VALUE CO-CREATION IN CUSTOMIZED-PRODUCT SUPPLY CHAINS:
A STUDY ON INDUSTRIAL AUTOMATION SECTOR

İLAYDA AK

Graduate School
Izmir University of Economics
Izmir

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ABSTRACT

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Ak, İlayda

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Today, value co-creation activities are quite common both in practice and in the literature. It is one of the greatest needs in the literature to examine the structure of value co-creation activities in detail in different sectors in order to understand the benefits they provide and the harms they cause. With the developing global economy, the structure of supply networks is becoming more complex day by day. Value co-creation activities need to be examined by resource integration activities in multi-actor supply chains rather than bilateral interactions such as supplier-customer. The multi-actor structure of industrial automation supply chains and the existence of customized products and services make the industrial automation sector suitable for this study. In this master's thesis, the industrial automation sector, which consists of multiple actors and includes the concepts of co-production and coopetition under the value co-creation, is examined with the service dominant logic and the effect of these value co-creation activities on customized products and services. As a result of semi-structured interviews with fifteen experts in the field of automation and the analysis of the interviews with content analysis, the effect of value co-creation activities in customized products and services and the factors affecting the value-in-use were illuminated. This thesis will provide academics with an idea of how effective end-user activities are in creating value in use, and allow them to improve; at the same time, it will guide the practitioners to improve the positive value and reduce the negative value that is revealed during the value co-creation activities.

Keywords: customization, co-creation, co-production, coopetition, value-in-use, industrial automation.

ÖZET

ÖZEL ÜRÜN TEDARİK ZİNCİRLERİNDE BİRLİKTE DEĞER YARATMA: ENDÜSTRİYEL OTOMASYON SEKTÖRÜ ÜZERİNE BİR ARAŞTIRMA

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Günümüzde, birlikte değer yaratma faaliyetleri hem pratikte hem de literatürde oldukça yaygındır. Birlikte değer yaratma faaliyetlerinin yapısını ve sağladıkları fayda ve meydana getirdikleri zararları anlayabilmek için farklı sektörler detayında incelenmesi literatürdeki en büyük ihtiyaçlardan biridir. Gelişen global ekonomi ile tedarik ağlarının yapısı gün geçtikçe daha kompleks bir hal almaktadır. Birlikte değer yaratma faaliyetlerinin tedarikçi-müşteri gibi ikili etkileşimlerden ziyade çoklu aktörlü tedarik ağlarındaki kaynak entegrasyonu faaliyetlerince incelenmesine ihtiyaç vardır. Endüstriyel otomasyon tedarik ağları çoklu aktörlü yapısı ve son kullanıcıya özgü özel üretim ve hizmetlerin varlığı, endüstriyel otomasyon sektörünü bu çalışma için uygun hale getirmektedir. Bu yüksek lisans tezinde çoklu aktörlerden oluşan ve birlikte değer yaratma adı altında birlikte üretme ve iş birliği içinde rekabet kavramlarını bünyesinde barındıran endüstriyel otomasyon sektörünün hizmet baskın mantığı ile incelenmesi ve bu birlikte değer yaratma aktivitelerinin özel üretim ürün ve hizmetler üzerindeki etkisi incelenmiştir. Otomasyon alanında yetkin on beş kişi ile gerçekleştirilen yarı yapılandırılmış mülakatlar ve mülakatların içerik analizi ile analiz edilmesi sonucunda özel üretim ürün ve hizmetlerde birlikte değer yaratma faaliyetlerinin etkisi ve kullanımdaki değeri etkileyen faktörler gün yüzüne çıkarılmıştır. Bu tez çalışması, akademisyenlere kullanımdaki değeri yaratırken son kullanıcı aktivitelerinin ne ölçüde etkili olduğuna dair fikir sunacak ve bunları geliştirmelerine olanak sağlayacak; aynı zamanda da uygulamacıların birlikte değer yaratma faaliyetleri esnasında açığa çıkan pozitif değeri geliştirmek ve negatif değeri azaltmaları konusunda yol gösterecektir.

Anahtar Kelimeler: özelleştirme, birlikte değer yaratma, birlikte üretme, iş birliği içinde rekabet, kullanımdaki değer, endüstriyel otomasyon.

To My Mother

I would like to dedicate this master thesis to my dear mother Aysun Zorlu, for her patience and support during all of my studies. She always motivated me and made me believe in myself. I couldn’t achieve this without you…

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A2A: Actor to actor

B2B: Business to business

E: End-user

EPC: Engineering, procurement, and construction contractor

FD: Foundational Premise

IA: Industrial Automation Firm

OEM: Original equipment manufacturer

P: Partner firm

PF: Project firm

S: Supplier (product manufacturer)

SDL: Service dominant logic

SE: Supplier and Engineering Firm

TP: Technology provider

VCC: Value co-creation

VIU: Value-in-use

CHAPTER 1: INTRODUCTION

Today's global business environment generates highly complicated supply chains. One of the reasons is that the number of actors involved is increasing and the determination of the actors' interaction points become compulsive. Even though the actors are in the same supply chain, their value perceptions are different because their goals are different. The main point is that despite different perceptions of value, actors in a supply chain co-create value.

> *"Value co-creation has gained the attention of academics and practitioners as an overarching concept that describes collaboration between multiple stakeholders"* (Prahalad and Ramaswamy 2000; cited in Ranjan and Read, 2016).

The main goal of managing a supply chain is to synchronize the requirements of the customer with the flow of material from suppliers in order to affect a balance between the conflicting goals such as high customer service, low inventory investment and low unit cost (Stevens, 1989). Since supply chains are complex networks with a high number of interactions and inter-dependencies among different entities, processes, and resources (Surana et al., 2005), the collaborative creation of value is an issue that needs to be addressed. Therefore, value co-creation studies in several industries are present in the literature (*tourism* - Font et al 2020; *agriculture*- Handayati, Simatupang and Perdana, 2015, *healthcare*- Moro Visconti and Morea, *logistics*- Vural, Göçer and Halldórsson, 2019). Many of the value co-creation studies lay on service-dominant logic (i.e., Osborne, 2018; Tommasetti, Troisi and Vesci, 2017; Font et al., 2021; Fuentes and Smyth, 2016, Ahn et al., 2020).

Service dominant logic articulates that enterprises "offer value propositions" instead of "delivering value" since firms propose value through market offerings, and customers continue value-creation process through use (Vargo, Maglio and Akaka, 2008). In fact, we cannot define value through the amount of nominal value, price received in exchange as value-in-exchange, instead, we should measure it by the adaptability and survivability of the beneficiary system as value-in-use because the value is always uniquely and phenomenologically determined by the beneficiary (FP10 of SDL) (Vargo, Maglio and Akaka, 2008).

According to Prahalad and Ramaswamy (2004b), the co-creation experience depends highly on individuals because each actor's uniqueness affects the co-creation process. These actors (customers) are rational decision-makers who aim to gain maximum benefits through products and services that their supplier offers (Etgar, 2008). Besides Kaur Sahi et al. (2017) states that during the value co-creation process,

> *"value is delivered both to the customer and to the firm (Auh et al., 2007), though customers tend to be more satisfied because they perceive added value from their service encounter in the form of customized offerings (Ouschan, Sweeney and Johnson,2006)".*

In other words, the positive outcome of value-in-use is the aim of the beneficiaries and for customized products and services customers attend co-production to maximize the positive outcome of value-in-use.

Vargo and Lusch (2004) determined the 6th foundational premise of service-dominant logic as "the customer is always a co-producer". After they changed this premise to "the customer is always a co-creator of value" since it was referring to goods-dominant logic terminology (Lusch and Vargo, 2006a). Co-production is a component of co-creation and it involves the participation in the creation of the core offering itself. Inventiveness, co-design, or shared production of related goods may help co-production to occur with customers and any other partners in the value network. Value co-creation and co-production are nested concepts, they both make the consumer endogenous and have similar implications. (Lusch and Vargo, 2006a).

It should not be forgotten that value co-creation can be reached through co-design and co-production leading to personalization (Zine et al., 2014). Co-production is directly linked to customization (Etgar, 2008). Therefore, (mass) customization is important for value co-creation studies.

Industrial automation sector has never been examined with a value co-creation perspective before, therefore semi-structured interviews as "the most frequently used interview technique in qualitative research" (DiCicco-Bloom and Crabtree, 2006; cited in Kallio et al., 2016) are conducted with selected individuals in the industrial automation sector.

1.1. Objective of the Thesis

The co-creation of value in means of value-in-use is studied in several industries such as *tourism* (e.g. Font et al 2020; Dolan, Seo, and Kemper, 2019; Rihova et al.; 2018), *agriculture* (e.g. Handayati, Simatupang and Perdana, 2015; Monavvarifard, Baradaran and Khosravipour, 2019), *healthcare* (e.g. Moro Visconti and Morea, 2019; Ferreira, 2019), *logistics* (e.g. Vural, Göçer and Halldórsson, 2019; Tuan 2017; Fernando and Chukai, 2018), *public services* (e.g. Kumar et al., 2016; Osborne, Radnor and Strokosch, 2016), *information technologies* (e.g. Demirezen, Kumar and Shetty, 2016), *B2B (business to business)* (e.g. Lin and Chen, 2018; Zhao and Cheng, 2017; Lacoste, 2016), *etc*. The industrial automation sector is highly applicable for a value co-creation study because the actors in the industrial automation supply chains highly interact with each other in means of co-production and coopetition activities. Industrial automation supply chains are highly complex due to;

- the multi-actor networks including customers (end-users, EPCs, trading firms, OEMs), suppliers, industrial automation companies (these companies are competitors and suppliers among themselves), partner firms, supplier-engineering firms, technology provider firms
- actors involved in the industrial automation supply chains or service ecosystems do not have strict roles as customers, and suppliers, because their roles are changing depending on the characteristics of the job.
- (mass)customized product service networks which are also accepted as complex product systems characteristics because of high-value, high-technology, and engineering-intensive products, systems, and services (Appio and Lacoste, 2019).

