.
	3	<ul style="list-style-type: none"> ● SOLUTION: Installers need time to mature in the model.
	4	<ul style="list-style-type: none"> ● SOLUTION: Customers need time to get used to this way of selling light
	2	<ul style="list-style-type: none"> ● PROBLEM: The installer finds it sometimes hard to get used to the new way of working together.
	1	<ul style="list-style-type: none"> ● PROBLEM: People at C-level are hazardous to buy LaaS as they do not want their processes to be disturbed
	5	<ul style="list-style-type: none"> ● PROBLEM: Customers are sometimes hesitant because they do not know for sure whether LaaS works or not.
	2	<ul style="list-style-type: none"> ● DEFINITION: Working together continues to improve but took some getting used to first
	2	<ul style="list-style-type: none"> ● DEFINITION: Services other than LaaS are greatly accepted
	2	<ul style="list-style-type: none"> ● DEFINITION: About 5% of the market is ready for LaaS
	2	<ul style="list-style-type: none"> ● PROBLEM: People high in the company are mostly very interested, people lower in the company however are harder to convince.
Process Optimization (light related)	2	<ul style="list-style-type: none"> ● CHANCE: Being able to deliver insights and suggestions to the customer about how they can better commission their lighting is valuable.
	2	<ul style="list-style-type: none"> ● CHANCE: Being able to automatically (or more easily) commission the lighting installation is very valuable.
	3	<ul style="list-style-type: none"> ● CHANCE: Being able to automatically trigger the maintenance process (without knowledge of the customer) improves unburdening dramatically.
	1	<ul style="list-style-type: none"> ● ANTI-CHANCE: Maintenance Assist automatic calling isn't valuable as LaaS suppliers will lose contact. Monitoring is valuable though
Process Optimization (not light related)	3	<ul style="list-style-type: none"> ● CHANCE: Being able to solve problems for the customer that are not primarily related to the lighting is very valuable
Light Management Optimization	1	<ul style="list-style-type: none"> ● CHANCE: Every LLC must be accessible without logging into them one for one.
	3	<ul style="list-style-type: none"> ● CHANCE: Being able to simplify your user interface and make it more intuitive is very valuable.
LaaS Description	3	<ul style="list-style-type: none"> ● PROBLEM: It is hard to draw up a good contract in terms of legal and insurance matters in LaaS
	4	<ul style="list-style-type: none"> ● DEFINITION: You can only call something LaaS when the ownership lies with the supplier.
	3	<ul style="list-style-type: none"> ● DEFINITION: To be able to offer LaaS, a company needs to be financially strong or have a financially strong partner.
	2	<ul style="list-style-type: none"> ● DEFINITION: The subscription fee is determined as an hourly fee (pay-per-use) (driven by burning hours)
	4	<ul style="list-style-type: none"> ● DEFINITION: The subscription fee is determined as a monthly fee (driven by contract length)
	2	<ul style="list-style-type: none"> ● DEFINITION: LaaS is very suitable for the 24/7 market
	6	<ul style="list-style-type: none"> ● DEFINITION: LaaS is a managed service in which you do not invest. You pay for the use of the product, not the product itself.
	4	<ul style="list-style-type: none"> ● DEFINITION: LaaS is a form of service in which the customer is fully unburdened.

	4 1 1 2 4 1 5 4 3 4 1	<ul style="list-style-type: none"> DEFINITION: LaaS can be offered as an operational lease DEFINITION: LaaS can be delivered as a Share-in-Savings model, which makes it legally easier. DEFINITION: In the future, companies will be more specialized in order to deliver the best solution DEFINITION: In a LaaS model, the energy bill can be taken over by the LaaS supplier. DEFINITION: Emerged from the fact that people are scared or don't have money to make big investments. DEFINITION: Customers do not always have to work with their own installer. DEFINITION: By implementing LaaS, people move from ownership to just use of the product. DEFINITION: Building a valuable customer relationship is very important for a LaaS company DEFINITION: At the end of a contract, the customer can upgrade their system and sign a new contract DEFINITION: At the end of a contract, the customer can let the supplier remove the installation (without a fee) DEFINITION: At the end of a contract, the customer can buy the lighting installation for the residual value
Customer Description	2 1 2 2 2 2 1 4 3 2 5	<ul style="list-style-type: none"> DEFINITION: Renovations and new housing is suitable for LaaS DEFINITION: Pay-per-use is suitable for customers who need a flexible lighting system DEFINITION: Governments are suitable for LaaS DEFINITION: Energysavings become a commodity. Customers want more than that DEFINITION: Customers want very different things depending on their stadia in servitization DEFINITION: Customers start to think about whether they really need to be owner of their installation DEFINITION: Customers have different preferences for subscription, there is no best subscription form DEFINITION: Customers focussing on core-business are suitable for LaaS DEFINITION: Customers find qualitatively good and comfortable lighting very important DEFINITION: Customers find costs and cost saving very important DEFINITION: Big projects (multi-site or great surface) are most popular, but some smaller project also adopt LaaS
Succes Factors	4 5 2 2	<ul style="list-style-type: none"> VALUE: Customers have no risks VALUE: Customers find the financial prospect of LaaS very attractive. DEFINITION: A lot of references are needed in order to make LaaS a success. DEFINITION: Not being able to gain enough references will result in bankruptcy of the company
Other	1 1 1	<ul style="list-style-type: none"> PROBLEM: Installers make mistakes when installing or commissioning the system DEFINITION: Traditional linear supply chain DEFINITION: The inside lighting is often more advanced than outside lighting

Table 23: The code book used to analyse the transcript