Aalto University
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EXPLORING CUSTOMER VALUE AND COMMERCIAL VIABILITY OF AUTOMATION ENABLERS

A Case Study from On-road Load Handling

Master's Thesis
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Abstract

This thesis is a research exploration into the commercial viability of advanced driver assistance services in the load handling industry, which eventually enable automation and autonomous activity.

Commercial viability is important for understanding the rate of change as well as the capability for digital transformation in the industry. Ongoing trends support the addition of technology onto hardware; this research seeks to understand whether this is commercially viable.

A case study method is used to deep-dive into the practicality from on-road load handling and the construction of advanced driver assistance services through the installation of software systems and external hardware. The case study company is a large original equipment manufacturer in the industry. A design science methodology is constructed and used, with the case study providing a research artifact for exploration.

Main results conclude that technology costs are greater than the monetary value created for customers, stating that in the short-term advanced driver assistance services are not commercially viable. However, trends such as urbanization, digitalization and the declining skills of drivers in the load handling industry support the long-term vision of automation and autonomous activity; in addition, there is a strong demand pull from the customers for increased automation, which also support the construction of driver assistance services.

Keywords Customer value, commercial viability, automation

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Tämä tutkielma käsittelee kuljettajanavustusjärjestelmien kaupallista potentiaalia logistiikka- ja kuormankäsittelyalalla. Kuljettajanavustusjärjestelmät ovat digitaalisia ratkaisuja, jotka mahdollistavat tulevaisuudessa automaation sekä laitteiden itsenäisen toiminnan.

Kaupallinen potentiaali on tärkeää, jotta voimme ymmärtää muutosnopeuden ja digitalisaation tason tällä toimialalla. Käynnissä olevat megatrendit ja suuntaukset tukevat teknologian lisäämistä laitteistoon, ja tämä tutkimus pyrkii ymmärtämään teknologian lisäämisen liiketoiminnallisen kannattavuuden tällä toimialalla.

Tapaustutkimusmenetelmää käytetään syventämään ymmärrystä käytännöstä tien päällä tapahtuvaan kuormankäsittelyyn ja kuljettajanavustusjärjestelmien todennäköisiin hyötyihin ja asiakasarvoihin. Tapaustutkimusyritys on suuri alkuperäisten laitteiden valmistaja tällä teollisuudenalalla. Design Science- menetelmä rakennetaan ja sitä käytetään tutkimuksen raameina; tapaustutkimus toimii osana tätä laajempaa kokonaisuutta.

Tutkimuksen keskeisin tulos toteaa, että teknologiakustannukset ovat suurempia, kun asiakkaalle luotu euromääräinen arvo, jolloin kuljettajanavustusjärjestelmät eivät ole lyhyellä aikavälillä kaupallisesti kannattavia. Megatrendit ja suuntaukset kuten kaupungistuminen, digitalisaatio sekä kuormankäsittelyalan kuljettajien jatkuvasti vähenevät taidot autojen hallinnassa kuitenkin tukevat pitkällä tähtäimellä kuljettajanavustusjärjestelmien rakentamista. Tämän lisäksi asiakaskysyntä automaatiolle ja itsenäisemmälle toiminnalle on vahvaa toimialalla, joka myös puhuu järjestelmien rakentamisen puolesta.

Avainsanat automaatio, asiakasarvo, kaupallistaminen

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What a journey! When I started this project a bit more than 6 months ago I wouldn’t have believed how much fun, frustration, exasperation, eureka! - moments and even desperation could fit into what I though was just another project. I feel exceptionally lucky to have had the opportunity to enjoy this journey through emerging technology and it’s practical, day-to-day application and commercialization; a field I was interested in but knew little about beforehand. I’ve managed to fit in enlightening discussions with colleagues all over Europe, long hours at the library buried under academia, as well as getaway trips to enhance focus and get writing done 😊.

I’d like to thank my thesis supervisor, for his work on guiding my thesis towards better structure; it is timesaving after all to use established ways rather than trying to invent something new all the time. I’d also like to thank all my colleagues and interviewees at my case company for lending a helping hand- without you this work would not have been possible, and I would not have been able to reach our customers; the ultimate source of value for a company. Finally, I want to thank my friends and family for the support, encouragement, and sharing our mutual struggles and occasional motivational lapses throughout the writing process.

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1 Introduction

Recently, the topic of automation and semi-automation in on-road load handling or logistics has risen to the forefront of consideration. Various companies working in the field are building automation enablers for an eventual future of fully automated and even autonomous load handling activities. These automation enablers are being built both from a demand-pull and technology-push perspective.

Advances in artificial intelligence, machine vision technology and lidar (light detection and ranging), as well as the constantly decreasing prices of these technologies make them an attractive area of exploration for companies. Strategic vision, such as leading the industry in digital solutions, push for innovations utilizing the latest advances in technology. At the same time, customers of these companies (i.e. the logistics operators) suffer from an acute shortage of skilled drivers (Lodovici et al., 2009; *The Driver Shortage : Issues and Trends*, 2016) and are actively engaging on-road load handling OEMs (original equipment manufacturers), demanding for load handling tools and cranes which are easier to operate and require less from drivers.

Past research has largely focused on the technical practicalities of autonomous or automated operation (Watzenig & Horn, 2017) or specific challenges faced when attempting to spread autonomous or automated on-road activities (Lee & See, 2004). An interesting gap is noticeable, specifically regarding the practical day-to-day questions of why and how early-stage automation, or automation enablers should be taken into use by logistics operators, and what are the actualized, practical benefits and challenges regarding this. The long-term benefits of automated on-road load handling are easily seen in terms of safety and efficiency, but the smaller, practical challenges, steps and customer value in implementing automation in the daily struggles of logistics companies has received less theoretical attention. This thesis seeks to fill that void, focusing on understanding the customer value created by automation enablers and providing a specific, practical view that could be applicable on a much wider context.

1.1 Background

Gartner's 2018 Hype Cycle recognizes several emerging technologies that will revolutionize the world, including concepts such as Democratized AI, Digitalized Ecosystems, and

Ubiquitous Infrastructure (Gartner, 2018). Within Democratized AI, there are subsections such as Autonomous Driving and Autonomous Mobile Robots.

It is quite easy to envision the benefits of widespread adoption of these technologies: increased traffic safety and security, reduced stress, improved productivity, reducing ownership and operating costs, to name just a few (Litman, 2019). What can often be lost in these futuristic dreams of tomorrow is that the path to a world where these technologies are widespread and a part of daily lives is murky and uncertain at best. The potential of a world of connected, intelligent machines making human life more pleasant is easy to view; it is the road that leads to that future that is unclear. In my opinion, it the road to this future that is also the most interesting and exciting field of study.

Change of the scale that these megatrends promise is not an overnight phenomenon, especially in commercial contexts. In a fast-paced competitive world, even early applications of semi-autonomous or semi-automated solutions need to prove that they create more value for customers, end users and society than their actuation costs or destroys, whether in terms of technology or otherwise. In other words, “If only technical issues mattered, driverless vehicles would soon be commonplace” (Hars, 2010). Without proof of both short- and long-term benefits, the road towards an automated future in on-road load handling becomes increasingly rocky.

It is this gap, the proof of value that this thesis seeks to fill.

1.2 Context and framing

This thesis focuses on the specific context of hooklifts. Hooklifts are a type of crane that are used in on-road load handling operations to lift containers onto trucks and off again. Figure 1 (below) shows a picture of a hooklift in action.

Figure 1: A hooklift: the context for this case study

The focus of this study is in understanding the customer value and commercial viability of the enablers for eventual automation and autonomous activity of lifting the container. These enablers include various camera and lidar installations that allow a software system to gain information and an awareness of the surrounding area. This information can then be used for eventual automation of the task of picking up the container, or even fully autonomous activity such as driving the truck to the container and then picking it up without driver prompts or supervision.

The approach for this research problem is a case study; the case company will hereafter be referred to as Load Handling OEM. For more detailed assessment, see section 3.2.1 on case studies.

There are still widespread technological and legal challenges regarding full and semi-automation of tasks that are done on public roads or in public areas. Therefore, this thesis will be a research exploration into the customer value and commercial viability of *driver assistance systems*, which utilize the data generated by camera and lidar installations to guide the driver in various activities related to picking up and putting down the container. These same driver assistance systems can eventually be used to semi-automate and fully automate the activity, as they are gathering the data necessary for such activities. Thus, the driver assistance system acts as an enabler for eventual automation and even autonomous activity of the hooklift.

1.3 Benchmarking autonomous vehicles

To aid in the discovery process of a proof of value for automation enablers in on-road load handling, I will conduct a brief benchmark into autonomous vehicles and the ongoing discussion and research in that field.

The purpose of this benchmark is twofold. First, to understand what customer value propositions are out there for semi-autonomous and advanced driver assistance services and how does current literature address automation activities and customer value. Second, to understand the relationship between the cost of technology used in automation and the value that has been delivered to the customer.

To look at automation in cars as a benchmark, the details of what automation means in this context must be understood and described explicitly. Automation in heavy machinery is not a single-step process. In the case of commercial cars, partial automation has long since been a part of the offering. Things such as lane steering control, reverse cameras and eco-driving modes are all part of a trend toward partial automation of driving activities. There are several standards of classification of autonomous activities, and most of them follow a multi-level approach starting from no automation (low levels) to full automation (high levels). For the purposes of this thesis, I decided to adapt SAE J3016 as a frame of reference (decribed in detail for example in Watzenig & Horn (2017)). Table 1 (below) details the SAE J3016 frame of reference for automation activities in cars.

Table 1: SAE J3016 levels of automation and their customer value propositions in cars

Level of Automation	Monitor	Narrative Description	Customer Value Proposition	Reference
0 (No Automation)	Human driver always monitors driving environment	Human driver performs all driving tasks	-	-
1 (Driver Assistance)		The execution of a specific task (steering, acceleration) by a system; human performs all other tasks	Well-documented practical safety benefits (reduced accidents)	(Kusano & Gabler, 2012)
2 (Partial Automation)		The execution of 1 or more tasks by a system; human performs all other tasks	Improved driver comfort and expected increased safety, energy efficiency	(Litman, 2019; Watzenig & Horn, 2017)
3 (Conditional Automation)	System monitors driving environment	The system performs all driving tasks; human is required to respond to system requests to intervene	Safety largely depends on ability to respond to system requests to intervene	(Litman, 2019; Watzenig & Horn, 2017)
4 (High Automation)		All driving tasks are performed by the system; human is not required to intervene	Minimal risk conditions achieved from safety perspective	(Watzenig & Horn, 2017)
5 (Full Automation)		Performance of all driving tasks by the system under all roadway and environmental conditions; indistinguishable from human driving.	Road network usage through connected autonomous vehicles.	(Watzenig & Horn, 2017)

Looking at the automation levels above, what is currently commercially available is up to level 2 and 3 automation, for example in the form of parking assistance and traffic jam assistance (level 2) and traffic jam chauffeurs (level 3) (Watzenig & Horn, 2017). In the context of this thesis, what is being proposed is an automation enabling driver assistance system, which would fit into level 1 and level 2 on the SAE scale, but enable the construction of level 3-5 automation in the future.

Table 2 (below) shows four different types of traffic environments where driving automation activities are currently taking place. In general, it can be stated that structured traffic environments are much easier to build automation systems for as they are more predictable and there is less potential for unknowns to be introduced into the scenario to be automated (Watzenig & Horn, 2017).

Table 2: Traffic environments and automation activities

	Low Velocity	High Velocity
Structured Traffic Environment	Traffic jams	Highways
Unstructured Traffic Environment	Parking and Maneuvering (this environment most closely resembles on-road load handling)	Urban & rural roads

Some companies are of the opinion that Level 3 automation lacks customer value compared to technology costs and is not necessarily worth developing ("Automated Driving at Daimler Trucks," 2019). However, the context described by Daimler is different than the context of Load Handling OEM. Daimler focuses on high velocity environments, whereas Load Handling OEM focuses on low velocity environments (see Table 2 above). Even though there is data, and industry players have acted to skip level 3 automation, the contextual differences are great enough to warrant exploration of automation in a different traffic environment.

The result of this brief benchmark is that value propositions for car automation tend to focus on driver comfort in the short term, improved safety and efficiency in the medium term, and optimized road network usage in the long term. This is valuable insight to keep in mind when articulating the results of customer value in load handling.

1.4 Aims of the study

This study explores customer value in automation enabling advanced driver-assistance services in the on-road logistics industry. As such, the aims of this study can be articulated in the following manner:

1. A deep-dive into the components of customer value in automation enabling advanced driver assistance services in hooklifts. This aim seeks to answer the

questions: *Why would customers purchase advanced driver-assistance services for on-road load handling? What are the specific streams of customer value for advanced driver assistance services?*

2. Understanding of the commercial feasibility of step-by-step automation solutions in the on-road logistics industry through the case example of hooklifts. This aim seeks to answer the question: *Is the value created for customers by automation enablers greater than the technology costs of these enablers?*

1.5 Thesis structure

This thesis is composed of four major parts:

1. Literature Review
2. Methodology
3. Findings
4. Discussion

In the Literature Review section, I explore contemporary literature around pertinent themes. These themes include customer value, commercial models and pricing, technology acceptance as well as the challenges of shifting to a service business as an OEM. I conclude the section with a synthesized research framework that will guide in the exploration of customer value in the empirical section of this thesis. In the Methodology section, I outline the use of Design Science methodology and the reasons for its application in this context. I also outline the ways of data collection through semi-structured interviews with various customers and key stakeholders, as well as how the received data is coded. In the Findings section, I outline my key findings from the empirical section and use them to create a context-specific iteration of the research framework for customer value exploration based on the literature review findings. In Discussion, I draw together the practical and theoretical discoveries and discuss the implications of these in the contemporary context. I also put forth limitations to this study and make suggestions for future research.