Value creation occurs at the intersections of activities of providers, beneficiaries, and other actors, and these actors continually integrate resources from multiple sources (Lusch and Vargo, 2014; Vargo and Lusch, 2011; cited in Vargo, Huotari and Vink, 2020), and further research analyzing value co-creation in complex networks should be applied to other service sectors to expand our understanding of this phenomenon (Edvardsson et al., 2014). Actors engage in service-for-service exchange and in related interactions that lead to resource integration in order to value co-creation to occur. Consequently, resource integration and value co-creation cannot occur without actor engagement.

The cumulative causation of these determinants generated the idea of the objective of this thesis as to determine the value co-creation activities and the factors affecting the value-in-use in the complex multi-actor customized product supply chains. With respect to this research objective, the targeted research questions are:

RQ1: How value is co-created among customized product supply chain actors through coopetition, coproduction, and codesign activities?

RQ2: What are the value co-creation elements enhancing value-in-use for customized products?

RQ3: What are the factors affecting value-in-use in customized supply chains?

1.2. Significance of the Study

As mentioned above, value co-creation studies in different industries contribute to the literature by clarifying specific industrial attributes. In other words, we cannot expect that the value co-creation activities and value-in-use objectives are similar for example in tourism and industrial automation industries. Therefore, one of the significances of this study is the interest of this master thesis covers the value co-creation activities in industrial automation supply chains. Based on the Fortune Business Insights' 2020 report, the global industrial automation market size was valued at USD 168.81 billion in 2019 and is projected to reach USD 326.14 billion by 2027. According to the most recent report data, the forecasted industrial automation market growth is %9,2 from 2021 to 2028 by reaching 355.44 Billion USD (Fortune Business Insights, 2021b). When we consider the findings of the current and projected market sizes, the importance of the industrial automation sector is undeniable and academic studies of this industry will contribute to industry growth.

On the other hand, industrial automation supply chains contain different types of firms. For instance, their supply chains are B2B (business to business) and the types of customers are end-user firms, EPCs, OEMs, trading firms, channel partners. They have suppliers in terms of raw-material suppliers, semi-finished goods suppliers, finished-good suppliers. This master thesis examines particularly the B2B activities in terms of sales, therefore the raw material suppliers are not involved in this master thesis. One of the interesting attributes of the industry is that the industrial automation manufacturing firms collaborate and compete at the same time depending on the project. Additionally, the industrial automation sector is (mass)customized product service networks which are also accepted as complex product systems characteristics because of high-value, high-technology, and engineering-intensive products, systems, and services (Appio and Lacoste, 2019).

In a nutshell, the significance of the study is determining the value-in-use outcomes of an industry that has never been studied before. Additionally, since this industry consists of multi-actor (mass)customized product supply chains, there are value co-creation and co-production activities. On the other hand, there are coopetition activities between the rivals (industrial automation manufacturers). In conclusion, this master thesis has a multi-actor value co-creation perspective on customized product supply chains through an industry in which co-production and coopetition activities are observable.

CHAPTER 2: LITERATURE REVIEW

2.1. What Is Value? From Value-in-exchange to Value-in-use

Values are what we care about (Keeney, 1996).

Based on the owner(s)'/buyer(s)' value system, the subjective part of the value of a product can change, and accordingly, the value of the product will change (Neap and Celik, 1999).

That is, the value characteristics of a product or service differ through the perception of each beneficiary. There are two concepts for value evaluation. The traditional concept is named as *value-in-exchange* considers value as embedded in tangible manufactured outputs (Vargo, Huotari and Vink, 2020). Goods-dominant-logic articulates that value is created (manufactured) by the firm and distributed in the market through exchange of goods and money (Vargo, Maglio and Akaka, 2008).

"Goods-dominant-logic relies on "consume" which means "destroy" or "use up" or "waste"" (Normann, 2001; cited in Vargo, Maglio and Akaka, 2008).

In other words, this old enterprise logic (Zuboff and Maxmin, 2002) defends that value is something produced by the producer and destroyed by the consumer (Normann, 2001).

For instance, by addressing the work of Flint, Woodruff and Gardial (1997), Ulaga and Chacour (2001) emphasize that

"a value judgment is the customer's assessment of the value that has been created for them by a supplier given the trade-offs between all relevant benefits and sacrifices in a specific-use situation",

which means that authors estimate value is determined by the firm, customers are giving sacrifices to obtain this value. Additionally, Cretu and Brodie (2007) explain that the perceived value of offering shaped by a tradeoff between benefits, such as perception of the product and service quality, of the firm's offerings and the sacrifices, such as prices and non-monetary costs of the offer (Eggert, Kleinaltenkamp and Kashyap, 2019). Furthermore, Lindgreen and Wynstra (2005) state that a customer is valuable to a firm only if the firm can offer something valuable to the customer (Eggert, Kleinaltenkamp and Kashyap, 2019). Simply, value-in-exchange is a concept that value is determined by a ratio between the quality of a product or service and cost (Sandström et al, 2008). From the perspective of goods-dominant-logic, the roles of ‘‘producers’’ and ‘‘consumers’’ are distinct; thus, value creation is often thought of as a series of activities performed by the firm (Vargo, Maglio and Akaka, 2008).

> In contrast to the value-in-exchange proposition, service-dominant logic claims that "*the enterprise cannot deliver value but only offer value propositions"* and *value is always uniquely and phenomenologically determined by the beneficiary* (FP7 and FP10 of SDL, Vargo, Maglio and Akaka, 2008).

The other concept for value evaluation, *value-in-use*, coined by Vargo and Lusch (2004) since value situates in the experiences of the customers (Prahalad and Ramaswamy, 2004b).

> *‘‘Moving the locus of value creation from exchange to use, or context, means transforming our understanding of value from one based on units of firm output to one based on processes that integrate resources’’* (Vargo, Maglio and Akaka, 2008).

Value-in-use results from the beneficial application of the resources (e.g. knowledge and skills) exchanged (Vargo and Lusch, 2004; cited in Vargo, Huotari and Vink, 2020).

> *‘‘Value-in-use, is a functional outcome… or objective that is served directly through product consumption’’* (Payne and Holt, 2001) since it "*reflects the use of the product or service in a situation to achieve a certain goal or set of goals"* (Flint et al.,1997).

The “*idiosyncratic, experiential, contextual, and meaning-laden”* (Vargo and Lusch ,2008) structure of value-in-use describes itself as the evaluation of the service experience through individual judgments of the sum of all the functional and emotional experience outcomes (Sandström et al., 2008). Lusch et al. (2008) defends that value-in-exchange is not the actual utility although it might represent the expected utility, because utility, as value-in-use

> “*can only be realized by and in the context of the life of the customer.”* (Lusch et al., 2008)

> Since value-in-use is a “*customer’s outcome, purpose or objective that is achieved through service”* (Macdonald et al., 2011),

> “*the extent to which a customer feels better off (positive value) or worse off (negative value) through experiences”* (Grönroos and Voima, 2013)

explains that there are positive and negative outcomes of value-in-use too. Value-in-use has been the subject of many scholars' studies, and although its definition has mostly adhered to the service-dominant logic, different opinions have emerged. Grönroos (2011) criticized Vargo and Lusch’s foundational premises of service-dominant logic and suggested instead of accepting the customer always a co-creator of value (FP7 of SDL, Vargo, Maglio and Akaka, 2008), it makes more sense to accept the statement of:

> “*the customer as the user and integrator of resources is a value creator”* (Grönroos, 2011)

> Additionally, Grönroos (2008) emphasized that “*the firm is fundamentally a value facilitator”* due to the fact that “*the customer creates value, and the firm facilitates value creation”* (Grönroos, 2011).

> Heinonen et al. (2010) have a similar approach to value-in-use by arguing that

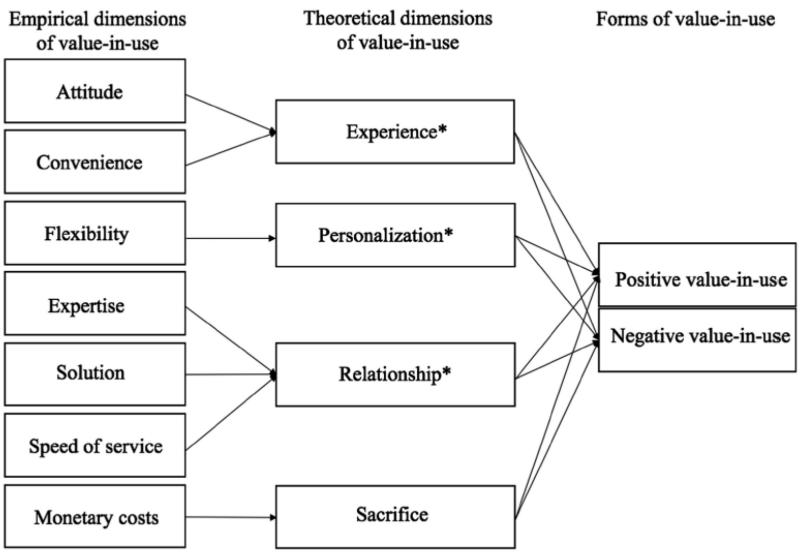
> "*value-in-use should be seen as everything that the company does that the customer can use in order to improve his life or business.*" (Heinonen et al., 2010)

Besides, Christian Grönroos's criticism toward service-dominant logic shaped the literature of service logic. Vargo, Huotari and Vink (2020) have claimed that service logic and service-dominant logic are similar frameworks because they both accept "value-in-use"; but they also emphasized that the service logic has a more dyad focus.