2 Literature review

As discussed in the previous section, emerging digital logistics solutions require wider framing and understanding to uncover value. The nature of digital solutions is such that value is generated through usage, data generation, analytics and continuous service rather than in the tangible product itself.

2.1 Customer value

In business literature, the term 'value' has multiple aspects attached to it. 'Value' as a term is present in strategic, financial, marketing, information systems and management literature (as well as others), each with unique connotations, definitions and perspectives (Huber, Herrmann, & Morgan, 2001). Even though 'value' is widely used in understanding consumer behavior, business implications and a multitude of other business-related fields, as a term it remains "indistinctive and elusive" (Zeithaiml, 1988) or "ill-defined" (Grönroos & Voima, 2013). Because of its widespread usage in differing contexts and variety of business literature, I believe it is necessary to explore the concept in detail to discover a fitting definition that can be used for the purposes of this study.

The notion and terminology of 'customer value' has a shorter history than other applications of the term 'value'. Value terminology originates from the field of economics, where Adam Smith (1723-1790) in his pivotal work The Wealth of Nations already introduced the fundamental value terminology, a binary of 'value-in-use' and 'value-in-exchange' (Eggert, Ulaga, Frow, & Payne, 2018).

It is these roots in the field of economics that has determined the evolution of value terminology in past business literature. Internal business activities such as manufacturing and finance, or competitor-focused industrial perspectives where delivering superior value is seen as a competitive edge were the focal point of value discussion until the 1990's (Huber et al., 2001). Examples of previous value definitions include 'strategic value', the value in competitive industry positioning of a company, or 'value' from a purely accounting perspective as revenue minus purchases (Huber et al., 2001). These applications have also inherited the term 'value' from goods-dominant logic, which emphasizes the tangibility of items exchanged and the value created from this exchange of tangibles (Skålén, Gummerus, von Koskull, & Magnusson, 2014). 'Customer value' is a term which has been introduced to business literature as the exchange of intangibles such as services becomes increasingly a part of the economic output of the modern era (Vargo & Lusch, 2004). As such, documenting and demonstrating claims of value becomes of paramount importance (Anderson, Narus, & van Rossum, 2006). ‘Customer value’ can also be seen as “the worth in monetary terms of the technical, economic, service and social benefits a customer company receives in exchange for the price it pays for a market offering” (Anderson & Narus, 1998). The term ‘Customer value’ is thus a largely external perspective into the exploration of value terminology, and as such requires further discovery.

Customer value has entered the academic conversation in the past few decades primarily through scholarship examining the role of customer value as a competitive advantage (for example (Day & Wensley, 1988; Woodruff, 1997)) and the resource-based view of the corporation where customer value related capabilities can act as a resource to be exploited (for example (Ceric, D’Alessandro, Soutar, & Johnson, 2016; Clulow, Barry, & Gerstman, 2007; Kim, Shin, & Min, 2016)). In my opinion, these strands of scholarship suggest that the modern focus on customer value is largely a result of corporations and companies reinventing their perspective into creating profit and fulfilling their legal obligations of generating return to shareholder. To do this, the companies focus on external activities and external stakeholders rather than internal activities

This recent trend of examining outside the corporation to create value has resulted in a shift in thinking, where rather than focusing on the efficient exchange of tangible goods and services, the modern business is as much about an exchange of intangibles such as customer value (Levitt, 1981; Vargo & Lusch, 2004). As business becomes an exchange of intangibles, new and more in-depth analysis of what constitutes value, or what constitutes an intangible that can be exchanged for, became necessary for corporations to maintain competitive advantage over one another (Huber et al., 2001).

This shift in value-oriented research and understanding has unearthed a plethora of varying conceptualizations of customer value such as ‘perceived customer value’, ‘value-in-use’ and the role of ‘customers as value co-creators’ (Tynan, McKechnie, & Chhuon, 2010) amongst others. Vakulenko, Hellström, & Hjort (2017) comprehensively discuss the evolution of these value conceptualizations and perspectives, concluding that “customer value can be created by both organizations and customers themselves”.

In the past few decades of research, customer value is largely focused on perceived customer value, the customer as a value co-creator and the role of customer value generating benefit to all stakeholders involved, not just customers. In addition, they conclude that “the conceptual perspective determines the nature of customer value" (Vakulenko et al., 2017). This is in line with thinking suggested by Pynnönen, Ritala, & Hallikas (2011) where the increasing complexity of attributes that deliver customer value that comes through digital services, platforms, and data analytics results in contextual and systemic complexities for value creation. Thus, based on the above literature, I propose that concepts such as value and customer value are very much context-dependent terms, to such a degree that it becomes necessary to define customer value before embarking on its exploration in this context. As part of this exploration, the following sections detail some conceptualizations of customer value in recent literature.

Table 3 below outlines and simplifies the various value conceptualizations considered in this thesis:

Table 3: Customer value conceptualizations from contemporary literature

Value Creator	Customer Value Conceptualization	Short Definition	Application Area	Example Literature
Organization	Organizations and Solution Providers as Creators of Value	Value is the net result of product benefits, created by organizations and exchanged for with customers	Fast-moving consumer goods (FMCG), other consumption-oriented goods & services	(Huber et al., 2001; Woodruff, 1997)
The individual customer	Perceived Customer Value	Value is highly personal and idiosyncratic; it is a combination of perceived sacrifice and perceived benefit	FMCG. Also applies to some services, but more modern thinking has replaced this application area	(Huber et al., 2001; Zeithaiml, 1988; Zhang, Liang, & Wang, 2016)
The daily user of the good or service	Value-in-use	Value is determined through the realization of the value proposition; value cannot be known before the product or service is in use	Long-lasting goods and services	(Boyd & Koles, 2018; Grönroos & Voima, 2013; Sweeney, Plewa, & Zurbruegg, 2018)
All involved stakeholders	Co-creation of Value	Value is embedded through interaction and dialogue with customers at each stage of development	Services	(Lombardo & Cabiddu, 2017; Petri & Jacob, 2016; Tynan et al., 2010; Vargo & Lusch, 2004)

Value conceptualizations overviewed in Table 3 (above) are not mutually exclusive, meaning that their division into application areas is not necessarily exact. Rather, this division into different value conceptualizations is a useful way to frame the discussion around what constitutes customer value in different contexts. There are definite overlaps for example regarding Perceived Customer Value and Value-in-use. For example, the purchase action of a long-lasting good or service is likely dependent on Perceived Customer Value, but the actual realization of that perceived value will occur during the usage process;

therefore, the more accurate view of what constitutes value in that context is likely seen through the framing of Value-in-use.

In the case of driver-assistance digital services for on-road handling, value-in-use seems to be an appropriate conceptualization for this specific application area. This is because driver-assistance services in this context are add-ons to hardware, i.e. hooklifts. Hooklifts are large, expensive pieces of mechanical equipment designed for constant usage. Whilst new features are tested with various customers, it is still a field of equipment manufacturing, where customers purchase a certain type of equipment rather than a comprehensive, tailor-made package. This means that co-creation of value is not a particularly suitable framing of the discussion.

The next sections hold detailed discussion and literature review on the conceptualizations provided in Table 3.

2.1.1 Organizations and solution providers as creators of value

From the industrial organization perspective, customer value is the net result of product or service benefits which a customer receives in a purchase exchange (Huber et al., 2001). This perspective holds that value is created by the organization, and then exchanged with customers. For commoditized products, or for exchanges of tangibles, this perspective is rather accurate; for example, the consumption of a cup of coffee and the expected value of a cup of coffee (a pleasant warm drink that perks you up) is very close to its perceived value. There are few nuances to be considered. However, when value delivery and transactions become more complicated, this perspective falls apart as it lacks the nuance to accurately depict activities organizations and their customers embark on to create value for each other.

In more complex environments, value creation can still be justifiably viewed as an organizational task. From this perspective, it is the duty of an organization to create and apply a set of tools within itself that it can use to learn more about its own customers, to ultimately deliver more value (Woodruff, 1997). From this perspective, organizations are largely responsible for the approach to creating customer value, but from an entirely different perspective. They need to build contexts in which it is possible to learn and discover about their customers, after which these contexts can be used to create customer value. In more complex environments, customer value is therefore not purely created by the organization, but the enablers of creating customer value are built within.

2.1.2 Perceived customer value

The perceived customer value view holds that the actual value a firm creates for its customers can be found from the customer's perception of the firm's resources, and in the implications of this perception (Clulow et al., 2007). The idea of perceived value can be further viewed as a combination of perceived sacrifice and perceived quality (or perceived benefit). Perceived quality is highly personal and subjective, requiring the accounting of multiple points of view from varying perspectives (Prior, 2013), whilst perceived sacrifice depends on both the monetary price and perceived non-monetary price of a product. Thus, perceived value is the overall assessment of the utility of a product based on the perceptions of what is received and what is given (Zeithaiml, 1988). Furthermore, perceived quality differs from objective quality in the sense that objective quality features the practical, technical differences that make one offering superior from another whereas perceived quality is linked to the individual making the assessment rather than the object(s) being assessed (Zeithaiml, 1988).

In this instance, value is essentially a combination of the economics concept of utility; the benefit a certain product or service provides and the accompanying sacrifice, or the costs associated to consuming the product or service (Eggert et al., 2018).

Higher-level abstractions refer to the fact that consumers (and customers) organize information including benefits of a product in multiple levels. At the lower level, physical characteristics and observable attributes are noted (such as price, features etc.), whilst at a higher level consumers and customers seek emotional payoffs which are multidimensional, abstract, and difficult to measure (Zeithaiml, 1988).

Highly related to the notion of perceived value is value anticipation: firms should be able to anticipate the value of an offering for specific customers; and not only the value, but also the benefit-sacrifice view as well as the outcome of the product offering (Zhang et al., 2016). This anticipation of the value of an offering affects perceived value; if customers expect a firm to anticipate their needs and respond to their future needs, the perceived value of the offering of the firm is bound to increase (Zhang et al., 2016).

Customer perceived value is in line with a static view of the organization, where customers evaluate what is offered by an organization and make a judgement on what is value with regard to the offering (Sweeney et al., 2018). This is in line with goods-dominant logic, the subject of previous discussion (Vargo & Lusch, 2004). Within this view of perceived value, there is little regard for potential value creation activities which occur after purchase.

2.1.3 Value-in-use

In value-in-use, value is realized or created during the service process with an organization, or after the service process in the customer organization (Grönroos & Voima, 2013; Sweeney et al., 2018). Value-in-use states that organizations do not offer value; they offer value propositions in the form of potential value, and it is then up to the customer organization to transform this potential into actual value, or value-in-use (Grönroos & Voima, 2013).

Value-in-use also states that value is not embedded into the moment of delivery (or any other isolated event); rather it is the result of a process (Macdonald, Wilson, Martinez, & Toossi, 2011). Within this process, technologies and skillsets are combined through relationships between customers and providers. Without these technologies and skillsets, the relationships have no value; and without the relationships, technologies and skillsets have no value (Ford, 2011). This suggests that value-in-use is thus based on an interaction of assets between customers and suppliers, where previous relationships and capabilities define what can be achieved that is of value.

From the value-in-use perspective, customer value is thus realized during the daily usage of a good or service, rather than something which is perceived beforehand, or fully co-created and a result of a mutual process. Coordination and information sharing after the act of purchasing are the key drivers of developing value-in-use (Boyd & Koles, 2018).

2.1.4 Co-creation of value

As business has become more and more an exchange of intangibles, recognizing what the needs of the intangibles are to be exchanged require specification from the customer side as well as the provider side. In essence, “value is defined and co-created with the consumer” (Vargo & Lusch, 2004). In addition to this definition and co-creation, value is also co-extracted; that is, value is mutually created and exploited by the customer and the provider of the good or service (Prahalad & Ramaswamy, 2004).

The thinking behind the co-creation of value states that with the increasing complexity of the nature of goods and services which are being exchanged, simple value propositions will no longer be enough to satisfy the complexity of this era. Thus, value is not something that cannot be delivered to a passive customer, but rather the result of embedded interaction and dialog (Tynan et al., 2010). Because of this customized nature of value and value propositions, they have become specific: value propositions are no longer created for a customer to accept or decline. Rather, they are consistently and patiently built together in such a way that declining a value proposition becomes meaningless, as the value proposition is as much a product of the customer as of the service or goods provider (Tynan et al., 2010). In this sense, value propositions become much more complex, depending of course entirely on what the product or service being sold or offered. They are a sum of human experiences from interactions and engagement between the parties, commonly the customer and the service provider (Ramaswamy, 2011).

Value co-creation as an aspect of customer value is more prevalent in solution-oriented business than in manufacturing or consumer business; the more complex the exchange, the more the value needs to be co-created. In solution-oriented business, where the deliverable becomes an intangible service offering rather than a concrete product or a servitized extension of a product, customer needs are the driving force behind value co-creation. Customer processes and the way in which customers compete their tasks are in some sense always unique to the individual customer; therefore, value delivery is specific to a distinct customer (Edvardsson & Olsson, 1996). As there exists a distinct lack of a physical product, the value delivered is usually specifically suited to a customer problem. Therefore one of the driving forces of value co-creation is a customer need to a specific problem or problem area, combined with the uniqueness of the problem or problem area to this particular customer (Edvardsson & Olsson, 1996; Petri & Jacob, 2016).