More Recently, Prior, Keränen and Koskela (2019) worked on customer participation antecedents and value-in-use goals in B2B service exchange. Based on interviews with 20 companies, they revealed that value-in-use goals are *risk minimization, quality, efficiency, and reputation maintenance.* **Risk minimization** is a motivator to the actors for engagement in activities that they perceive a high chance of success and/or less possible failures (Brown, 1994; cited in Prior, Keränen and Koskela, 2019). Important sub-elements of risk minimization are *risk prevention*, *confidence in suppliers* and *in dependence from suppliers*. **Quality** is related to the degree of satisfaction that the actor obtains from the functional attributes of a product/ service system. Important sub-elements of quality are *product/ service reliability* and *high functionality*. **Efficiency** is related to the degree of satisfaction that the actor obtains from the timely and cost-effective installation of product/ service system elements. Important sub-elements of efficiency are *cost minimization* and *time minimization*. **Reputation maintenance** is a motivator for the actors to engage in activities that are presumedly to create significant social benefits to them by enhancing the positive perceptions held by other actors and increasing the actor's social capital (Zinko et al., 2012; cited in Prior, Keränen and Koskela, 2019). Important sub element of reputation maintenance is *social approval*.

Eggert et. al. (2018), worked on conceptualizing and communicating value in business markets by examining value-in-exchange and value-in-use. Authors argue that the evolution of the value literature has a focus on resource exchange and value-in-exchange to an emphasis on resource integration and value-in-use. They identify distinct stages of conceptualizing customer value and articulating customer value propositions. Followingly, they argue on how value is created in a customer idiosyncratic use situation is important in nowadays competitive marketplaces. Firstly, they noted that the emphasis on communicating the value-in-exchange that is delivered to customers has shifted to value-in-use which is co-created with customers. By doing so, suppliers and customers jointly develop the value proposition through their joint resource integration. Secondly, they noted that value propositions mean creating a dialogue that a unique customer solution. The value can be understood in depth when supplier and customer share deep insights and together carefully craft and manage their joint value propositions. Thirdly, they highlighted that value-in-use includes actors within the ecosystem, not only supplier and customer interactions. Because, *value propositions in an ecosystem are linked together, as the interactions between actors change the availability of resources and the offers that are made.*

The aim of the Medberg and Grönroos (2020) is to provide an empirical account of value-in-use from service customers' point of view. Their study confirms the existence of negative value-in-use, which has earlier been suggested by Plé and Cacéres (2010) and Grönroos and Voima (2013). Based on the interviews with 26 customers from Finland's four largest retail banks, they identified seven empirical dimensions of positive and negative value-in-use such as *solution, attitude, convenience, expertise, speed of service, flexibility and monetary costs.* Their study also corresponds to the study of Ranjan and Read (2016) by associating the seven empirical dimensions of value-in-use to experience, personalization, relationship, and sacrifice as shown in Fig. 1.



Note(s): *Ranjan and Read (2016)

Figure 1. Theoretical framework of value-in-use (Source: Medberg and Grönroos, 2020)

> ***"Solution** refers to the degree to which the service provider solves the customer's problem". "**Attitude** refers to the attitude of the service staff toward the customers". "**Convenience** represents the overall easiness and smoothness of the service process for the customer". "**Expertise** refers to the degree of competence, skill and knowledge shown by the service staff". "**Speed of service** relates to how quick and rapid the service delivery process is". "**Flexibility** refers to the willingness of the service staff to adjust and tailor their services to meet the individual needs of the customer". "**Monetary costs** refer to the customer's perception of the service provider's fees, charges or interest as advantageous or unfavorable". In short, all these seven dimensions formalize the form of value-in-use as positive and negative value-in-use.*

In conclusion, since the *value is idiosyncratic, experiential, contextual, and meaning-laden* (Vargo and Lusch, 2008), scholars tried to understand its dimensions regarding to value-in-exchange and value-in-use.

> "*In sum, viewing value propositions through the lens of value in use extends the concept beyond the traditional notion of a value delivery offer or promise that perceives value as embedded within the product. The value in use perspective views the value proposition as a proposal that seeks the co-creative engagement of actors, sharing chosen resources, acquiring valuable knowledge and contributing to mutually rewarding outcomes"* (Eggert et al., 2018).

2.2. Value Co-Creation

Service-dominant logic offers a metatheoretical framework by identifying service as a process of using one's resources for the benefit of another actor, rather than goods, as the fundamental basis of economic and social exchange (Vargo and Lusch, 2004; 2017; cited in Vargo, Huotari and Vink, 2020). Therefore, service-dominant logic argues that all economies can best be understood in terms of service-for-service exchange (Vargo, Huotari and Vink, 2020). In other words, this exchange enables reciprocal value creation and this is only possible through collaboration and exchange with multi-actors, and this process is called value co-creation in service-dominant logic (Lusch and Vargo, 2006a; Vargo, Maglio and Akaka, 2008; cited in Vargo, Huotari and Vink, 2020). Value co-creation argues that value cannot occur until an offering is used since experience and perception are necessary to value determination (Vargo and Lusch, 2006b). Therefore, value is determined by the beneficiary as the co-creator of value in the basis of value-in-use (FP6 and FP10 of SDL; Vargo, Maglio and Akaka, 2008).

> "*High-quality interactions that enable an individual customer to co-create unique experiences with the company are the key to unlocking new sources of competitive advantage. Value will have to be jointly created by both the firm and the consumer*. Besides, "*co-creation is about joint creation of value by the company and the customer. It is not the firm trying to please the customer."* Prahalad and Ramaswamy (2004a)

The focus of value co-creation of Prahalad and Ramaswamy in the year 2004 was dyadic which lays on firm and customer, but these statements are the cornerstone of value co-creation.

Ford et al. (2017) state that value creation requires the involvement of "*others, motivating other actors and mediating are fundamental in developing relationships and creating value*" (cited in Ramaswamy and Ozcan, 2020).

> "*Co-creation describes the resource integration process that occurs during practices between actors linked together within a service ecosystem"* (Frow, McColl-Kennedy and Payne, 2016).

A service ecosystem means a composition of actors and their respective resources, linked together through value propositions in a network of relationships (Frow et al, 2014; cited in McColl-Kennedy and Payne, 2016).

> *An ecosystem bounds actors and their resources, with direct and indirect resource-sharing activities influencing its well-being* (McColl-Kennedy and Payne, 2016).

Resources are "*anything, tangible or intangible, internal or external, operand or operant, an actor can draw on for increased viability"* (Lusch and Vargo, 2014).

Operand and operant resources are two broad types of resources which more recognized in service-dominant logic literature. While operand resources such as natural resources, require an action taken upon them to be valuable; operant resources, such as knowledge and skills, are capable of acting on other resources to contribute to value creation (Vargo, Huotari and Vink, 2020).

The resources sharing through co-creation practices impacts the dependency of actors within the ecosystem and this dependency may create problems or opportunities (McColl-Kennedy and Payne, 2016). The work of Bonamigo et al. (2020) identifies the facilitators and inhibitors of value co-creation with a systematic literature review. The results show that there are 11 facilitators of value co-creation [1] ***involvement of actors*** - customers act as co-producers of the solution by bringing their resources into the service process (Aarikka and Jaakkola, 2012; cited in Bonamigo et al., 2020), hence enabling the cost reduction of service provision, which leads to an increased financial performance of the suppliers (Siahtiri, 2017; cited in Bonamigo et al, 2020)-; [2] ***synergy amount participants*** -the collaborative interactions of companies results in generating higher value than the sum of each partner can create alone (Goold and Campbell, 1998; Gyrd and Kornum, 2013; Liu, 2019; cited in Bonamigo et al., 2020).-; [3] ***resource complementarity*** -although complementarity resources are different, they complement each other and therefore generate higher value when combined (Harrison et al, 2001; Mitsuhashi and Greve, 2009; cited in Bonamigo et al., 2020)-; [4] ***personal relationships between actors*** -personal relationships and the similarities of the participants brings partners closer, and generate better actor's integration in the value co-creation (Hakanen and Jaakkola, 2012; Wang et al., 2013; Zhang and He, 2014; Zhang et al, 2016; cited in Bonamigo et al., 2020).-; [5] ***value compatibility*** - similarities among firms strengthen work relations and facilitates communication between the actors involved in the joint creation of value (Chang et al., 2019; cited in Bonamigo et al., 2020).-; [6] ***specialized knowledge*** -partner's expertise and experience is central for developing original solutions that increase value cocreation outcomes (Chang et al., 2019; cited in Bonamigo et al., 2020).-; [7] ***trust*** -trusted relationships deepen ties between stakeholders and improve value co-creation in B2Bs

(Rod et al., 2014; Marcos-Cuevas et al., 2016; Heim et al., 2018; cited in Bonamigo et al., 2020).-; [8] ***geographical proximity*** –the benefits of geographical proximity are face-to-face communications which facilitate the absorption of tacit knowledge (Liu and Ma, 2019;cited in Bonamigo et al., 2020), and reduced operating costs (Hsieh and Lee, 2012; cited in Bonamigo et al., 2020).-; [9] ***information exchange through technology*** -information technologies increase inter-firm cooperation since it improves the information flow between the stakeholders (Tsou and Hsu, 2015; Rogers and Clark, 2016; cited in Bonamigo et al., 2020).-; [10] ***the establishment of a network*** -*it fosters value co-creation, as firms cooperate with their network of partners to develop solutions and to create innovations* (Martinez Fernandez and Miles, 2006; Kohtamäki et al., 2013; Hedvall et al., 2019; cited in Bonamigo et al., 2020).-; [11] ***governance*** -governance enables co-creation since it avoids opportunistic behavior and the loss of intellectual property during the the joint creation of value (Schwetschke and Durugbo, 2018; cited in Bonamigo et al., 2020).-; and 4 inhibitors of value co-creation [1] ***incompatability between actors*** -differences in the organizational cultures of the firms in the joint creation of value can prevent common goals for value co-creation (Enz and Lambert, 2012; Mattera and Baena, 2015; Manser et al., 2016; cited in Bonamigo et al., 2020).-; [2] ***actor's inexperience in the context of value co-creation*** -the co-creation of within experienced actors and inexperienced actors, the problem of asymmetrical knowledge occurs and it endangers the value co-creation process (de Faria et al., 2010; cited in Bonamigo et al., 2020).-; [3] ***lack of measurement of value co-creation*** – "*the absence of measures makes it difficult to stipulate the financial returns from cocreation and to perceive its actual benefit; thereby demotivating firms to co-create"* (Enz and Lambert, 2012; cited in Bonamigo et al., 2020).-; [4] ***opportunism in sharing information*** – "*refers to to the risks, to which firms are exposed when they share their resources, information, and competencies with other companies in value co-creation"* (Filieri et al., 2014; cited in Bonamigo et al., 2020).

From past to present, value co-creation has a significance in academic studies. Because *the customer is always a co-creator of value* (FP6 of SDL, Vargo, Maglio and Akaka, 2008), there are many dyadic (supplier-consumer) value co-creation studies in literature. On the other hand, a shift from a single supplier and single customer dyadic perspective to a many-to-many perspective where customer networks interact with supplier networks is critical since the value co-creation process is not limited with supplier-customer relationships (Edvardsson et al., 2014). For instance, studies such as: value co-creation in complex value networks with many actors in health care services (Edvardsson et al., 2014), complex interactions and feedback structures of the service systems for value co-creation in mobile application services (Wang, Lai and Hsiao, 2015), value co-creation in multi stakeholder networks (Pera, Occhiocupo and Clarke, 2016; Reypens, Lievens and Blazevic, 2016), triadic approach of value co-creation in maritime logistics (Vural, Göçer and Halldórsson, 2019) and in B2B industrial relationships (Vivó, Saura and Gallarza, 2020), stakeholder engagement -internal and external- toward value co-creation in the F&B packaging industry (Giacomarra et al., 2019), and electronics closed-loop supply chain value co-creation considering cross-shareholding (Zhang and Meng, 2021) are some examples of value co-creation studies with multi-actor perspective. Since value creation occurs at the intersections of activities of providers, beneficiaries, and other actors, and these actors continually integrate resources from multiple sources (Lusch and Vargo, 2014; Vargo and Lusch, 2011; cited in Vargo, Huotari and Vink ,2020), this master thesis comprises of a multi-actor value co-creation approach too.

2.3. Actor Engagement

Customer engagement has been articulated as a key driver of performance by including "*customers' lifetime value" (Schmitt et al., 2011),* the competitive advantage of the firm *(Kumar et al., 2010; Kumar and Pansari, 2016) and "financial performance" (Gupta and Zeithaml, 2006)* (cited in Li, Juric and Brodie, 2017).

Today's highly interactive and dynamic business environment forces us for a broader perspective beyond dyadic interactions to the interactions among a network of diverse actors or groups of actors (Li, Juric and Brodie, 2017); therefore, instead of the term customer engagement, the actor engagement perspective should be implemented.

> "*Actor engagement is defined as both the actor's disposition to engage, and the activity of engaging in an interactive process of resource integration within a service ecosystem."* (Storbacka et al., 2016)

Actors engage in service-for service exchange and in related interactions that lead to resource integration in order to value co-creation to occur. Consequently, resource integration and value co-creation cannot occur without actor engagement.

Since value co-creation is difficult to observe empirically and the actor engagement and related resource integration are observable; while explaining complex supply chains the actor engagement is more suitable due to the more likely it to be designable and manageable (Storbacka et al., 2016).

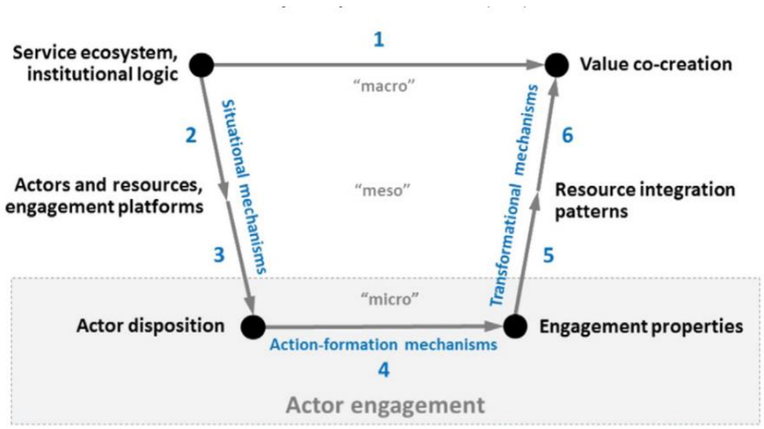


Figure 2. The Coleman bathtub: Actor engagement explains value co-creation. (Source: Storbacka et. al)

Storbacka et al. (2016) figurated The Coleman bathtub: Actor engagement explains value co-creation in order to show the realization of actor engagement by investigating macro, meso and micro level conditions.

- Firstly, **institutional logic of** a **service ecosystem** forms a context for **actors to engage with their resources on engagement platforms** (Storbacka et al., 2016). Engagement platforms are physical or virtual touch points designed to provide structural support for the exchange and integration of resources (Li, Juric and Brodie, 2017).
- *"These* ***situational mechanisms*** *form the* ***meso-level conditions*** *for action influencing the engaging actor, and, combined with the* ***actor's disposition*** *to engage, they lead to engagement activities, that can be characterized by observable* ***engagement properties****"* (Storbacka et al., 2016). Actor's disposition is actors' capacity of the utilization of their connections concerning their personal or collective interest (or both) (Li, Juric and Brodie, 2017).
- Various **resource integration patterns** emerge on the meso-level due to the multi actor engagement and which transforms extant resource configurations of the actors, leading to **value co-creation** (Storbacka et al., 2016).

- Consequently, actor engagement is the disposition of actors to engage, and the engagement activity in an interactive process of resource integration within the institutional context provided by a service ecosystem (Storbacka et al., 2016).

The idea of generic actors that have ownership of resources or access to resources is highlighted by the concept of resource-integrating actors (Storbacka et al., 2016). These actors are open systems and depends on the other’s resources to survive (Vargo, Maglio, and Akaka, 2008; cited in Storbacka et al., 2016). Consequently, all actors are basically engaged in similar ways in resource integration processes. Therefore, strict roles for actors as "producer - consumer" or "seller - buyer" are passing since actors can have several different roles (Storbaca et al., 2016).

The **engagement properties** are defined both in the work of Storbacka et al. (2016) and Li, Juric and Brodie (2017). According to Storbacka et al. (2016), we can identify four issues relating to engagement properties which are:

1. **Co-production vs. value-in-use activities.** Storbacka et al. (2016) suggested that the engagement activities can be described as co-production and value-in-use activities. In co-production activities actors engage in order to realize co-design, co-development, co-production and co-promotion (Frowet al., 2015, cited in Storbacka et al., 2016) of products. On the other hand, in value-in-use activities, we see actor engagement for value-creating activities with the utilization of the resources of other actors’, with none actively present actors (Storbacka et al., 2016).
2. **Relational properties.** By analyzing the types of relationships that the actor possesses within the service ecosystem, we can determine the relational properties of an actor. Following questions can help for the determination of types of relationships: “how many relationships the actor has; how many of these relationships can be classified as primary contacts; how central the market actor's position is within the ecosystem; and what the actor's relative power position is” (Storbacka et al., 2016).
3. **Informational properties.** Engagement differs in terms of information. Whether the actor is trying to influence, is open to influence, or trying to mobilize support or access to resources are the issues to be considered. (Storbacka et al., 2016).

4. **Temporal properties.** "Engagement varies in terms of duration, regularity and frequency. Hence, engagement may be momentary or on going" (Storbacka et al., 2016). The recentness of an engagement is most probably connected to the impact that the engagement has on the actor resources (Storbacka et al., 2016).

Li, Juric and Brodie (2017) extended the literature by providing a more concrete and practical understandings of engagement properties but did not conflict with the findings of Storbacka et al., (2016). They modeled the actor engagement as shown in Figure. 3.

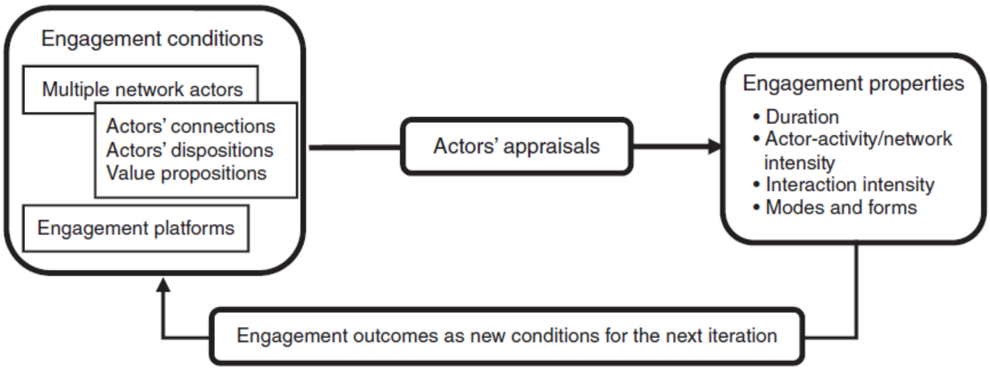


Figure 3. The iterative process of multi-actor engagement in the network (Source: Li, Juric and Brodie)