In addition to customer need, co-creation of value needs to be enabled by the customer and their organization. This requires heavy internal resourcing from the customer side; aspects such as objective & scope, knowledge transfer, target orientation, commitment and people resources need to be communicated to solution providers (Petri & Jacob, 2016). What this means is that truly delivering a co-created value proposition rather than an internally thought out one is incredibly work-intensive on the side of the customer as well.

All the above raises the question of practicality: how is value co-created in practice? Value can be viewed as the sum of all net-positive interactions within a ‘field’, a space where actors such customers and service providers come together to co-create value (Lombardo & Cabiddu, 2017). In this modeling, all the actors bring ‘capital’ with them to the field, meaning resources and capabilities which can contribute and define value creation within the field (Bourdieu, 1985). There are different types of capital: economic, social, cultural and symbolic (Bourdieu, 1986). Each type of capital has multiple ‘currencies’ related to it.

For example, economic capital includes items such as ROI and cost savings, cultural capital includes education, eloquence, bilingualism etc. Social capital includes social networks and personal connections, and symbolic capital includes things such as titles and hierarchical positions. Each currency is additionally defined by four aspects that measure the variation in that type of capital: access, liquidity, convertibility, and attrition. Each of these four aspects measure how that type of currency can change throughout the field. The fundamental thesis of this ‘field’ is that players or agents within it struggle with each other in order to achieve a better position, and the chief model of the struggle is the exchange of these currencies in order to achieve that better position (Lombardo & Cabiddu, 2017).

The above field analogy is a useful model to understand the relationships between customers and service providers, and to frame the specific actions which they take as a part of a wider whole. Co-creation of value occurs when actors collaborate to increase access to capital, to enable the exploitation of capital and to reduce the attrition of capital (Lombardo & Cabiddu, 2017).

2.1.5 Frameworks to assess the delivery of customer value

As discussed, product and service valuation by customers is an inherently complex and multi-faceted challenge. As part of the larger trend in a shift towards a customer/consumer oriented mindset, this has been recognized in academia and multiple attempts to create general frameworks have been undertaken (see for example (Huber et al., 2001; Keränen & Jalkala, 2013; Macdonald et al., 2011; Smith & Colgate, 2007; Tynan et al., 2010)).

As the purpose of this exploratory study is to understand the dimension of customer value in advanced driver-assistance services, there are some practical requirements for a framework to aid in this exploration. The primary purpose of customer value frameworks is to assess how the solution that is being proposed delivers value to a customer (Keränen & Jalkala, 2013); the aims of this study support this notion. As seen previously, customer value creation and delivery contain numerous perspectives, and there exist many ways in which value can be created and delivered. From the perspective of on-road load handling, a framework which explores the practical considerations of constant usage of a physical solution with added digital capabilities is necessary. The framework needs to be open to practical application into a case scenario, rather than open to higher-level strategic thought.

With these requirements in mind, I will explore the suitability of the framework proposed by Smith & Colgate (2007) to this purpose. This framework focuses on a practical hands-on approach to customer value. Rather than flowcharts depicting value flows, the framework is focused on specific components of value and how they are realized in practice. The framework focuses on four types of value: functional/instrumental, experiential/hedonic, symbolic/expressive and cost/sacrifice, as well as five sources of value: information, products, interactions, environment and ownership/possession transfer.

Functional/instrumental is “concerned with the extent to which a product (good or service) has desired characteristics, is useful, or performs a desired function” (Smith & Colgate, 2007). Functional value can also be seen as products that “solve… problems” (Park, Jaworski, & MacInnis, 1986). From this perspective, functional/instrumental value is highlighted as the practical features of the product or service offering and their suitability to customer problems or challenges. As value-in-use is the discovered application area for on-road load handling, the inclusion of this type of value for a framework of analysis is on solid ground. Functional customer value can also be viewed as related to the economic benefit received by the individual using a good or product (Calvo-Porral, Faíña Medín, & Montes-Solla, 2016), which contradicts (Smith & Colgate, 2007). However, this value framework includes a section on cost/sacrifice value type; this will be explored in a later paragraph.

Experiential/hedonic value describes the extent to “which a product creates appropriate experiences, feelings, and emotions for the customer” (Smith & Colgate, 2007). Fairfield (2015) discusses value creation through experienced positive emotions whilst customers interacting with either the product or customer service representatives, suggesting merit in the approach and definition. Strong positive emotional peaks increase the overall value of a full customer journey (Van Hagen & Bron, 2014). However, negative emotional experiences with a company destroy value in the customer’s eyes much faster than value is created through positive experiences (Fairfield, 2015). This ties into the wording “appropriate” in Smith & Colgate (2007), leading to the conclusion that ‘appropriate’ could be replaced with ‘positive’ to maintain meaning in the context of digital services for on-road load handling. Particularly in the context of value-in-use, the focus on positive experiences from using on-road load handling solutions rather than appropriate experiences seems warranted; as value is defined through daily usage, if the experience of that usage is not positive then value is not really being created.

Symbolic/expressive is “concerned with the extent to which customers attach or associate psychological meaning to a product” (Smith & Colgate, 2007). Symbolic/expressive value can also be seen as customers “representing something other than the obvious function” (Rintamäki, Kuusela, & Mitronen, 2007) of the product or service they are consuming. Thus, companies do not offer finished products as value propositions. Rather, the attached meaning to the customer defines the value received, and needs to be co-constructed together (Saarijärvi, 2012). From this perspective, symbolic/expressive value seems to be a key element in value cocreation, but perhaps not in value-in-use, the discovered application area for on-road load handling solutions. Regardless, there is enough academic merit to justify this type of value and its utilization in the practical framework for the purposes of this thesis. Furthermore, symbolic value has particularly high prevalence in luxury goods, or in parallel, to goods or services which can be considered premium in comparison with alternatives. Customers who experience positive feelings towards symbolic value of a certain brand will likely associate positive feelings with that brand (Jung Choo, Moon, Kim, & Yoon, 2012). As the context for this thesis concerns a premium-branded solution (as any additional services on a hooklift are considered premium in the industry), the inclusion of this value type is further strengthened.

Cost/sacrifice value is perhaps the most discussed value aspect in academia. In addition to seeking benefits, customers and consumers seek to minimize costs and sacrifices associated with owning, using, purchasing or otherwise interacting with a product or service (Smith & Colgate, 2007). Customer value as a combination of sacrifice and received benefits has been around since early research conceptualizations (see for example the description of the evolution of value terminology by Suryadi, Suryana, Komaladewi, & Sari, 2018; or Zeithaiml, 1988). However, in the terms of customer value of a particular solution, this value type focuses on *reducing* the costs and sacrifices made by the customer (Smith & Colgate, 2007). From this perspective, the earlier critique noted by Calvo-Porral et al., (2016) on the differentiation of cost/sacrifice and functional value seems valid, and the question must be asked: what specifically differentiates functional value from cost/sacrifice value? Functional value focuses on the specific utility of the solution being offered (Smith & Colgate, 2007), whilst cost/sacrifice specifies value as a reduction in costs (Woodall, 2003). Therefore, the differentiator must be noted that reduction in customer costs or sacrifices are the key to this type of value; however, in terms of advanced digital solutions for logistics, it has been noted that economic benefits in terms of cost reduction are long-term rather than immediately identifiable (Schröder-Hinrichs, Song, Fonseca, Lagdami, & Shi, 2019). This means that potential cost/sacrifice value to be uncovered in the discovery process will likely be long-term and needs to be specified during customer value iterations. Based on literature findings, the inclusion of this value typology is justified.

In addition to these four types of value, the framework recognizes five sources of value: Information, Product, Interactions, Environment, and Ownership/Possession transfer. These five sources are based on various value chain activities where at different touchpoints value is created for the customer.

The competence of suppliers (both operational and in terms of marketing communication) can be a source of customer value (Golfetto & Gibbert, 2006). This ties in to many of the value chain activities and sources discussed by Smith & Colgate (2007). Supplier competence can thus create meaningful information, product features (operational competences) and interactions (marketing communications). This suggests that some of the sources of value listed in Smith & Colgate (2007) are relevant for value creation. However, I believe the inclusion of these five sources of value, whilst consistent with value chain thinking and activities taking place in the value chain, is not widely theoretically justified; for the purposes of this thesis, they provide reasonable guidance for exploration, but the construction of the framework to include these five sources does not seem justified in this context.

Rather, based on the contextual nature and application area of value-in-use, a slightly modified framework should be used. The baseline proposed by Smith & Colgate (2007) is still relevant, but context-dependent modifications on sources of value need to be made. In chapter 2.4 I propose a research framework, considering specifications regarding on-road load handling and Load Handling OEM’s positioning within this domain. This proposal is based on the original Smith & Colgate (2007) framework and the literature review above. Various interviews with Load Handling OEM experts as well as Load Handling OEM customers will be used to further understand the value the company brings to its customers.

2.2 Service business, commercial models and pricing

One of the challenges for an organization that is creating additional digital services on top of existing hardware is the differences between the thinking required to sell and produce goods as opposed to selling and producing services. From the perspective of this thesis, the nuances and complications of these differences will not specifically be touched; the focus will rather be on various pricing models that can be used for advanced driver-assistance services, and the feasibility of these models.

2.2.1 From an industrial OEM to a service provider

Through the fast pace of development of modern technology, various OEMs (original equipment manufacturers) are enhancing their digital service offering as part of widening their product portfolio as well as reinventing the organization. There are many reasons for this type of development such as gaining strategic advantage through product innovation, building unique customer relationships, dealing with commoditization, or creating superior value for customers through specific, integrated product offerings (Coreynen, Matthyssens, & Van Bockhaven, 2017). Fundamentally, from the perspective of this thesis, I am interested in how these developments impact customer value and potential pricing and productization of these digital services.

Coreynen et al., (2017) further identify three distinct servitization developments: industrial servitization, commercial servitization and value servitization. Most relevant to this discussion is the concept of value servitization: where through a renewal of value chain activities and providing new digital services companies can directly impact and integrate into customer processes. This sort of servitization actions lead to a development of various resources and capabilities which tends to be more radical and new to an organization (Abernathy & Clark, 1985). Considering the case study of advanced driver-assistance services, this becomes a relevant hypothesis; building advanced service offerings that have not been seen before in an industry is likely to improve the resources and capabilities of Load Handling OEM as an organization.

Transformation, or the journey from an OEM to a service provider can be described as a continuum moving from a pure product company where services are add-on to a service-driven company where products are add-on and part of a wider value proposition (Oliva & Kallenberg, 2003). This continuum consists of various broadly defined stages, but worthy of note amongst them is consolidating service offerings, entering installed base services, expanding installed base services, and eventually taking over end user’s entire operations (Oliva & Kallenberg, 2003). This service transition continuum has also been split into a three-part version consisting of service initiation, service anchoring and service extension (Lütjen, Tietze, & Schultz, 2017). Advanced driver-assistance services mainly take place in the field of expanding installed based services (or service anchoring), as the focus of advanced driver assistance is to further aid end users in using the installed base products, as well as to further intertwine the hardware offering with the service. In service anchoring, non-price value of the service is also being explored and established; service innovation is not systematic as feasibility of various services must be established first (Lütjen et al., 2017). From this perspective, the scope of this thesis fits in perfectly with the service anchoring conceptual process. However, from the point of view of automation enablers, the eventual strategic goal of advanced driver-assistance services is to take over end user's operation of the installed base, so further service anchoring into a core feature of the end customer's need. This final stage is recognized as being rather futuristic in the service transition of product-centric OEMs; as of the writing of the seminal research by Oliva & Kallenberg (2003), no manufacturers had achieved this stage yet.

This thinking of service transitions as a continuum has also been heavily criticized, as service transitions tend to be more multi-faceted and multi-dimensional than a continuum suggests, especially with the emergence of digitalization and digital technologies (Kowalkowski, Windahl, Kindström, & Gebauer, 2015). For the purposes of this thesis however, a continuum-oriented thinking is enough as the primary purpose lies in customer value discovery rather than the internal developments of Load Handling OEM.

Furthermore, the key challenge in servitization is not in moving to a new type of business offering, but rather in "implementing service as a business logic" (Jacob & Ulaga, 2008). This is the foundation of Service-Dominant-Logic (SDL), first proposed by Vargo & Lusch (2004), where services and serving the customer become the paradigm of thinking. During the journey from an OEM into a service provider, companies often face the 'service paradox'; they are unable to earn expected returns from services, partially due to challenges in growing services, transforming business models, innovating new services and charging for new services from customers (Kowalkowski, Gebauer, & Oliva, 2017). In addition to the service paradox, creating and selling services tends to come across three main challenges. First, the economic potential might not be understood (comparing the sale multi-million-euro piece of equipment to a few thousand-euro service contract regarding that equipment). Second, providing additional services might be considered out of scope and beyond competencies for the organization, including cultural differences between service and product sales. Third, the firm might fail in deploying a successful service strategy (Kowalkowski et al., 2017; Oliva & Kallenberg, 2003). In addition to these three main challenges, the role of the salesforce of an industrial OEM must be considered. It has been suggested that only one third of the salesforce of an industrial goods-drive organization will transition painlessly to selling hybrid offerings (Ulaga & Reinartz, 2011). The reasons for this are complex and multi-faceted, but a simplified summary suggests that the magnitude of change, the specificities of hybrid offerings, and the proficiencies related to hybrid offerings sales are the main reasons (Ulaga & Loveland, 2014).