Firstly, the context for engagement activities among multiple actors in the network are formed by the **engagement conditions**. The conditions are comprised of "**multiple network actors** (their **connections, dispositions and value propositions**) and the **engagement platforms**" (Li, Juric and Brodie, 2017). Actors interact with each other in the network and the sub-components are explained by the authors as:

- ***Actor connections***: connections which have emerged in the past, and currently continue to influence the actors' engagement
- ***Actors' relational connections***: connections related with actors' social roles and positions
- ***Actor dispositions***: actors' capability for utilizing their connections concerning their personal or collective interest (or both)
- ***Value propositions***: they reflect resources available to others

Engagement platforms are designed as a physical or virtual touch points to offer structural support for the exchange and integration of resources and actors are engaged with one another on different platforms (Li, Juric and Brodie, 2017). Then, "**actors' appraisals** represent the mechanism underlying how engaging actors form their activities" (Li, Juric and Brodie, 2017). The appraisal that actors accept is the process from engagement conditions to properties. "Appraisals are the actors' assessment of something or someone" (Nyer, 1997; cited in Li, Juric and Brodie, 2017). The appraisals include four forms:

- **Actors' appraisals of intensity and valence of value propositions:** The degree of the invitation is perceived as relevant increases the intensity of the value proposition (Chandler and Lusch, 2015; cited in Li, Juric and Brodie, 2017), and the chance of the actors to engage by accepting this invitation is higher. Value propositions can be perceived as destructive as well as beneficial (Li, Juric and Brodie, 2017).
- **Actors' appraisals of connection-disposition alignment:** Actors decide if the other actors' value propositions and connections align with their own dispositions (Chandler and Lusch, 2015; cited in Li, Juric and Brodie, 2017).
- **Actors' appraisals of alternative engagement platforms:** actors prefers to engage on certain platforms due to: [1] "a certain engagement platform is designated by other actors", [2] lack of availability for accessing to other platforms [3] a particular platform will have more compatible attributes with the engaging actors, their dispositions and associated engagement properties (Li, Juric and Brodie, 2017).
- **Actors' appraisals of alternative engagement activities:** Engagement activities are different for the actors and they create different outcomes in means of attained value and the scope of their influence. Actors that possess various dispositions (capabilities) will decide the possible activities for them, the most valuable activity for them, and the best activities to help reaching their engagement goals (Li, Juric and Brodie, 2017).

The **engagement properties** "demonstrate the activities of multi-actor engagement in the network" and Li, Juric and Brodi (2017) identified five dimensions to characterize these properties:

- ***Duration:*** the longer time frame for an engagement activity enhances the chance to higher number of actors to engage in the network and strengthens the relational connections.
- ***Actor-activity intensity:*** "the number of actors or different groups of actors engaging in a certain activity". The actor-activity intensity increases if the number of actors or groups of actors is high, or vice versa.
- ***Actor-network intensity:*** "the number of actors or groups of actors engaging in the network during certain phases". There can be certain phases in which actors are present and not present. The phases that actors are engaging may differ.
- ***Interaction intensity:*** "how active and intense the interactions in a certain engagement activity and in a certain phase are". The degree of the interactional intensity affects the strength of the influences of the engagement that may be generated.
- ***Modes and forms:*** "diverse multi-actor engagement behavioral expressions"

Actor's dispositions effect the perception of **engagement outcomes** as positive and negative. "A multi-actor perspective reveals the complexity of engagement valence" (Li, Juric and Brodi, 2017). In conclusion, the engagement outcome is accepted as **value-in-use** by the authors.

This master thesis aims to examine how the co-actions of the actors i.e., co-production, coopetition, and co-creation of value affect the value-in-use in industrial automation supply chains. The actor engagement approach will be helpful since it provides a better understanding of the actors' actions while creating the value-in-use.

2.4. Co-production and Customization

> *"The co-creation experience depends highly on individuals. Each person's uniqueness affects the co-creation process"* (Prahalad and Ramaswamy, 2004b).

Besides, consumers are rational decision-makers who want to gain maximum benefits through services (whether a product or service) they are using (Etgar, 2008). That is, a positive outcome of value-in-use is important for them. For customized or mass customized services, customers attend co-production in order to maximize the positive outcome of value-in-use. “Co-production” and “value co-creation” are different concepts. The co-creation of value takes place in the usage/consumption stage (as value-in-use), on the other hand, the co-production takes place within the production process which precedes the usage stage (Lusch and Vargo, 2006b, cited in Etgar, 2008). Furthermore, they are similar concepts since they both refer to collaboration (Brandsen and Honingh, 2018). We can reach value co-creation through co-design and co-production leading to personalization (Zine et al, 2014). Customization and mass customization are directly related to the beneficiaries’ expectations and require collaborative actions of the customers with suppliers. Co-production is directly linked to customization (Etgar, 2008). Thus, customization and mass customization have significance in value co-creation and this master thesis aims to examine customized product networks from a value co-creation perspective. To reach this aim, in this master thesis the industrial automation sector is examined due to its complex multi-actor service networks and customized and mass customized solutions.

We commonly see co-production activities in industrial automation companies. Since their product range comprises of (mass)customized products; co-production and co-design with the customer is essential. Based on Etgar’s (2008) Co-production Model, the co-production examples in the industrial automation sector are explained as follows;

Co-production is related to the expansion of consumer choices. For example, Consumers who buy computers from the Dell Company have a chance to create unique configurations of PCs regarding their choice of component parts (Etgar, 2008). Similarly, with the Dell Company, industrial automation companies generate a (mass) customization. For example, a selected process control equipment may have more than 100 different types in means of end-product due to the configuration options provided by the firm.

Customization can be achieved through information provision. When consumers share relevant information about their demand with the firms, these firms can produce appropriate products according to these specifications. This strategy requires only marginal use of consumer operand and operant resources (Arnould et al., 2006; cited in Etgar, 2008). It is not expected from consumers to learn new skills which can create poor self-performance risk in the process. The aim of this strategy is to diminish the risk of mismatching in means of receiving products that do not fit their preferences (Etgar, 2008). Industrial automation companies expect an adequate amount of information from their customers to avoid the risk of mismatching since they offer customized solutions.

Technological changes allow low-cost interactions between consumers and suppliers and among consumers themselves by decreasing the economic costs, time, and effort required for consumer participation in value creation (Walker et al. 2006; cited in Etgar, 2008). Industrial automation companies provide detailed information about their goods and services on their web site. i.e., Customers can reach general specification sheets for each product on an industrial automation company's website. Even Endress+Hauser provides an online product configurator tool that enables customers to generate sizing of the product (selecting the appropriate product based on the customer's field), display and compare the price, and give an order. Endress+Hauser's online product configurator is an example for co-production of the goods in the design stage, thus, it can be said that they co-design the product with their customers. Endress+Hauser uses customers' operant resources (such as the technical knowledge and skills of their customers) to decrease the workload of its own employees.

Co-production entails the usage of "consumer's operand and operant resources" (Arnould et al., 2006). For instance, a major resource that consumers practice in co-production is their time which is still a scarce resource for everyone and its usage in coproduction reflects economic, social, and psychological costs for the consumers (Etgar 2006; cited in Etgar, 2008).

> "*An important component in the arsenal of such skills is dialogical capability, defined by Ballantyne and Varey (2006) as a process of learning together rather than just an exchange of information" (Etgar, 2008).*

Consumers that accomplish them are therefore more likely to engage in co-production (Etgar, 2008).

Reaching to customization is the major motivation to engage in co-production. When there are noticeable differences about product attributes regarding to the brands, the co-production activities may take place. Industrial automation and control products are appropriate for this example since the "technological permutations in the composition" of an industrial automation product" are much greater and expand continuously. Therefore, consumers' involvement in the planning of the configuration of an automation product they order is highly beneficial" (Etgar, 2008).

Etgar (2008) refers to Geyskens et al. (1998) and Lusch et al. (1992) by stating the importance of trust in co-production. When consumers believe that their production partners are capable to achieve performing required activities as promised and providing relevant outcomes to them, they tend to engage more in co-production. The industrial automation company's product range is an important factor that shapes trust. For example, if the automation company possesses wide range of product portfolios, the customer trusts the industrial automation company since the automation company provides solutions to the customer's request. If the company does not have all the necessary products in their product range, they get an offer by another company (supplier or competitor) and add this product to their offer. If the customer does not want different branded products, this narrow product range will be a disadvantage for the industrial automation company.

> *"Customization is a reliable way to deliver superior customer value"* (Scholl-Grissemann, Stokburger-Sauer, and Teichmann, 2020).

Simonson (2005) claims that mass customization might be most suitable to customers who have well-defined and stable preferences. Mass customization allows customers to design customized products and services that the manufacturer produces for later ordering (Franke et al., 2010; Piller, 2004; cited in Scholl-Grissemann, Stokburger-Sauer and Teichmann, 2020). On the other hand, due to the customization of the products, the inventory policies of the industrial automation companies are commonly just-in-time production, and thusly, the delivery is generalized as just-in-time delivery. This structure may sometimes become a disadvantage, because of the increment of delivery time. In this kind of situations, the improvements of the production time or the fast delivery methods may be implemented by the industrial automation companies to convince the customer to drive a profit.

Participating in customization requires resources such as; the customer's level of product category involvement or interest in the product category (Stokburger-Sauer and Hoyer, 2009; cited in Scholl-Grissemann, Stokburger-Sauer and Teichmann, 2020) and the customer's level of expertise -reflecting the cognitive structures and processes required to perform product-related tasks- (Alba and Hutchinson, 1987; cited in Scholl-Grissemann, Stokburger-Sauer and Teichmann, 2020). Additionally, customization requires co-creation and co-production activities with customers. Since co-creation requires time, mental and physical effort, and personal information; customers want to engage in co-creation when their participation generates a high degree of customization (Heidenreich and Handrich, 2015).