Overall, what should be synthesized from this brief overture into service literature is that developing value-adding new digital services and commercializing them is an extremely difficult task; it is largely limited by organizational structures and a lack of resources and capabilities within the organization. From the perspective of this thesis, what this means is that a deep-dive into customer value of a new service offering is in no way a comprehensive discovery of value creators and value aspects attached to that specific service, but rather the beginning of a longer exploration into customer mindsets and what can be created in this field.

2.2.2 Business models and commercial models

Business models can be described in multiple and varying ways; indeed, research in business models has been found to be siloed and according to varying definitions of what constitutes a business model (Zott, Amit, & Massa, 2011). However, even though the definitions within literature differ, it is still necessary to explore a suitable definition for this context. A business model can be roughly described as an overview of the way a company does its business (Dijkman, Sprenkels, Peeters, & Janssen, 2015) or, perhaps in a more detailed manner, as the "rationale of how an organization creates, delivers and captures value" (Osterwalder & Pigneur, 2010).

Business models and discussions around them have become popularized in recent decades as technological improvements and globalization increase the availability of various options for managers, increasing the degree of complexity and risk in the modern business environment (Osterwalder, 2004). With these increases in environment complexity, commercializing and monetizing new offerings can become rather complicated. Especially regarding the emergence of new technologies, latent value propositions become central to understanding how value can be captured (Chesbrough & Rosenbloom, 2002). Latent value propositions are defined as value propositions that have not been realized yet, i.e. there is no money exchanging hands. This perspective finds support in later literature as well with Berry (2011) stating "excellent organizations always give customers non-price reasons to be customers". Thus, commercial models can begin from identifying value propositions latent in technology; defining an offering related to this technology; finding a potential customer segment for whom this offering might be of interest; and finally aligning existing problems or new possibilities with this offering (Chesbrough & Rosenbloom, 2002).

Following the discussion above, the business model seems to be a far-reaching and over-encompassing perspective. Considering the scope of this thesis, the literature on creating and delivering value is discussed in the customer value segment; this segment will focus on various options and possibilities to capture customer value through various commercial models and methods of commercialization. Therefore, for the purposes of this thesis, I will shift to using the term *commercial model* and define it as such:

Commercial model: The specific way in which an offering will capture the value created to the customer.

Following this definition, to outline a commercial model, the value created for customer needs to be identified as well as the pricing of each value offering. Section 2.1 deals with customer value concepts in detail, whilst section 2.2.3 will deal with pricing.

2.2.3 Pricing

There is a plethora of research available on various quantitative models for strategic pricing and pricing of new technological innovations (see for example Bass & Bultez (1982); Janssen & Moraga-Gonzalez (2004); Slade (1990)). However, extensive quantitative modeling of pricing is beyond the scope of this thesis. Rather, I will take a more qualitative value-based approach, meaning that within the empirical context of this research I will outline customer value streams and make efforts to specify the monetary value for each of these value streams. As a baseline for this empirical approach, theoretical understanding of value streams and their relation to pricing are necessary.

Considering this perspective, Hogan & Nagle (2005) outline a framework called the Strategic Pricing Pyramid (see Figure 2 below). This pyramid is an approach to pricing where the fundamental building block is customer value and tools for value creation, called Value Creation. Value Creation is followed by cost-to-serve and organizational controls, seen at the Price Structure level. This is then followed by organizational constraints and controls such as marketing communications and internal policies, called Price & Value Communication. This leads to the upper two levels of the pyramid, discussing negotiation tactics, price setting procedures, and actual price. These last two layers are called Price Policy and Price Level, respectively. For the purposes of this thesis, it is enough to cover the bottom two layers (value creation and price structure) and assess their suitability and rigor for a value-based pricing framework (shown in Figure 2 below).

Value Creation is defined as understanding what creates meaningful value to different customers and customer segments, whilst Price Structure is defined as aligning value created with cost-to-serve and segmentation of customers (Hogan & Nagle, 2005). There is immediate similarity in this approach compared with Chesbrough & Rosenbloom (2002), who claim that commercial models begin with identifying customer value. In previous research on business models and emerging technologies, it has been discovered that value propositions are the most important relative building block of business models related to Internet of Things (IoT) applications (Dijkman et al., 2015). More specifically, they discovered that when using the Business Model Canvas ontology pioneered by Osterwalder (2004), value propositions are, relative to the other building blocks, considered the most important aspect when considering various IoT applications and enterprises working in the field of IoT. This is an interesting discovery and suggests that in business models of emerging technologies, uncovering customer value is a key differentiator for building successful business as also suggested in the framework proposed by Hogan & Nagle (2005). On a related note, Anderson & Narus (1998) argue that all customer offerings have two fundamental characteristics: value and price. Price may differ, but it will not impact the value a customer receives, only the likelihood of an offering being accepted. This further strengthens the argument found in the framework that value should be the fundamental building block of price.

It is also interesting to note that pricing considerations require a degree of independence both from financial sides as well as sales sides; neither required revenue or customer needs should fully dictate pricing (Kittlaus & Clough, 2009). From this perspective, a value-based approach would seem like an appropriate balancing act.

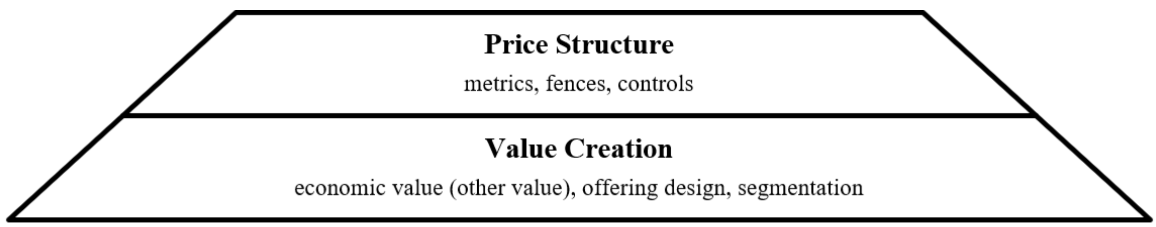

Figure 2: The Strategic Pricing Pyramid, adjusted from Hogan & Nagle (2005)

Following the literature review above and Figure 2 (above), pricing of digital services should thus follow closely an understanding of what the created additional value for customer is, what the specific customer problems that are being solved are and what the cost-to-serve is. This specification is enough to consider the commercial aspects of this case study.

2.3 Technology acceptance and automation

2.3.1 TAM and UTAUT

As part of understanding the value and commercial potential of advanced driver assistance services in the on-road logistics industry, considering the wider perspective of customer willingness and eagerness to adapt emerging technologies becomes highly relevant. Considering the adoption of emerging and new technology, it is necessary to review the literature on technology and automation acceptance, particularly from a skepticism point of view to understand what has been documented in the past as either driving or enabling skepticism of adoption.

The Technology Acceptance Model (TAM), first proposed by Davis, Bagozzi, & Warshaw (1989), is the seminal work on technology acceptance and skepticism by individuals and organizations. Throughout the past decades, multiple iterations, extensions and adaptations of TAM have been created to suit various purposes. The fundamental tenements of TAM remain the same. Perceived usefulness and perceived ease of use are the fundamental building blocks, followed by user's attitudes, intentions and actual behavior regarding the information system (Davis et al., 1989). This model has been extended several times to include various new variables, such as social influence processes (subjective norms, voluntariness, image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, perceived ease of use) (Venkatesh & Davis, 2000). Anchors, adjustments and experiences have been added which account for how perceived ease of use leads to behavioral intention, that is using or not using the system (Venkatesh, 2000). In addition, interventions and determinants to information systems usage have been considered in past research (Venkatesh & Bala, 2008). TAM has been found to be a valid and robust model with potentially very wide application into a variety of fields where new technologies and information systems emerge (King & He, 2006). Therefore, taking TAM into consideration when assessing the potential technology skepticism related to automation enablers seems a sound choice.

All these perspectives into TAM have been combined to a Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003). The model is based on extensive empirical research and literature review, and fundamentally postulates that use behavior is based on two factors: intention to use and facilitating conditions. Intention to use is further divided into performance expectancy, effort expectancy and social influence.

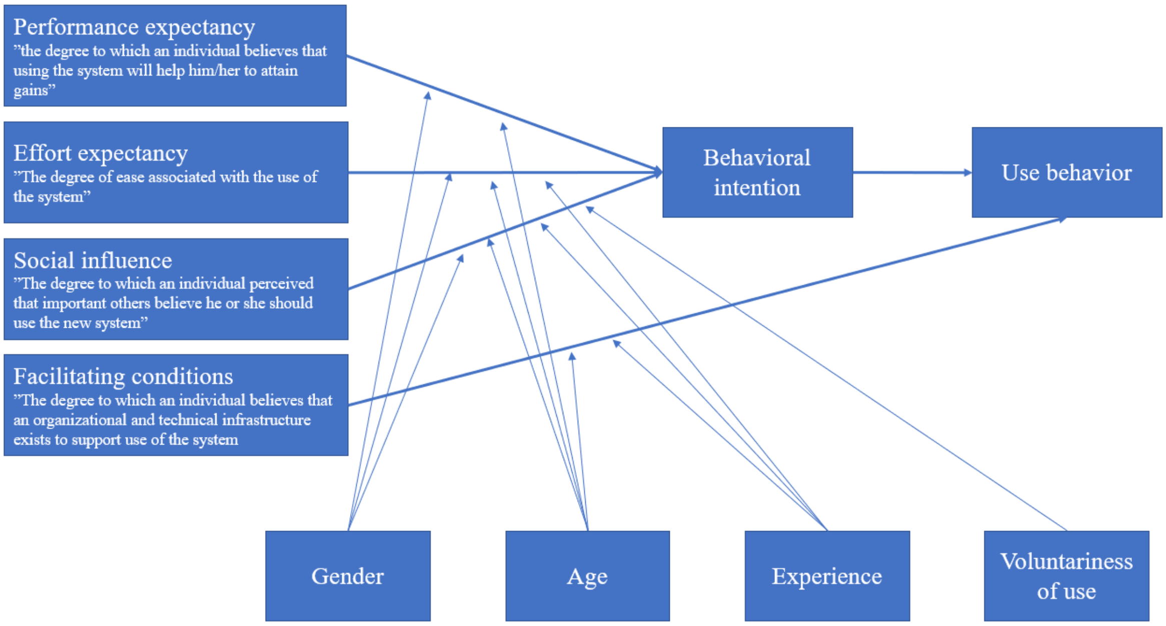

Figure 3: The UTAUT model, adapted from Adell (2010) and Venkatesh et al., (2003)

Figure 3 (above) shows UTAUT. Considering expected use of driver assistance services in cars, it has been found that *performance expectancy* and *social influence* have a statistically significant impact on intention to use a driver assistance system that supports the driver in keeping a safe speed and distance to the car in front of them (Adell, 2010). This suggests that UTAUT has valuable insight to provide for uncovering the potential for customer value in advanced driver assistance services. Furthermore, the need to validate perceived usefulness and perceived ease of use in order to determine potential adoption of this system is highlighted (Venkatesh & Bala, 2008). Perceived usefulness is the most important determinant when assessing intention to use for on-board monitoring systems in trucks and other large goods vehicles (Ghazizadeh, Peng, Lee, & Boyle, 2012). *Perceived usefulness* is one of the factors from TAM which pertain to *performance expectancy* in UTAUT (Venkatesh et al., 2003), suggesting that the view from Adell (2010) of *performance expectancy* and *social influence* is further strengthened.

From this review of TAM and UTAUT, it can be concluded that factors that are specifically important when considering customer value are *performance expectancy* and *social influence.* The customer value framework to be used therefore needs to be adapted to include these factors.

2.3.2 Automation and automation enablers: benefits and challenges

Automation of a task changes the task structure of the task previously done by humans alone. This means that the task at hand changes, as new tasks and responsibilities are required such as monitoring and coordinating activities with the new automated system (Ghazizadeh, Lee, & Boyle, 2012). Thus, adoption and integration of automation into the new task structure together with the human aspect is key when considering technology acceptance and intention to use and adapt automated technology (Ghazizadeh, Lee, et al., 2012). In other words, "automation does not supplant human activity: rather, it changes the nature of the work humans do, often in ways unintended" (Parasuraman & Riley, 1997).

As a benefit using these systems, self-reported stress as well as physiological stress measured through heart rate is lower when using semi-automated systems in vehicle parking; in addition, the quality of the performance of the parking action is higher (Reimer, Mehler, & Coughlin, 2016). As vehicle parking is a complex low-velocity environment comparable to the usage of a hooklift, it is not an unreasonable assumption that similar results could be achieved when relating to driver actions when using a hooklift. A further point of interest is that usage of semi-automated assistance systems caused unintended lapses in normal safety behavior such as using turn signals (Reimer et al., 2016). This lends credence to a suggestion that semi-automated systems might result in drivers engaging less in standard safety protocols, rather opting to trust and use the system.

However, this element of trust in automated systems is strongly contradicted in previous research. Key barriers to widespread adoption of semi-automated solutions include trust, education and sociopolitical implications (Reimer, 2014). Trust is difficult to build as there will always be a small rate of failure in automated activities and trusting technology with a certain built-in unpredictability is a challenge unto itself (Lee & See, 2004; Reimer, 2014). What this means is that identified components of customer value need to be able to overcome the barriers of trust and education when relating to hooklifts. This is further reinforced as using semi-autonomous machinery has been found to be cognitively taxing, since there is a missing key element of trust in the automated activities (Chavaillaz, Wastell, & Sauer, 2016). This suggests that even though one of the value propositions of a semi-automated crane is easier work environments through increased driver comfort, this might not be the case as being the responsible operator is still extremely stressful. The customer value application area value-in-use shows its relevance again, as it can be expected that constant usage of a system both proves its value and increases the degree of trust in its users, thereby fulfilling the value proposition.

2.4 The research framework

For the purposes of this thesis, I adapt the customer value framework proposed by Smith & Colgate (2007) based on other relevant literature considerations discovered in the previous sections. Table 4 (below) outlines the adapted framework.

Adaptations made (shown as superscripts in Table 4):

1. Functional value should solve for customer problems (Park et al., 1986)
2. Positive experiential peaks create value, whilst negative ones destroy it at a much greater rate than the positive ones create it (Fairfield, 2015; Van Hagen & Bron, 2014)
3. Represent something other than the obvious function; especially in luxury or high-end goods (Jung Choo et al., 2012; Rintamäki et al., 2007)
4. Reductions in costs as value are likely long-term rather than short-term (Schröder-Hinrichs et al., 2019; Woodall, 2003)
5. An OEM building digital services improves resources and capabilities of the organization (Coreynen et al., 2017)
6. Service anchoring, expanding installed base services to create more value for existing customers (Lütjen et al., 2017)
7. The ‘service paradox’ will create unforeseen challenges internally in value capture (Kowalkowski et al., 2017)
8. Intention to use and facilitating conditions are the primary drivers that determine use (Venkatesh et al., 2003), and of intention to use it is *performance expectancy* and *social influence* which are the most relevant (Adell, 2010).
9. Stress in activities is lower and quality of those activities is higher with assistance services (Reimer et al., 2016)

Table 4: The Research Framework

Sources of Value	Types of Value			
	Functional / Instrumental	Experiential / Hedonic	Symbolic / Expressive	Cost / Sacrifice
Information	Informs, educates, and helps customers realize performance outcomes and improve competencies[5]	Copy and creativity can provide or enhance these experiences	Can position a product, help customers identify with it, help make associations and interpret meaning	Helps customers evaluate alternatives, make more informed, faster and less stressful decisions; helps lower prices by greater competition
Products	Directly provides features, functions and characteristics that allow expected performances[8,9] and outcomes and solve customer problems[1] and expand existing value[6]	Provide sensory experiences such as reduced stress[9] augmenting goods or as the focal product clearly outweigh the negative experiences[2]	Enhance consumer self-concepts, provide personal meaning, offer self-expression, provide social meaning and social influence[8] and go beyond obvious functions[3]	Price and augmented considerations, such as operating costs, assembly, ease of use, warranty, service terms, help reduce costs and sacrifices in the long term[4]
Interactions (with employees and systems)	Sales call frequency and duration, service interactions and responsiveness, and interactions with systems provide or enhance desired performance or outcome	Service attributes (politeness, friendliness) + service recovery, customer support systems	Staff & system interactions make customers feel better about themselves, provide personal meaning; privileged interactions support status & prestige and go beyond functions[3]	Interactions with people and systems add or reduce economic & psychological cost of a product and increase or reduce the personal investment required to acquire and consume in the long term[4]
Environment (purchase and consumption)	Decorative features and attributes of the purchasing or consumption environment contribute to functional/instrumental value by enhancing or detracting from product performances and outcomes	Features and attributes of the consumption environment	Symbolic value of where a product is consumed provides meaning	Contributes to the economic cost of a product psychological cost, personal investment and risk
Ownership/ possession transfer	Correct, accurate and timely fulfillment processes (order taking, packing, delivery)	Fulfilling delivery promises and how something is delivered, pride of ownership and product potency (future potential)	How it is delivered and by whom can create symbolic value	Can be enhanced by payment terms, billing, return policies, access to systems but is challenged by the 'service paradox'[7]

Based on the literature review, the framework in Table 4 provides enough background to begin the exploratory process into understanding customer value in automation enablers in on-road load handling.

3 Methodology

This research follows the Design Science methodology laid out by Holmström & Ketokivi (2009) which is discussed in detail in section 3.1. Within this Design Science process, a case study is carried out in accordance with exemplars laid out by Yin (2012) in section 3.2.1, with semi-structured interviews as the primary data collection method. The interviews are conducted as an exploratory process, taking a guideline from Wengraf's (2001) qualitative interview procedures described in section 3.2.3. Data coding is discussed in section 3.3, with exemplars from Flick, von Kardoff, & Steinke (2004).

3.1 Applying design science to customer value exploration

Technology and digitalization enhance interconnectivity and how people and systems interact and affect one another: this interaction as a phenomena is fundamentally new, as in different from previous ways of creating value, and therefore this interaction requires new ways of discovery (Ramaswamy & Ozcan, 2018). As such, a traditional research approach found in the explanatory science research department is likely insufficient. Considering this, I will explore the application and suitability of design science to this research problem.

Customer value along with commercial models, unlike various more practical engineering challenges, cannot be definitively solved for or discovered beforehand in isolation of the customer. Customer value is a discovery process where value is generated through conversation and interaction with customers, as well as through customer processes and operations (Macdonald et al., 2011). This interaction and co-development of customer value and co-extraction of that value through commercial models are by necessity iterative processes where interaction is key to success (Prahalad & Ramaswamy, 2004).

Because the end goal is to improve the present and create the future rather than to accurately describe the present or the past, a standard explanatory research approach is insufficient. Descriptive research is driven by explanation, which is necessary but in management and business applications understanding a challenge is not enough; there needs to be enough information to also generate solutions (J. E. van Aken, 2004). In contrast to descriptive research, design science approaches focus on prescription rather than description, where the result of a research process is also suggested action rather than a more precise perspective on the present. Discussion around value-adding digital services also focuses rather explicitly on improving the present through understanding it, resulting in a prescription and a solution; this is a core facet of design science (J. van Aken, Chandrasekaran, & Halman, 2016).

Discovery processes are fundamentally different types of research challenges; they require a continuous, iterative approach to a broad-spectrum problem area rather than a specifically defined problem. In design science, artificial phenomena have to be created by the researcher, because as an exploratory approach the phenomena that is being studied does not yet exist (Holmström & Ketokivi, 2009). In the context of customer value and the value-in-use application area to be used for this case study, this means the showing of a concept video of the suggested solution. This video provides an artificial phenomenon which can then be reflected on by discussants to generate ideas for value and commercial model iterations. The video also provides a preliminary artifact to be used in exploration and added into; this concept of artifacts that can present solutions to practical problems is central to design science (Holmström & Ketokivi, 2009).

The nature of problems that call for design science to be used can be such that the research methodology matches the research process: for problems that are ill-structured or ill-defined, the design science approach is likely more valuable as the research methodology can match the research process as iterative and exploratory (Holmström & Ketokivi, 2009; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007).

Considering the above, I believe design science to be the correct approach for this type of research problem. This thesis will follow the four-stage design science methodology laid out by Holmström & Ketokivi (2009), shown below in Table 5.

Table 5: Application of a design science methodology (Holmström & Ketokivi, 2009) in customer value and commercial modeling

Stage of Design Science	Description of stage	Application of stage to advanced driver-assistance services in on-road load handling
Stage 1: Solution incubation	In this stage problem solving and solution spotting are vital.	First interviews with internal employees to understand the research problem. Creation of the design science artifact.
Stage 2: Solution refinement	In this stage the solution is subjected to empirical refinement. Testing is also carried out.	Internal and customer interviews with the artifact. “Refinement through iteration” yields relevant and functioning results (Holmström & Ketokivi, 2009).

Stage 3: Explanation 1: Substantive Theory	The theoretical relevance of the solution is defined. Context-specific theoretical contributions are extrapolated.	Interview data is used to validate theoretical contributions as well as testing the viability of the solution for practical application.
Stage 4: Explanation 2: Formal Theory	The development of theory which is not limited to the empirical context under study.	This stage is out of scope for this thesis.

3.2 Data collection

Data for this thesis was collected through detailed semi-structured interviews with the case company and the case company's customers, Load Handling OEM. As such, the case company provided a case study to use as a design science artifact. Interviews were held with mainly key account customers as well as internal stakeholders with relevant experience with either key account customers or emerging technologies.

3.2.1 Case study: Load Handling OEM

For this thesis, the subject of customer value in automation enablers will be approached through a practical case study company. The case company is a global on-road load handling OEM with multiple different product lines. This thesis will use one of their product lines, the hooklift, as the baseline for exploration. In my opinion, a case study is a prudent way of approaching research problems like this as it provides a practical real-world touchpoint to a research problem which is very much practical in nature.

In case study literature, it has been established that case studies are useful for research purposes when the questions that are being addressed are either descriptive or explanatory, or in other words, when what is being sought are rich descriptions or insightful explanations (Yin, 2012). Case studies also focus on fieldwork and studying a phenomena or incident in their real-world context, providing data in "natural settings" (Yin, 2012).

Case studies also provide domain-specific real-world knowledge that at its best can be generalizable into insight of larger tendencies. Thus, case studies can "provide a means to … explain events observed within the specific context of the new setting" (Wynn & Williams, 2012) meaning that even though the results of a case study, due to its domain-specific nature, are not directly applicable to new populations or contexts, the interplay of mechanisms and causal tendencies observed in the original case study can provide valuable information and act as generalization into theory (Wynn & Williams, 2012).

For this specific context, the question of interest is how customer value is created or co-created through the use and design of advanced driver assistance services for on-road load handling. As the pertinent question is framed through gaining an understanding into the elements of customer value and it’s commercialization, the best approach is through an exploratory case study (De Massis & Kotlar, 2014). In addition, the requirements set forth by Design Science as a research approach dictate for an exploratory method through real world artifacts or artificial phenomena (Holmström & Ketokivi, 2009); the use of a case study provides exactly such an artifact. Therefore, using a case study is a good approach to collecting data in research problems such as this.

3.2.2 Using key account customers for data collection

To gather data for iterations on customer value and commercial modeling, semi-structured discursive interviews were held with both Load Handling OEM professionals and various key account customers. For the purposes of this thesis, key account customers refers to strategically important customers who are open to collaborative ways of working rather than transactional ones (Woodburn & McDonald, 2011). By this definition, key account customers are central to the strategic objectives of a company; they are willing to learn, explore and co-create together to reach mutual benefits. Key account customers are ideal to iterate Design Science solutions with, as they are strategically incentivized for mutually beneficial solutions.

Customer knowledge has been proven in managerial research to be a key resource and source of competitive advantage for many companies by several authors; Salojärvi, Saarenketo, & Puumalainen (2013) write a comprehensive overview of the literature, establishing that proactive use and dissemination within the organization of information provided by customers results in valuable knowledge assets. It can therefore be stated that iterative processes that focus on identifying relevant value aspects should include the provision of customer information; particularly in cases of value-in-use where the daily experience of the customer determines value.

Customer knowledge and the use of customer-specific knowledge, especially in the form of key accounts is important for companies (Salojärvi, Sainio, & Tarkiainen, 2010). Successfully managing international key accounts improves market performance of an organization; trust between actors in key account management is an essential element of success in this regard (Jean, Sinkovics, Kim, & Lew, 2015). As part of building this trust, companies can enact various key account management practices which result in measurable results, such as increased customer satisfaction and increased shared investment into new ventures (Davies & Ryals, 2014). From this perspective, using Load Handling OEM's key account customers for exploratory purposes makes sense, as it is not just an act of design research but simultaneously a part of larger relationship management that has great potential payoffs in the future.

3.2.3 Semi-structured discursive interviews

The interviews with the key account customers will be discursive and open-ended to create an atmosphere of sharing and discussion conductive to design science research and honest feedback on the artifact to be presented. In addition, discursive and open-ended interviews have potential to lead to a wide variety of received data. This is particularly useful to exploring vague and poorly defined concepts such as customer value, since "the more abstract the theoretical concept, the greater the number of indicators that need to be examined" (Wengraf, 2001) which suggests that eliciting a wide variety of perspectives during interview situations is required to properly understand the elusive notion of customer value. In addition, using customer input to fuel innovation in the style of design science, interviews should focus on capturing customer's desired outcomes rather than features, products or services that deliver these outcomes (Ulwick, 2002).

The interviews will be structured in the following manner:

1. <u>Elaboration around the topic</u>. The interviewee will be asked to describe their business challenges related to operating hooklifts. The follow-up questions will guide the interviewee towards discussing the following themes:
   a. <u>Value Streams</u>. This theme seeks to draw narrative from the interview regarding challenges in current operations that can effectively be solved for by the design science artifact.
   b. <u>Technology Acceptance</u>. As per Venkatesh & Bala (2008), during this section of the interviews it is important to identify customer's *perceived usefulness* and *perceived ease of use*. Without understanding these, actual value created for customer remain open for interpretation.
   c. <u>Automation Enablers</u>. Interviewees will be asked to describe their perception of automation in this field, and the potential enablers for it and the need for automation.
2. <u>Extracting more story from the topic</u>. Anything of interest, or anything that the interviewee is particularly passionate about will be followed up with

further questions. However, this must be done carefully as not to elicit false replies based on interviewee expectations of what the interviewer wants to be discussed (Wengraf, 2001).