In short, customers' willingness for collaboration is essential since customization requires co-creation and co-production activities. Customer involvement in value co-creation is important for businesses that compete to satisfy personalized demands with the aim of gaining competitive advantage (Zhang and Chen, 2008).

> *"A personalized co-creation experience reflects how the individual chooses to interact with the experience environment that the firm facilitates"* (Prahalad, and Ramaswamy, 2004a).

2.5 Coopetition

There are simultaneous cooperative and competitive relationships between competitors (Bengtsson and Kock, 2000). The term "coopetition" is used in the literature to describe the collaborative and competitive relationships between competitors.

> *"Coopetition is a strategic and dynamic process in which economic actors jointly create value through cooperative interaction, while they simultaneously compete to capture part of that value"* (Bouncken et al., 2015).

In order to clarify the definition of coopetition, we should underline this phenomenon's key characteristic which is the paradoxical nature of coopetition resulting from the simultaneity of cooperation and competition (Bengtsson and Kock, 2014). The coopetition capability is the ability to think paradoxically and to initiate processes that help firms attain and maintain a moderate level of tension, regardless from the strength of the paradox (Bengtsson, Raza-Ullah and Vanyushyn, 2016). The attractive opportunities and the risk of misappropriation by the partner generates a dilemma of coopetition for the firms and generates tension between rivals (Gnyawali and Park, 2011). Additionally, Wilhelm and Sydow (2018) defines coopetition capabilities -which is emphasized by Bengtsson, Raza-Ullah and Vanyushyn (2016)- as,

> *“The ability to control competitive tensions while creating joint value from collaboration”.*

Coopetition has been examined with different perspectives in the literature. For instance, one group of researchers applies the game theory on coopetition and perceives competition as a win-win relationship and emphasizes the balance between value creation and value appropriation. The second group of researchers applies a resource-based view on coopetition and argues the benefits of mutually developing and leveraging technologies and resources. Others favor the network approach and argue the importance of cooperative ties between competing firms (Bengtsson and Kock, 2014). Since this master's thesis was built on the basis of value co-creation, the concept of coopetition was studied more through value creation.

The participating firms’ capability of managing the coopetition is important for firms to generate benefits of coopetition. While cooperation lays on the enlargement or protection of “value” through joint efforts, the competitions lays on the desire to capture a bigger proportion of “value” privately (Gnyawali and Park, 2011). Thus, with a value creation perspective, the origin of coopetition is “enlarging the business pie” (Brandenburger and Nalebuff, 1996; cited in Ritala and Tidström, 2014). Creating greater value or benefit that improving the firm performance is a motivator for firms to generate cooperation with competitors (Rusko, 2011). Each company can contribute to coopetition with its core competence (Bengtsson and Kock, 2000) and the partners whom bring more critical resources to the relationship can generate a higher percentage of the benefits (Pfeffer and Salancik, 1978; cited in Gnyawali and Park, 2011).

Competitors are linked to each other in directly by relationships to the same buyer, thereby connecting the competitors' relative positions (Granovetter, 1985; cited in Bengtsson and Kock, 2000). Furthermore, different types of relationships between competitors are possible:

> *"competitors used as sub-contractors, being a subcontractor of the competitor, competitor as partner to respond to call for tenders, or competitor as an important source of information"* (Lechner, Dowling and Welpe, 2006)

and these type of complicated relationships between competitors are present in industrial automation sector too. Since the traditional well-defined roles of actors to create value no longer exists, a customer in one activity can simultaneously be a competitor, supplier, or partner in another activity. Thus, dynamic coopetition definitions should emphasize the interplay between multiple actors, and also account for the continuously changing roles played by different actors (Johansson, 2012; Wilkinson and Young, 1995; cited in Bengtsson and Kock, 2014).

2.6.Theoretical Foundations of the Study – Service-Dominant Logic

Today, we believe that the old worldview of economics was wrong due to separating goods and services into two different concepts (Maglio et al 2008). Traditional economics worldview takes shapes from the goods-dominant-logic (Lusch and Vargo 2006a; Vargo and Lusch 2004) which considers value as embedded in tangible manufactured outputs and determines the value basis on "exchange value" (Vargo, Huotari and Vink, 2020). Goods-dominant-logic relies on "consume" which means "destroy" "use up" "waste" (Normann, 2001, cited in Vargo, Maglio and Akaka, 2008). In other words, this old enterprise logic (Zuboff and Maxmin, 2002) defends that value is something produced by the producer and destroyed by the consumer (Normann, 2001). The statement of Coombs and Miles (2000):

> *"Material products themselves are only physical embodiments of the services they deliver, or tools for the production of final services."*

is presumptive evidence that the economic worldview needed a radical change.

The revolution came insight in the twenty-first century with the insist of Vargo and Lusch (2004) by thinking businesses and economics based on service-dominant logic (Maglio et al, 2009). In other words, “all economies are service economies” (FP5 of SDL, Vargo, Maglio and Akaka, 2008). Service-dominant logic articulates that rather than separating outputs into two different concepts (manufactured products and services), a common denominator “service” as a process should be used (Vargo, Huotari, and Vink, 2020). Firms propose value through market offerings, customers continue the value-creation process through use, thus enterprises cannot deliver value, but only offer value propositions (Vargo, Maglio and Akaka, 2008). In brief, value is not something defined by “the amount of nominal value, price received in exchange” (value-in-exchange), it should be measured by “the adaptability and survivability of the beneficiary system” (value-in-use) due to the fact that value is always uniquely and phenomenologically determined by the beneficiary (FP10 of SDL) (Vargo, Maglio and Akaka, 2008).

> *“As value shifts to experiences, the market is becoming a forum for conversation and interactions between customers, customer communities, and firms”* (Prahalad and Ramaswamy, 2004a).

Thus, value creation is no longer solely within firms’ boundaries, instead, value is co-created among various actors within the service network (Edvardsson et al., 2014).

In the light of these, we must understand the fact that value is co-created within various actors in service networks. By meaning a service network, the fundamental idea is that the value creation process should be emphasized in a holistic network view since each actor interact with each other, and consequently value co-creation arises. A service system can be defined as the interaction of configured resources -people, technologies, other resources- with other systems to create mutual value (Maglio et al, 2009). In other respects,

> *“the concept of service focuses on the process of serving rather than on a type of output, such as “services” (plural) – intangible goods. Consequently, service-dominant logic is not about making services more important than*

goods, but rather about transcending the two types of outputs through a common denominator—service, a process" (Vargo, Huotari, and Vink, 2020).

In fact, companies provide services to receive similar services from others, and this idea generates a holistic view that the action of each actor in a supply chain affects other networks and the value is co-created upon many actors (Vargo, Huotari and Vink, 2020). While goods dominant logic considers the aim of exchange as the firm profit, service-dominant logic argues that the purpose is value co-creation (Vargo, Huotari, and Vink, 2020).

In service-dominant logic, value is broadly defined as "an emergent, positively or negatively valenced change in the well-being or viability of a particular system/actor" (Vargo and Lusch, 2018).

> *"In this view, for value co-creation to occur, there must be integration of the beneficiary actor's resources with those applied by the service provider and others. All of this, in turn, implies that every time value emerges as a result of resource integration, it is always co-created by multiple actors"* (Vargo, Huotari and Vink, 2020).

> *"Value is perceived experientially and differently by diverse actors in varying contexts, and that each instance of value co-creation can have multiple possible assessments, including negatively valenced ones"* (Vargo, Akaka and Vaughan, 2017; cited in Vargo, Huotari and Vink, 2020).

Also, it should be mentioned that in service-dominant logic, rather than using terminologies such as B2B (business to business) or B2C (business to customer), A2A (actor to actor) is preferred due to

> *"the generic A2A orientation makes all actors simultaneously providers and beneficiaries through direct and indirect service-for-service exchange"* (Vargo and Lusch, 2011; cited in Vargo, Huotari and Vink, 2020).

The 10 foundational premises of service-dominant logic are shown below:

Table 1. 10 Foundational Premises of Service-Dominant Logic, (Source Vargo, Maglio and Akaka, 2008)

FP1	Service is the fundamental basis of exchange.
FP2	Indirect exchange masks the fundamental basis of exchange.
FP3	Goods are a distribution mechanism for service provision.
FP4	Operant resources are the fundamental source of competitive advantage.
FP5	All economies are service economies.
FP6	The customer is always a co-creator of value.
FP7	The enterprise cannot deliver value, but only offer value propositions.
FP8	A service-centered view is inherently customer oriented and relational.
FP9	All social and economic actors are resource integrators.
FP10	Value is always uniquely and phenomenologically determined by the beneficiary.

Finally, attributes of service-dominant logic are explained by referring the work of Vargo, Maglio and Akaka (2008): The value is accepted as value-in-use in service-dominant logic. Firm, network partners, and customers are the co-creators of value therefore, a multi-actor involvement is present in value co-creation. The value creation process is as follows, firms propose value through market offerings, customers continue the value-creation process through use. As mentioned before, the purpose of the value is to increase adaptability, survivability, and system wellbeing through service (applied knowledge and skills) of others and we can measure value in means of the adaptability and survivability of the beneficiary system. The resources used are mainly operant resources, sometimes transferred by embedding them in operand resources. Operand resources such as natural resources, require an action taken upon them to be valuable; operant resources, such as knowledge and skills, are capable of acting on other resources to contribute to value creation (Vargo, Huotari and Vink, 2020). The role of the firm in this value co-creation process is to propose and co-create value and provide services. The role of the goods proposed by the firms to the beneficiaries can be described as a vehicle for operant resources since goods enable access to benefits of firm competencies. Consequently, the role of the customers as beneficiaries is to co-create value through the integration of firm-provided resources with other private and public resources. In conclusion, this master thesis accepts service-dominant logic premises while examining a value co-creation study in customized supply chains.

CHAPTER 3: INDUSTRIAL AUTOMATION SECTOR

3.1. Industrial Revolutions and Automation

Industry means the production in highly mechanized and automized (Lasi et al., 2014). manners. Through the centuries, humankind works on industrialization in order to decrease the human interface -helps error reduction based on humans-, increase mechanization and consequently more efficient production techniques. Industrial revolutions help the acceleration of scientific and technical studies and facilitates inventions. For that matter, the revolutions in the industry are classified into four regarding the technical achievements and used energy resources. First industrial revolution started by 1760 is in the field of mechanization (Lasi et al., 2014). The used energy resource was coal and mainly developed in textile steel industries (Prisecaru, 2016). Second industrial revolution (1900-1960) used electrical (mainly) and oil as energy resources and developed in metallurgy, auto and machine building industries (Prisecaru, 2016). The widespread of digitization (Lasi et al., 2014) came up with the third industrial revolution (1960-2000). The energy resources were nuclear energy and natural gas and mainly developed in auto and chemistry industries. Today's one of the most important topics, Industry 4.0 has started by 2000s uses green energy and mainly developed in high tech industries. In short, the term "Industry 4.0" describes different – primarily IT driven – changes in manufacturing systems (Lasi et al., 2014). Today, Industry 5.0- A Human Centric Solution became a byword which is mainly about artificial intelligence. The sole focus of Industry 4.0 is to improve the efficiency of the process, and it thereby inadvertently ignores the human cost resulting from the optimization of processes. This is the biggest problem that will be evident in a few years when the full effect of Industry 4.0 comes into play (Nahavandi, 2019). Therefore, the studies about Industry 5.0 is highly dominant for industrial automation companies with the aim of personalizable autonomous manufacturing solutions.

Hereby, industrial automation sector works on the behalf of technological revolutions and serves their customers with various automation solutions. As we all know, companies target a consistency in the market to continue revenue generation and structure processes accordingly. Quality, consistency, and competitiveness cannot be achieved without automating process of manufacturing goods and delivering services. In line with this trend, the application of automation today is omnipresent in almost all applications, from deep water sea to space, and has gained the confidence of the world for achieving desired results. (Sharma, 2016). The industries that industrial automation serves for can be classified into two which are discrete industries (automative, electronics, heavy manufacturing, packaging, others-aerospace and defence, high tech and others) and process industries (oil&gas, chemicals, pulp & paper, mining and metals, healthcare, others-pharmaceuticals, petroleum, and others).

Automation delegates the work from humans to machines with the aim of higher speed, higher precision and output and reduced costs and the predominant objective of automation is to make more efficient processes. During the most recent 100 years, automation went through a critical change by the evolvement of handling and transformation of materials to the handling of information. We can especially see this change in factory and process automation (Sauter et al., 2011). It can be said that, the products offered by industrial automation companies provides communication networks. Most of them are connected to a control room or office and able to be commanded by them.

> *"Innovative instrumentation systems now control complex processes, ensuring process reliability and safety, and provide a basis for advanced maintenance strategies"* (Jämsä-Jounela, 2007).

ANSI/ISA-95 model is an accepted standard by the International Society of Automation, and it shows the layers of automation from level 0 to level 4.

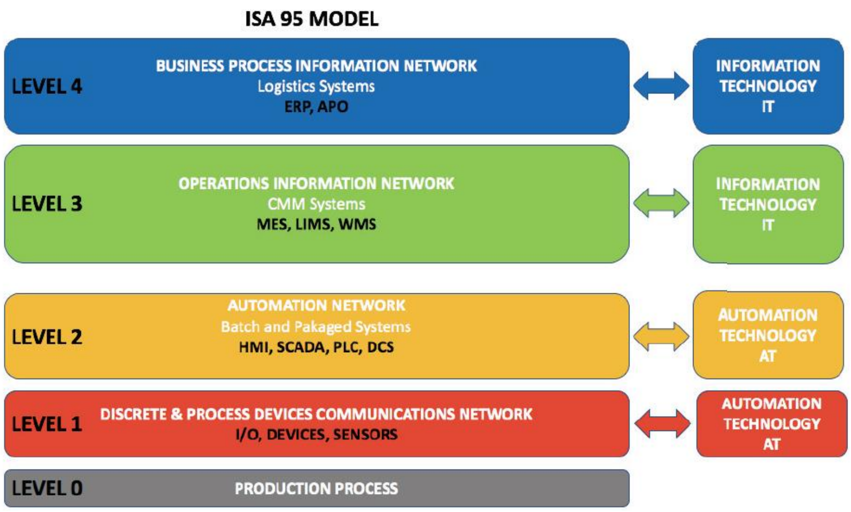


Figure 4 – ANSI/ISA-95 hierarchical levels (Source: Saturno et al.)

"Level 0 defines the real physical processes. The automation devices and systems responsible for the automation of manufacturing processes are represented by levels 1 and 2, where actuators and sensors monitor the field devices in level 1 linked to automation and control systems represented by level 2 (DSC, SCADA, PLC). Level 3 is composed by monitoring systems used to manage manufacturing Operations through the control of productivity, quality and maintenance indicators (MES, LIMS, WMS). Level 4 consists of Enterprise Resource Planning (ERP) systems that are responsible for business planning and logistics through the entire supply chain. The hierarchical structure formed by the proposed architecture in the ISA 95 standard is presented as the following organizational sequence" (Saturno et al.,2017).

Even if this ANSI/ISA-95 is accepted and used as a traditional pyramid for industrial automation,

"the automation layers should be restructured since each level works with an integration principle" (Saturno et al.,2017).

The newly suggested model is shown in Figure 5,

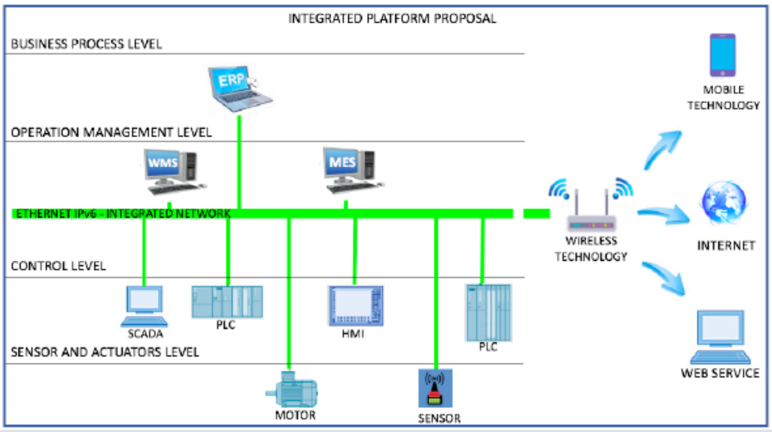


Figure 5. Proposed architecture model (Source: Saturno et al.)

"In this new model, the technologies optimized for a system allow a real efficiency increase in all the functions of an architecture. Providing new technologies to improve the flexibility and connectivity between the functions

of an architecture directly contributes to the actual efficiency increase of the entire process involved" (Saturno et al., 2017).

Due to the fact that each level works and serves together, the automation products should be perceived in an integrated manner.

3.2. Industrial Automation Sector and Products

The forecasted industrial automation market growth is %9,2 from 2021 to 2028 by reaching 355.44 Billion USD (Fortune Business Insights, 2021b). The development of innovation in technologies such as applicatiopm programming interface (APIs), cloud technology, and machine learning increased the demand for automation. Augmented reality (AR), digital twin, Industrial Internet of things (IIOT) are supposed to be the important trends prevailing the industrial automation market growth. Sensors, relays, switches, robots, and other automatic control devices are factory automation technologies aiming at productivity increment while simultaneously producing cost decrement. Therefore, the firms in the manufacturing sector are looking forward to automation products (Fortune Business Insights, 2022). Industrial automation decreases the amount of human interference and provides advantages such as low operating cost, high productivity, high quality, high flexibility, high information accuracy, and high safety. On the other hathe nd, high initial cost is the disadvantage of industrial automation.

Table 2. Advantages and Disadvantages of Industrial Automation (Source: Surecontrols, 2013)

Header	**Explanation**	**Advantage Disadvantage**
Low Operating Cost	Saving of the monthly wages of the workers due to replaced human workforce with automated solutions. The maintenance cost is less since automation products do not often fail.	Advantage
High Productivity	Due to less amount of maintenance, manufacturing companies can be available to work for 7x24 and 365 days and this brings a significant amount of productivity.	Advantage
High Quality	Automation eliminates the human-error. Uniform quality manufacturing in different times.	Advantage

Table 2. Continued

High Flexibility	Programmable robots and machines to do jobs more flexibly.	Advantage
High Information Accuracy	Automated data collection brings improved data accuracy and reduced data collection costs.	Advantage
High Safety	Deploying robots in hazardous conditions to make the production lines safe for the employees.	Advantage
High Initial Cost	The initial investment cost of switching a human production process to an automated production process is very high.	Disadvantage

Industrial automation products can be segmented as sensors, drives, switches and relays, controllers, industrial robots, and others. Furthermore, the automation solutions can be described as distributed control systems (DCS), supervisory control and data acquisition system (SCADA), manufacturing execution system (MES), safety instrumented system (SIS), programmable logic controller (PLC), human-machine interface (HMI), and others (Fortune Business Insights, 2022).

3.3. Industrial Automation and Customization

Benefits of automation for manufacturing processes can be described as the reduction in production loss through a reduction in unproductive time through automated decisions, resource optimization, higher security, safety, and reliability, faster response and results because there is no human intervention (Sharma, 2016). These benefits are coming from the appropriate automation solutions for the customer's field. Based on the process, the selected solution can be a standard product e.g., used for a temperature, pressure measurement or a customized product e.g. used for separating and analyzing chemical compounds in the gas phase of industrial processes. Since the industrial process of each customer is different than the other, the selected product needs a customized system integration solution. Therefore, industrial automation companies possess customized products as well as standard ones in their product portfolio. Industrial automation products are appropriate for mass customization indeed.