3. Further questions arising from analysis of the first two parts. After a suitable period, if there remain any specific open questions, the interviewees will be contacted again for a short follow-up.

The process laid out above finds support from literature such as Wengraf (2001) and is in my opinion sufficient to elicit narrative regarding the subject at hand.

The table below (Table 6) maps out all the interviews conducted for this thesis. In total, 17 interviews were conducted across 5 different countries. The interviews were mainly carrier out through telco, except where the interviewee and the interviewer were in close geographical proximity. The interviews featured perspectives from 21 distinct people, of which 11 were customers and 10 were internal stakeholders. The column title '# of people present' does not accurately display this, as some of the people interviewed were present for multiple sessions. All customers interviewed were key account customers. See section 3.2.2 for an overview of why choosing key account customers as a data source is beneficial. Internal stakeholders interviewed were salespeople or frontlines deeply involved with key account customers or R&D engineers involved with developing digital solutions. They were chosen as interviewees because of their market and technology knowledge.

None of the interviews held were recorded. I will discuss and speculate on this further in section 5.3 on limitations.

Table 6: Full list of interviews (internal and customer)

Number	Date	Country	Internal or Customer	# of people present	Roles of participants	Length	Purpose of Interview
1	12.11.2018	Country 1	Internal A	2	Product Manager	1 hour	Establishing context
2	16.11.2018	Country 1	Internal B Internal C	2	Director of product development, product owner	30 minutes	Value hypothesis mapping
3	28.11.2018	Country 2	Internal D	1	Global Key Account Director	30 minutes	Reflection on customer value and interview questionnaire
4	3.12.2018	Country 1	Customer A	3	Fleet manager	2.5 hours	Interview on industry challenges

5	5.12.2018	Country 1	Customer A	1	Fleet manager	30 minutes	Follow-up on commercial models
6	5.12.2018	Country 2	Internal D	1	Global Key Account Director	30 minutes	Follow-up on customer value and connection to global customers
7	12.12.2018	Country 3	Internal E	1	Head of local sales	1 hour	Local perspective into customer
8	7.1. 2019	Country 2	Internal F	1	Head of local sales	1 hour	Local perspective into customers
9	8.1.2019	Country 1	Customer B	2	Fleet manager, Services manager	1 hour	Interview on value potential
10	10.1.2019	Country 4	Internal G Internal H	2	Key account manager and frontline sales	30 minutes	Local perspective
11	20.2.2019	Country 4	Customer C Internal G Internal H	5	Fleet manager, business responsible, technical manager	2 hours	Interview and concept introduction
12	25.2.2019	Country 2	Internal I	2	Head of local sales	20 minutes	Local perspective into customer
13	26.2.2019	Country 2	Customer D	1	Fleet manager and training responsible	45 minutes	Interview on value potential
14	7.3.2019	Country 4	Customer E Internal G Internal H	2	Fleet managers	1.5 hours	Interview and concept introduction
15	15.3.2019	Country 2	Customer F	1	Fleet manager	45 minutes	Interview and concept introduction
16	22.3.2019	Country 5	Customer G	2	Owner, Test Driver	1 hour	Interview on practical value
17	28.3.2019	Country 4	Customer H Internal H	2	Fleet managers	2 hours	Interview and concept introduction

3.3 Data coding and analysis

Interview data for this thesis will be coded according to the five stages of analysis for semi-structured interviews laid out by Flick et al. (2004). The stages and their application to this thesis is laid out in Table 7 below.

Table 7: Stages of analysis for semi-structured interviews, based on Flick et al (2004).

Stage of analysis	Description of stage	Practical Application
Stage 1: Formation of Analytical Categories	Categories for analysis are set up based on interview material. Done by intense and repeated reading of the material	Detailed notes from the interviews were reviewed and reread.
Stage 2: Assembling the categories	Categories brought together, tested and revised. Contains detailed descriptions of the individual categories. Detailed description of individual categories and different version for each category.	Categories were assembled by labeling interview passages with certain thematic tags, then writing descriptions of these tags. Internal interviews were used to validate this part.
Stage 3: Coding the material	Interviews are coded according to analytical categories. Coding refers to relating specific passages in the text (transcript or notes) to an identified category. Each interview is assessed and classified according to analytical categories. Descriptive labels for each category formulated, and they must be distinct.	Rereading the interview material and labeling passages with coded tags is done.
Stage 4: Quantifying the material	Based on coding, case overviews are produced	Coding leads to various concepts using the Gioia methodology.
Stage 5: Case interpretations	Individual cases are selected for in-depth analytical study based on stage 4	This stage is out of scope for this thesis.

After conducting this interview coding, I expect to have identified various first order concepts. These concepts will need to be further refined into overarching second order themes and aggregate dimensions. This is directly in line with the Gioia Methodology (see for example Gioia, Corley, & Hamilton (2013)).

4 Findings

This findings section will loosely follow the Design Science structure laid out by Holmström & Ketokivi (2009) and described in Table 5 in Section 3.1. First, I will define the problem in practical detail using empirical data. Then, I will incubate and refine solutions. Finally, the refined solution will be tested, and the results of the test discussed.

Table 8 (below) shows an overview of my findings: the identified context, aggregate dimensions and second-order themes. For a comprehensive list of first-order concepts along with detailed descriptions, please see Appendix A.

Table 8: Findings overview: Context, Aggregate Dimensions and Second-order Themes

Context	Aggregate Dimensions	Second-order Themes
Safety and Efficiency	Customer Pain Points	Lack of skilled drivers
		Poor visibility from cabin
		Diverse operating environments
	Feedback on Service Features	Obstacle Detection & Driver Assistance
		Hook Height & Roller Alignment
	Adoption Drivers	Customer needs
		Pioneering technology
		Drivers want/need assistance services
		Decreased insurance costs
	Adoption Blockers	Technology skepticism
		Limited scope of hooklift activity
		Perception of environmental complexity is viewed as unsolvable
		Company maturity solves for problems in other ways
		Increased cost of purchase

4.1 Defining the problem: safety and efficiency

All the aggregate dimensions discovered ultimately have to do with either safety or efficiency. Therefore, I have taken the approach to describe safety and efficiency as an overarching context. Depending on the interviewee, these two context creators consistently come across as one of the top priorities and they are the underlying reasons for any innovations in this field. All aggregate dimensions, and the following second-order themes deal with concerns that touch on either safety or efficiency.

4.1.1 Customer pain points

Customer pain points are defined as specific themes or problem areas within the current way of operating that the customers believe are their key business challenges and need to be solved for. In terms of understanding the commercial potential of automation enablers, these pains are something that advanced driver assistance systems need to address to be of interest to customers.

Within Customer Pain Points, three specific second-order themes were discovered.

Lack of skilled drivers. Customer interviews confirm and identify the lack of skilled drivers as a specific problem area. Customer B confirms that “new drivers arriving in the company can’t drive yet; they also rarely stay in house as the work is physical and demands long hours”. Finding drivers is further validated with Customer C, who says drivers do not want to come work for them as this is a “dirty job”, and “You must love to drive a truck to do this work”. Customer A further states that “in the future, finding drivers will be our biggest problem”, whilst Customer H states “finding enough staff to do the work” as one of their key challenges. This lack of skilled drivers is further mentioned and discussed by Internal B, Internal C, Internal D, Internal E, Internal F, Internal G, Internal H and Internal I. Their perspective can be summarized that a lack of skilled drivers is the fundamental reason behind a large portion of safety challenges faced by the industry.

Poor visibility from cabin. Customer G states that the visibility from the cabin is so poor that he needs to get out during even simple operations to view the environment. Customer H currently uses an assistant driver (essentially a second person in the cabin) to act as guide for the primary driver because the visibility is so poor. Customer H further states that with advanced and accurate reverse cameras, the driver can do this alone, but these systems are deemed as too costly for their current quality. Customer D has invested heavily into camera vision systems to improve the visibility of surroundings from the cabin, as this is viewed as the single largest pain point of this customer.

Diverse operating environments. Customer B states that “the complexity of the operating environment defines the usefulness of services like this”. The more complex the environment (meaning the number of people, vehicles and objects in it, the levelness of the ground, how much space there is for maneuver etc.) the more challenging the operation of a hooklift, therefore the more useful features with offer driver guidance. Customer E concurs, describing that in their business, they use the same trucks in multiple environments such as cities and construction sites, where the constantly changing environment creates a key challenge for them.

4.1.2 Feedback on service features from customers

There are two distinct parts to the features of the design science artifact used for this research. Obstacle Detection and Driver Assistance refers to using cameras and lidar technology to create awareness and visibility of the operating environment which can be further used to build guidance services that enable the driver to maneuver in the environment effectively to put the truck in a valid position to pick up the container. Hook Height Detection refers to the hook arm part of the hooklift, and through cameras and lidar technology guiding the driver on the height and positioning of the hook arm required to successfully lift the container. Roller Alignment focuses on improving the visibility of the guidance rollers and the safety locking mechanism, to ensure that while the container is being pulled onto the truck it will be aligned with the truck bed and arrive in the correct position so that the safety locking mechanisms can successfully lock it into place.

Obstacle Detection and Driver Assistance. These features, whilst essential for automation and eventual autonomous tasks, are interestingly viewed with high skepticism from the customer side. Customer F mentions that automation or autonomous tasks are not desirable from their perspective as they wish to keep the driver engaged throughout the operation. Customer F also points out that properly functioning obstacle recognition can be immensely valuable as operating environments often have challenging maneuverability and effectively reducing damages can be key. Customer A and Customer G suggest that features like this one, whilst technically providing added value in terms of reduced damages and more efficient operations, will likely not be used by drivers as they feel these features can question their competency and particularly more experienced drivers will dislike technological assistance.

Hook Height Detection and Roller Alignment. Hook height guidance and roller alignment is validated as a key area of interest by all but one interview (Customer A, Customer B, Customer C, Customer D, Customer E, Customer F, Customer H). The perception from the customer side is that these features are easy fixes to common problems and would increase efficiency. According to Customer E, maloperation of the hook arm creates the greatest slowdowns in operating cycles and damages which they need to fix. Customer G discusses the roller alignment feature, stating that it is an easy to fix to a common problem; because of improper roller alignment, he sees containers and trucks tipping over monthly. Customer D states that hook height misalignment causes considerable damages to property but views it as a cost of doing business rather than a specific, solvable problem.

4.1.3 Adoption drivers

This section refers to interview themes that aid in the adoption of emerging technologies in this industry. Four key adoption drivers were identified. Customer needs refer to the fact that automation enabling advanced driver assistance services can fulfill real life needs and solve for priority problems. Pioneering technology refers to interviewees describing their willingness to take part in creating the future of the industry by actively piloting and taking into use emerging technologies. Drivers want/need assistance services refer to what the drivers themselves, rather than the managers of their companies, feel about assistance services. Decreased insurance costs refer to the potential of reducing insurance costs through taking into use vision systems that prevent accidents.

Customer needs. Customer C discusses at length how their customer's demand for more automated and autonomous solutions in hooklift operations. This suggests that there is real demand pull from the operative side to take into use technologies such as this. Internal A, Internal B, Internal C and Internal D also agree with this statement; from their experience, various stakeholder groups are asking for more autonomous features in on-road load handling machinery.

Pioneering technology. Customer C views that technology like this is the future and that driver behavior and actions need to be augmented with technology to reduce mistakes and accidents. Internal B and Internal C agree, continuing that they believe being a pioneer in technological innovations will not only reduce driver mistakes and accidents, but will add to the brand value of Load Handling OEM. Customer E states that human aspect will remain and be needed in this business, but the foreseeable future will require support form technology to remain competitive. Customer A continues along the same lines, stating that removing actions from the driver and having them done through automation or autonomous operation is likely beneficial in the long term. Customer C agrees; they want drivers to do as little as possible in the future. Interestingly, Customer A specifies that driver assistance services are likely not valuable as they still enable drivers to act against the guidance of the system; more autonomous action is required to gain full benefits. Furthermore, Customer H notes that Load Handling OEM is in a unique position due to its global customer base to drive technologies like this forward and should capitalize on that position to build the future of this industry.

Drivers want/need assistance services. Customer B states that advanced driver assistance services "will likely reduce the barriers to enter this industry" as younger drivers enjoy using technical gadgets. This finds support from Customer C, who says "newer drivers will be happier if the job is made easier". Customer E agrees with these sentiments, believing that younger drivers will adapt to new technologies faster and be more enthusiastic about their jobs with the aid of technology. These ideas find support also from Internal B and Internal C, who believe that advanced driver assistance services can make work more pleasant and meaningful. On the other hand, Customer G points out that driver assistance systems will likely increase the confidence of drivers, empowering them in their daily jobs and allowing them access to more information by which to make decisions.

Decreased insurance costs. Customer D mentions that camera systems which fulfill certain local requirements in terms of added visibility lead to lower insurance costs.

4.1.4 Adoption blockers

Adoption blockers relate to identified themes which prevent the adoption of automation enabling advanced driver assistance services in this industry.

Technology skepticism. Overall, the interviews identified that customers in this industry are highly skeptical of the capabilities of emerging technologies. Customer B summarized this skepticism by saying that all technological innovations in this field have three main concerns: "durability, operational reliability and sensitivity to failure". Customer B continues that in case of technology failure, the entire machinery becomes useless without a failsafe.

Customer F is worried that "computer systems will make people lazy", leading to carelessness in the activities that are ultimately the driver's legal responsibility to handle safely. Customer D agrees, concluding that driver assistance systems could decrease the perception of safety, as drivers will no longer follow procedure in ensuring safe operations but will just let the system guide them without checking whether the system is correct. Customer H adds onto this the perspective that there might be too much technology that serves different purposes in this operating environment, such as vision systems, fleet management systems, task managers, communications tools etc.

In addition, the functionality of hook height guidance under uneven ground and other environmental concerns is raised by Customer B, Customer C, and Customer E. This is a realistic concern, but it portrays a basic mistrust of technology and what it can accomplish in this operating environment.

Limited scope of hooklift activity. From the perspective of Customer A, Customer B, Customer D, and Customer F, advanced driver assistance services for picking up containers have a limited scope in terms of usefulness. These customers feel that picking up and setting containers is not the most critical activity in their business, but rather the driving of the truck from one place to another. Fully autonomous vehicles, that drive themselves might provide more value in terms of safety and efficiency than autonomous container pickup.

Perception of environmental complexity is viewed as unsolvable. When asked if they view automation and autonomous activity in the industry possible, Customer G replied with a “That’s stupid!”. With further elaboration, Customer G described that the environmental uncertainty is always too large to fully trust any automated or autonomous features. According to testimony, there will always be people, obstacles or other machinery moving about in the operating environment, making automation near impossible. Customer B seems to agree, stating that they are mistrustful of how systems will perceive the environment around them. This ties in with technology skepticism discussed earlier; there seems to be a fundamental mistrust of emerging technology in this industry.

Company maturity solves for problems in other ways. Customer D and Customer H are already solving for the various identified pain points (see section 4.1.1) by extensive internal initiatives. Customer D states that all their drivers go through two weeks of induction training, and their internal processes and procedures are such that they effectively maintain the skill level of their driver base whilst investing into various camera systems to increase visibility. Customer D is clearly a digitally mature company, for whom early stage automation enablers do not create added value. Customer H is investing heavily into various IoT solutions to create more awareness of their operating environment; as such, they are increasing their own control over their environment, thereby decreasing the variance of environmental factors and decreasing the chances of accidents. Customer H also has special insurance policies which lead them to not be concerned with damages created by driver mistakes.

Increased cost of purchase. In addition to a technology skeptical industry, on-road load handling is also very cost conscious. Load Handling OEM is already branded as a premium provider, making its offering more expensive than the competition. Customer A directly states that as it stands, “the added value of this application is not worth the price”. Customer B and Customer E agree, stating that in their opinion the price is too high without automated or autonomous features added on. This view finds strong support from Internal E, who states that at the end of the day, customers care about “euros, euros, euros!”. From the perspective of Internal E, Load Handling OEM is already struggling to compete as a premium provider; customers in his country are operating on such slim margins as is that they are not willing to pay for any additional functionalities regardless of the perceived benefits, especially if those benefits involve risks such as taking into use emerging technologies.

4.2 Iterating the research framework

This section is an iteration of customer value frameworks used as a guidance for this exploration. As per the Design Science process, potential solutions must be iterated and refined through empirical and theoretical contributions.

4.2.1 Solution incubation

Table 4 in section 2.4 shows the original research framework, with the modifications made after the literature review. Part of understanding customer value for automation enabling advanced driver assistance services has been the constant iteration of what customer value means in the context of on-road load handling.

As part of conducting Design Science Research, one of the earlier stages is ‘Solution incubation’ (see table 5 in section 3.1). I establish and understand the operating context of Load Handling OEM as well as its customers. In addition, this stage focused on introducing me to the artifact created, so that further portions of the research could be carried with enough contextual awareness of the area under exploration. As a result of this stage, initial hypotheses of customer value drivers of automation enabling advanced driver assistance services were discovered and mapped to the adjusted Smith & Colgate (2007) framework (see Table 9 below). Table 9 is a direct result of interview data from Internal B and Internal C.

Table 9: Preliminary value hypotheses mapped onto the research framework

Sources of Value	Types of Value			
	Functional / Instrumental	**Experiential / Hedonic**	**Symbolic / Expressive**	**Cost / Sacrifice**
Information (advertising, PR, brand management)			Creating and advertising high-tech solutions strengthens the Load Handling OEM brand as a trailblazer in the industry	
Products (features, attributes)	Direct features of these services are perceived as beneficial for customers	The experience of using assistance services makes everyday work more pleasant		Features of the product minimize long-term operating costs & increase safety of operating environment
Interactions (with employees and systems, service quality, operations)	Interacting with the system fulfills the value proposition of beneficial features	Using the system creates feelings of competence, confidence, and capability in the customer's work	Customers experience prestige in using high-tech solutions; they feel advanced in comparison with their peers	Constantly interacting with the system reduces costs related to driver failure; interacting with the system increases health & safety of employees and surroundings
Environment (purchase and consumption)	Impact of environmental conditions is lessened through service features	Customers experience pride being seen using high-tech services	Being seen using high-tech premium brand solutions signals quality to customer's customer	
Ownership / possession transfer		Owning high-end and high-tech solutions provides value as customers experience pleasure through ownership	Owning high-end premium solutions provides value to customer's customer	

As per Table 9 (above), the hypothesis from Internal B and Internal C is that primary customer value comes from lessening the impact of environmental aspects through appropriate features and reducing costs of operations through these features. In addition, the Load Handling OEM brand value will be improved from being perceived as an industry trailblazer. Additional value hypotheses mentioned by Internal B and Internal C are improving customer experience of using Load Handling OEM products through advanced driver assistance services; however, this is a secondary value hypothesis.

4.2.2 Solution refinement

Following this initial iteration, I propose an updated version of the research framework with considerations from substantive theory as well as the empirical data presented in section 4.1. This updated version proposes a context-specific customer value framework that can be used for the purposes of exploring customer value in the context of on-road load handling. The framework is shown below, in Table 10.

Table 10: Final iteration of the research framework for digital solutions in on-road load handling

Sources of Value	Types of Value			
	Functional / Instrumental	**Experiential / Hedonic**	**Symbolic / Expressive**	**Cost / Sacrifice**
Information (advertising, PR, brand management)			Creating and advertising high-tech solutions strengthens the Load Handling OEM brand. Being ahead of vs competitors has brand value.	
Products and interactions (features, attributes)	Container choice & guiding, hook height assistance, obstacle detection, roller alignment are valuable features.	The experience of using these features makes everyday work more pleasant and meaningful. This attracts new talent to the field.		Features of the product minimize long-term operating costs & increase safety of operating environment
Usage environment	Impact of environmental conditions is lessened through these features.	Customers experience pride being seen using high-tech services.	Being seen using high-tech premium brand solutions signals quality to customer's customers.	
After-sales	Functionalities are properly maintained through extensive service network, enabling constant benefits to customers.	After-sales networks create seamless and convenient customer experiences.		Efficient after-sales service organization reduces customer's costs and sacrifices
Ownership		Owning high-end and high-tech solutions provides value as customers experience pleasure through ownership	Owning (higher investment) high-end premium high-tech solutions provides value to customer's customer.	

In this proposed framework, Types of Value stay the same as in the original Smith & Colgate (2007). See section 2.1.5 for a literature review discussion on these various Types of Value.

However, the column Sources of Value undergoes considerable changes. Sources of Value are understood as value chain activities that create value for customers. As such, they are bound to depend considerably on the industry they are applied to, as in different industries different value chain activities will create value for customers.

Information as a value chain activity is retained from the original framework. Feedback from Internal B, Internal C and Internal I confirms that high-tech solutions improve the brand value of Load Handling OEM. Internal I further states "Looks fantastic!" when asked to describe the value of the solution, and states that advanced driver assistance services are a brand image boost. Therefore, information is largely a creator of symbolic/expressive type value creator.

Products and interactions are combined into a single value chain activity. This is because from the literature review conducted in section 2.1.3, it is established that value-in-use is the proper customer value application area when discussing advanced driver assistance services. What this means in practice is that when it comes to on-road load handling, products and interactions are inseparable, as the value for customer of the product is created through the daily interactions and usage of the product. In addition, Customer A states that they buy Load Handling OEM products because "we can't break them on purpose", suggesting that the high quality of Load Handling OEM products is a customer value in and of itself.

Usage environment is a specified version of the original purchase and consumption environment. Because of the nature of on-road load handling solutions, consumption environment is a key source of value. This is further highlighted through empirical data: Customer G, Customer E and Customer H validate the importance of the usage environment as a value chain activity, stating that the more complex the environment, the more value advanced driver assistance solutions can bring.

After-sales is an additional source of value specific to the context of heavy machinery. Because heavy machinery requires lots of maintenance, the ability of Load Handling OEM to provide a comprehensive after-sales network is a key value chain activity creating customer value. This is highlighted by Customer A, who cites well working after sales as their secondary value creator.

Ownership is the final value chain activity applicable to this specific context. Customer A says they will likely purchase some installations of advanced driver assistance services because owning hooklifts with these services has symbolic brand value. In addition, Customer C and Customer E believe that owning installations of advanced driver assistance services might aid them in recruiting new drivers to their respective companies.

4.3 Solution testing: discovering commercial viability through customer value

Using the understanding of customer value through the research framework described in section 4.1 and 4.2, I will proceed to estimate the commercial viability of advanced driver assistance services in on-road load handling.

With Hogan & Nagle's (2005) Strategic Pricing Pyramid and the accompanying process description (see Figure 2 and the literature review in section 2.2.3), the conclusion that a detailed understanding of the customer value offering leads to a price can be reached. A detailed understanding of the customer value offering is described both in section 4.1 and 4.2. Looking at all this data from a big picture perspective, three explicit customer value streams are identified. These three streams, almost verbatim, are also specifically listed by Customer C and Internal I when discussing the value streams of advanced driver assistance solutions for on-road load handling. Table 11 (below) shows these three customer value streams along with the discovered commercial value and further comments on each stream.

Table 11: Commercial pricing of identified value streams

Value Stream	Commercial Value	Additional Comments
Reduced accidents	17 monetary units	Refers to minor damages to property caused by mishandling of hooklifts by drivers
Simplified hooklift activity (first-time right)	*unknown*	Includes time efficiency benefits of faster and easier operation
Increased safety of operating environment	15 monetary units	Reduced human accidents by increasing visibility of environment

Commercial value for **reduced accidents** is calculated using customer estimates on how much money they lose on an annual basis for minor damages caused by mishandling hooklifts. Commercial value is calculated by taking the total annual estimate, then dividing it by the proportion of hooklifts to total trucks in their fleet, to gain an approximation of annual damage costs per hooklift. This method led to the per hooklift figure of 17 monetary units paid out in minor damages. Overall, Customer C, Customer D, Customer E, Customer F and Customer H were willing to contribute estimates of annual damages caused by misusing hooklifts; this 17 monetary units is based on the average of the numbers they provided as per the method described above.

Simplified hooklift activity is left as *unknown*. This is because this value stream assumes that using advanced driver assistance services improves the efficiency of hooklift usage. In practice, this means that with the aid of driver assistance, drivers would be able to pick up containers on the first try rather than making a mistake reading the environment or position of the container and crane and needing several tries to succeed. To effectively measure this, driver performance data based on the observed performance difference between using driver assistance services and not using them would be needed.

Increased safety of operating environment is based on benchmarking the pricing level of current camera-based driver vision improving solutions. The value proposition of a solution like this different, as they only provide improved vision rather than driver guidance. However, from a customer perspective, fundamentally improving the visibility of the operating environment to the driver is a value driver in and of itself. Internal F, Internal I, Customer D and Customer F all provided estimates on the specific number that they currently pay for camera systems which provide improved visibility. These estimates average out at 15 monetary units.

Further along the customer interview script, I posed a question regarding the **willingness to pay** for an advanced driver assistance solution that delivered the kind of value described. Considering the contextual challenges described in section 5.3, the figures received as a response should not be considered entirely exact, as the interview situation was also treated as the first step of a sales negotiation by some participating stakeholders; it is entirely possible that this led to lower estimates of pricing. Discussing willingness to pay, Customer H provided the figure of 10 monetary units; Customer D and Customer F stated that they would be willing to pay less for this advanced driver assistance solution than they would for a more comprehensive driver vision improvement system (which cost around 15 monetary units), as they perceived the added value as smaller.

Overall, benefit to customer can be proven at 32 monetary units, but preliminary analysis of willingness to pay caps at 10 monetary units. In addition, technology costs, bill of materials and business line margins of the advanced driver assistance solution combine for a cost between 35-50 monetary units. This means that with the current technology cost and perceived value, customers are unlikely to be willing to pay for this solution on a wide scale. Individual purchases are still likely to occur, as some customer value drivers are based on symbolic/expressive value creators (see Table 10 and the accompanying discussion). Therefore, in the short-term advanced driver assistance services that act as automation enablers are **not commercially viable**.

5 Discussion

5.1 Managerial implications

Regarding the managerial implications of my research conducted, three distinct implications deduced from the findings section arise:

Building automation enabling advanced driver assistance services in on-road load handling is not a viable standalone business with current technology costs. Based on the findings in section 4.3, current technology costs for constructing automation-enabling advanced driver assistance services eclipse the monetary sum of customer value as well as the customer willingness to pay. This is only a result of a context-specific case study; however, an industry-specific press release ("Automated Driving at Daimler Trucks," 2019) makes the same arguments. Customer value elements such as ease of use, increased safety, and symbolic value of advanced digital service offerings were discovered to create quantifiable customer value but not enough to equal or exceed technology costs of constructing these services now.

Long-term trends still support building these services. There is considerable belief in the industry, both inside Load Handling OEM and demand-pull from its customers, that automation is the way of the future and that automation enablers will be needed in the coming years. Particularly challenges regarding skilled drivers are perceived as growing in the future (as also validated by Lodovici et al. (2009) and *The Driver Shortage : Issues and Trends* (2016)). In addition, the larger macro trend of population growth and urbanization is seen as a driving force that creates demand for further automation of mechanical activities. This combination of urban congestion and ever-decreasing levels of skill are simply perceived as too challenging for automation to not be a future necessity. Automation enablers and driver assistance services are viewed as futuristic, but perhaps still too far away to impact the immediate daily operations.

Technology skepticism within the industry is too high for digital transformation to take place currently. Here, digital transformation refers to widespread adoption of advanced driver assistance service. Skepticism within the industry is so high as to require further proof of value and baby-steps through initial use cases. Drivers as well as fleet managers and other personnel within customer companies are extremely skeptical of the reliability of the functionalities claimed by advanced driver-assistance services. As this is a practical industry, the reliability of these functionalities will need to be proven through rigorous daily use. The discovered value conceptualization of value-in-use for these types of applications supports this conclusion.

5.2 Theoretical implications

Theoretical implications of my work are achieved by further validation of existing theoretical concepts and trends and by redesigning Smith & Colgate's (2007) customer value framework to suit a specific context. From this perspective, Design Science Stage 3 (contribution to substantive theory (Holmström & Ketokivi, 2009)) is achieved.

Validation of existing theory include adding to the body of knowledge which concludes an upcoming driver shortage crisis in the on-road load handling industry noted for example by Lodovici et al. (2009). Customer and internal interviews indeed confirm that skilled driver shortage is a key future challenge faced in this industry, and needs to be addressed on multiple fronts, of which one is making operation of heavy machinery easier. In addition, the Design Science process laid out by Holmström & Ketokivi (2009) is used and found to be sufficient, if not excellent, for conducting this type of exploratory research. Their process description provided the necessary framework, and this research further proofs the adaptability and usability of the process. Of customer value conceptualizations, I mentioned in the introduction that customer value has been described as “indistinctive and elusive” (Zeithaiml, 1988) or “ill-defined” (Grönroos & Voima, 2013); after conducting my research, I believe these descriptions are more accurate than ever, with customer value being entirely dependent on the individual customer and their perceptions; in the past, this has also been noted by Huber et al. (2001) and Clulow et al. (2007).

A redesign of Smith & Colgate (2007) to suit a practical context is further discussed and iterated in section 4.2. Suffice to say that on the grounds of theoretical implications for customer value in on-road load handling and customers of industrial OEMs, after-sales and usage environment were discovered as significant value chain activities which create customer value in this context. After-sales as a source of customer value finds support in previous literature as well, see for example Verstrepen, Deschoolmeester, & van den Berg (1999). In addition, due to the customer value conceptualization of value-in-use, the products and interactions value chain activities are found as indistinguishable and merged into a single value chain activity (Grönroos & Voima, 2013; Sweeney et al., 2018; Vandenbosch & Dawar, 2002). This is something that is likely to apply to other application areas as well that deal with similar heavy machinery, despite the industry or context. The same applies for after-sales; any heavy equipment is likely in need of constant maintenance, whereby after-sales becomes a significant value chain activity in that industry (Verstrepen et al., 1999).

5.3 Limitations

A potential limitation is the scope of the study conducted; the benefits and suitability of a case study deep-dive are analyzed in section 3.2.1, but there are limitations to using a single case study as the design science artifact. Limited scope of data collection is one of these; a hooklift is only one type of on-road load handling solution where exploring the commercial viability of automation enablers is relevant. Further case studies, considering different types of lifts and cranes would likely have yielded more complete data on the customer value and commercial viability of automation enablers.

5.3.1 Language challenges

Due to the nature of the logistics industry as attracting practically-minded individuals who are usually not familiar with a wide variety of languages, and the countries in which the interviewees were selected, some interviews had to be conducted with the aid of intermediary parties who provided translation as well as perspective within the interview. Therefore, it must be recognized that some of the interview data received is not as fully fleshed out in narrative as it would have been had the interview been conducted in the native language of the interviewee.

Interviews conducted in Country 4 and Country 5 featured third parties who acted as translators. This resulted in scenarios where a considerable portion of the narrative generated by the interview questions was discussed in the language of the country of the interviewee. As the interviewer, I do not fluently speak the languages of Country 4 and Country 5, meaning that some of the narrative was limited. The effects of this are unknown, as I cannot analyze what I don’t understand. However, it is still worth noting that language was a limiting factor in collecting data.

5.3.2 Unrecorded interviews

None of the interviewed customers were comfortable with the interview being recorded. This led to me having to rely on extensive notes whilst making the interview, and it is entirely possible some narrative was missed out because of this reliance on note-taking rather than transcriptions.

I have several hypotheses on why the interviewees declined recording. The first is my perception of the industry as skeptical of technology as well as ‘blue-collar’ in nature. This means that the people who I interviewed are not personally familiar with research methods as they have not been trained in them but are instead very practically oriented. This can create a healthy but also encumbering attitude towards academic research and could be a factor increasing their reluctance of being recorded.

My second hypothesis is one I personally find more believable. The subject of the interviews was emerging products for Load Handling OEM and customer value. Both are secretive and sensitive subjects, with the fear that business critical information is being discussed and revealed by all parties. Even though the customers I interviewed were key account customers of Load Handling OEM and therefore have long-lasting trusting relationships, I did not have personal relationships with any of the interviewees before the interview. It is therefore possible that this lack of personal relationships made the interviewees more wary than usual and led to them being uncomfortable with the interview being recorded.

5.3.3 Multiple parties present at interviews

Some of the interviews were accompanied by company representatives such as salespeople, product owners and R&D engineers. This means that for some of the interviews, there were multiple agendas to be covered in the meeting. Salespeople were of course interested in trying to sell the design science solution artifact at hand and gain pre-orders, whilst R&D engineers were hoping for specific technical feedback. Scientific research was therefore not a primary priority for some of the interviews, and the data collected may be limited by this fact. In addition, because of the context of new product development involved, the situation may have been viewed from the interviewee’s perspective as the beginnings of a sales negotiation, which might make them reluctant to fully divulge all the relevant facts.

5.4 Suggestions for future research

Interesting future research problems abound in this field, as technological development continues accelerating the push towards automated and autonomous solutions. Specifically, exploring the customer value and commercial feasibility of automation enablers in other contexts for on-road load handling stands out as an immediate potential area of future research. The use of hooklifts, whilst widespread, is only a small portion of how goods are moved on roads. There are other types of load handling solutions, such as loader cranes and tail lifts, where automation enabling services are being constructed. Understanding the differences and similarities of context-specific lift and crane types when considering customer value and commercial viability is a potential avenue of future research.

In addition to on-road load handling, a big picture view of understanding the modularity of goods movement and the potential for automation in it is necessary for the future. What this means is that in addition to on-road load handling, goods need to be moved in differing contexts, for example from port to port, port to inland terminal, inland terminal to factory, et cetera. An interesting research route would be to understand the potential for automation and building automation enabling services and eventual automation throughout the whole chain of goods movement, rather than just a specific part of it such as on-road load handling.

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Appendix A: full table of first-order concepts

The table below shows the discovered 1st order concepts, 2nd order themes and aggregate dimensions (Gioia et al., 2013), with first-order concepts matching analytical categories and the detailed descriptions as described in (Flick et al., 2004)

Aggregate Dimension	Second-order theme	First-order concept	Detailed description
Customer Pain Point	Lack of skilled drivers	Acute shortage of drivers skilled enough to handle container operations	Skilled driver shortage is a uniform and well-documented trend; long-term rather than immediately solvable
		Driver mistakes and misuse lead to financial loss	Widely confirmed; however, some customers treat this is as “a cost of doing business” rather than something preventable
	Poor visibility from cabin	Trailer loading, and unloading is complicated and challenging	Interviews in Country 5, Country 2 and Country 3 confirm trailer operations create priority pain points for customers; specifics remain unclear as this was out of scope
		Poor visibility from cabin leads to manual work for drivers	This decreases speed and efficiency of operations; Country 2 customer solves for this by re-fitting cameras in their own spaces after buying
		Missing rollers or locking mechanism creates safety issues	These are “**most visible**” driver mistakes, so something they can expect or want to be removed; non-visible mistakes cause more damages
	Diverse operating environments	Maneuvering in tight environments slows down operations and creates safety hazards	Customers who work in construction experience this pain strongest. This is something mandatory for a profiled customer
		Diverse operating environments create risks that drivers are poorly equipped to deal with	Variety in customer’s customers and their operational environments require skilled drivers aided by technology for successful operations
Adoption Driver	Drivers want assistance systems	Drivers will love guidance systems	Drivers want their job to be as easy as possible
	Drivers want assistance systems	Reduced driver activities	Keeping driver responsibilities to a minimum is seen as a benefit
	Technology pioneering	Driver assistance is an important first step to get industry feedback on automation enablers	Industry feedback and response is key in how automation will develop in the future; a simple

			starting point is needed, and driver guidance is it
	Drivers want assistance systems	Easier to attract drivers to the industry with solutions like this	Pain of lack of drivers can realistically be solved for with advanced enough assistance
	Technology pioneering	Technology like this will be needed in the future	Offering seems futuristic and has some “wow” factor attached to it
	Drivers want assistance systems	Driver confidence increases when using systems like this	More confident drivers can in turn be more efficient and safer in hooklift activities
	Technology pioneering	Customers appreciate R&D initiatives and participating in them	Some viewed these interviews as industry knowledge sharing and were quite excited to see the product even though there is no intention to buy
	Decreased insurance costs	Decreased insurance costs through effective camera systems (Country 2)	Might be Country 2-specific, but it is possible to lower insurance costs by using comprehensive camera systems.
	Technology pioneering	Load Handling OEM is well positioned to drive innovation of solutions like this	Customer C commented that Load Handling OEM’s global reach and R&D quality should enable them to be drivers of automation in this industry
	Customer needs	Customer’s customers want solutions like this	Customer F have customers who are asking after automation and semi-automation
Adoption Blocker	Technology skepticism	Technology skepticism on safety and performance reliability	Aspects such as durability, operational reliability and sensitivity to failure come across consistently; what happens when the system doesn’t function as planned?
	Limited scope of hooklift activity	Ensuring safe driving is more important than safe hooklift operations	Safe operations are primarily about safety whilst driving rather than safety whilst using the hooklift.
	Perception of environmental complexity is viewed as unsolvable	Environmental complexity is viewed as too big for automation and assistance to have impact	“It is stupid”. Even with cameras and guidance, trust on the technology side is low
	Technology skepticism	Over-reliance on technology creates driver complacency, decreasing safety	Fear of driver’s abandoning processes and procedures because innovations make work too easy
	Customer-side effort required to gain benefits	Training and guidance required with new systems	Fear that taking into use new systems will require considerably education and effort

	Perceived lack of safety	Higher operating speeds and efficiency appear as unsafe	Customers don’t use highest speeds on current hooklifts as these speeds are viewed as unsafe. Arguing efficiency with the product can create the same perception of a lack of safety
	Company maturity solves for problems in other ways	Own insurance arrangements reduce cost of accidents along with the need to solve for accidents	Customer C has internal insurance systems, meaning they don’t feel the pain of costly driver mistakes
	Company maturity solves for problems in other ways	Mature customers find less value in this solution	Companies that have dealt with these safety challenges have enacted internal procedures and sought external help outside of Load Handling OEM to solve for them (retrofit camera installation in Country 2). Next best alternative is ‘better’
	Increased cost of purchase	Any extra costs are painful	Load Handling OEM is already an expensive alternative, adding to the cost needs to be carefully justified
	Limited scope of hooklift activity	Solution scope is too narrow to truly impact safety	Safe operations are based on wider environmental awareness than hooklift vision
	Company maturity solves for problems in other ways	Experienced drivers do not need or want guidance systems	Habit and technology skepticism are too strong to change behavior in favor of driver assistance, regardless of the benefits
	Technology skepticism	Customers need to see and use systems like these to gain trust that they work	Customers need to trial and try these solutions to find operational suitability and problem-solution fit
	Limited scope of hooklift activity	Trailers create most safety challenges	Trailer operations seem to create most safety challenges for some customers, and they are not addressed in the solution package
	Company maturity solves for problems in other ways	Customer company is already investing heavily into digital	Because of these investments, they are unwilling to add anything else onto the plate. They have already done the work of what they want as the solution and are moving forward independently
Feedback on Service Features	Hook height & Roller Detection	Hook height detection	Key interest area. Easy fix to a common problem.
		Roller Alignment	Key interest area. Easy fix to a common problem.
	Driver Assistance and Obstacle Detection	Obstacle Detection	Skeptical of the practicality of this feature.

		Driver Assistance	These features can question the competency of drivers and thus go unused.