"Mass customization has been considered as a means of competition. It is also consistent with the recent thrust in the industry toward increasing manufacturing flexibility (greater variety and customer responsiveness)" (Tseng, Jiao and Merchant, 1996).

Since a wide range of automation products is designed to fit the customer's manufacturing operations. Even for a simple pressure gauge, there are many options in device modeling in order to reach the most appropriate product for the customer.

With the industrial revolutions, the role of industrial automation becomes more significant. The customized structure of the industrial automation products and services brings co-production and co-design activities into life. Also, the coopetition activities within the industrial automation networks occur. Co-production and coopetition activities are the sub-topics of value co-creation. The value co-creation activities result in the value-in-use. Value co-creation activities require the integration of the resources of the actors within the supply chain. Since the industrial automation supply chain consists of multiple actors, the analysis of value co-creation activities within industrial automation supply chain contributes to the literature with the illumination of multi-actor value co-creation effect on value-in-use.

3.4. Industrial Automation Actors

Industrial automation manufacturers are the actors that provide appropriate automation solutions to their customers by their manufacturing activities. They manufacture automation products in line with Industry 4.0. trends to decrease human force in the customer production processes.

Suppliers of the automation companies may be long-term or temporary suppliers. There are raw material suppliers, semi-finished product suppliers, and finished-product suppliers. This master thesis considers only the finished-product suppliers. Suppliers also need an adequate amount of information by the automation companies in order to determine the convenient product. This master thesis examines particularly the B2B activities in terms of sales, therefore the suppliers involved in this master thesis are finished-good suppliers.

Technology providers provides advanced software that integrate the systems of the customer. Their products often need and industrial automation product for installation. Technology providers provide similar products to the end-users as automation companies; therefore, they cooperate and compete at the same time.

The categorization of the industrial automation companies' customers are: end-user firms, EPC contractors, trading firms, and OEMs. End-user firms possess detailed information about their field's activities since they operate them. An adequate amount of technical information can be provided by the end-user firm since their operant resources such as knowledge and skills are present by their own employees. EPC contractor means

> *"A form of building contract used for a large or otherwise complex project under which the builder (the EPC contractor) will deliver a completed project on a turnkey basis. The EPC contractor is an abbreviation for engineering, procurement and construction contract."* (Thomson Reuters, 2021)

EPC contractors participate in the end user's tender bids. In these bids, they expect industrial automation companies to a quick reply with no detailed technical work. If an EPC contractor becomes the winner of the bidding, they obtain detailed technical information gathered by the end-user company. Consequently, in this stage, EPC contractors expect detailed work from the industrial automation companies.

Supplier and engineering firms provide engineering studies for the end-user field. They can work with EPC firms for the automation engineering studies or they can directly work with the end-user or industrial automation firm. They can also purchase and sell industrial automation products.

Trading firms means the companies which generate only the selling of the product. In other words, they obtain the technical information from the end-user firm and gather the quotation from industrial automation companies. They are intermediary firms that usually have lack technical skills.

OEM companies use the products of industrial automation companies as a component to produce a final product. "Original equipment manufacturers (OEMs) often develop and market products that comprise technologically separable components procured from independent suppliers" (Ghosh and John,2009). Since they produce the final product, they are able to generate technical information for industrial automation companies.

Partner firms possess long-term or temporal agreements with industrial automation companies. They often have knowledge and skill about the industrial automation company’s products. Partner firms co-work with the industrial automation company or independently

CHAPTER 4: METHODOLOGY

In this study, the value co-creation activities and their effect on value-in-use in customized product supply chains are analyzed. The thesis is based on qualitative data analysis to deeply analyze the topic. For this reason, the semi-structured interview is the cornerstone of the methodology.

4.1. Semi-Structured Interview Method

This literature review shaped the research questions to reach the objective of the thesis. As mentioned before, the industrial automation sector has not been explored yet in means of value creation. Therefore, the semi-structured interview method is selected since it has proved to be both versatile and flexible (Kallio et al., 2016).

> *"Interviews are the most commonly used data collection method (Taylor, 2005) and the semi-structured format is the most frequently used interview technique in qualitative research (DiCicco-Bloom, and Crabtree, 2006)"* (cited in Kallio et al., 2016).

Semi-structured interviews, allow the participants to freely express their ideas and feelings; while at the same time giving the ability to the interviewer to introduce topics and questions through the needs of the interview process. Semi-structured interviews are commonly preferred by the researchers if the possible participants have certain experience and know-how about the subject. For this reason, in semi-structured interviews, respondents generally selected for their experiences and opinions that are helping to the exploration of the research topics in-depth (Matthews and Ross, 2010)

> *"Whether a newly designed or established program is being evaluated, evaluators must collect relevant information from multiple individuals"* (Gugiu and Rodríguez-Campos, 2007).

Therefore, identification of the key informants who should be interviewed is important in a semi-structured interview (Gugiu and Rodríguez-Campos, 2007). Actors involved in the industrial automation supply chains or service ecosystems do not have strict roles as customers, and suppliers, because their roles are changing depending on the characteristics of the job. Therefore, while generating interviews, we decided to focus on the experiences of participants rather than the organization they work for, to understand how they evaluate the value-in-use when they find themselves in different positions, such as customers or suppliers. It should not be forgotten that there are exact end-users of the products and they are the evaluators of value-in-use as the beneficiaries. The interview questions are shaped regarding the literature review and the most critical aim was to understand the value-in-use in forms of positive and negative while discussing the co-production, coopetition, and value-co-creation actions of the participants.

An interview questionnaire is prepared including 22 open-ended questions about industrial automation, customization, value co-creation, co-production, coopetition, and value-in-use. Also, an explanation of each notion is provided with an information form. Before the question phase, each interviewee was informed about customization, operand/operant resources, value co-creation, co-production, coopetition, and value-in-use to enable them to understand the concepts since these are very literature-centric terminologies.

We noticed that the first person participating in the interview had difficulty understanding the concepts and questions. She could understand the concept of value and comment on co-creation, but she did not understand co-production very well. For this reason, real-life examples for each concept that can be understood by the participants were added to the information form and supported by visuals. On the other hand, we changed the way we asked the questions and tried to capture the participants with simpler sentences, and this method worked. The interviews lasted an average of 1 hour, and additional questions were asked to examine the topics in detail in order to encourage the participant to speak according to the course of the conversation. In this way, the participants explained the business processes that will allow us to analyze the concepts in a more comfortable way. In addition, many participants became more aware of the value-creating activities in their work during the interview and were eager to continually provide examples as the conversation continued.

In this master thesis, we determined an interviewee group experienced about industrial automation sector which is from different roles in the supply chain and generated semi-structured interviews with them.

Table 3. Sample Size of Interviews

Supply Chain Member	Interviews	
	#N (company)	#N(people)
Industrial Automation Firm	4	7
Technology Provider	1	1
End-user	3	3
OEM	2	2
EPC	1	1
Supplier & Engineering Firm	2	2
Total	**13**	**15**

Table 3 shows the sample size of the interviews. There are 6 different types of actors, 13 companies, and 15 interviewees within the sample group. One interviewee was experienced in an industrial automation firm and technology provider therefore the total number of people is 15 rather than 16.

Then, the information generated by the semi-structured interview is analyzed with content analysis and examined the similarities and differences in the responses of the participants. The results are explained with a comparison with the existent literature.

4.1.1. Interviewee Sample

The interviewee sample consist of industrial automation firms, technology providers, end-users, OEMs, EPC, and supplier-engineer firm. The participant profile to the semi-structured interviews is mentioned in Table 3.

Two of the interviewees, IA2 and IA4, had work experience in multiple firms. Therefore, we asked questions according to their experiences about both of the companies.

Automation raw material suppliers were not included in the sample because all the automation companies interviewed were global companies and raw material suppliers were located abroad. For this reason, interviews were held with end product suppliers, where they can buy products that they can assemble into their own products or use together. Since the purpose of this thesis is to act with a service-dominant logic perspective, the main focus was to interpret how the participants shared their resources while providing product service in their way of doing business and how they revealed the value with them.

Table 4. Profile of the Interviewees

Interviewee	Role	Automation Work Experience	Company Info	Company Information	Duration of the Interview
IA1	Sales Engineer	3 years	Industrial Automation Company A	Number of production facilities: 13 Number of employees: 10.000 + Scope: International	60 min
IA2	Middle Level Sales Manager	16 years	Industrial Automation Company B Industrial Automation Company C	Company Number of production facilities: 10 Number of employees: 10.000 + Scope: International Company Number of production facilities: 10+ Number of employees: 10.000 + Scope: International	58 min
IA3	Middle Level Sales Manager	4 years	Industrial Automation Company A	Number of production facilities: 13 Number of employees: 10.000 + Scope: International	70 min
IA4	Middle Level Sales Manager	22 years	Industrial Automation Company D Industrial Automation Company E	Company Number of production facilities: 10 Number of employees: 10.000 + Scope: International Number of employees: 1000-5000 Scope: International	60 min
IA5	Sales Manager	25 years	Industrial Automation Company D	Company Number of production facilities: 10 Number of employees: 10.000 + Scope: International	48 min
IA6	Middle Level Sales Manager	16 years	Industrial Automation Company A	Number of production facilities: 13 Number of employees: 10.000 + Scope: International	56 min

Table 4. Continued

IA7	Middle Level Sales Manager	5 years	Industrial Automation Company A	Number of production facilities: 13 Number of employees: 10.000 + Scope: International	71 min
E1	Maintenance Engineer	7 years	End-user - Chemical Industry	Number of production facilities: 2+ Number of employees: 1000-5000 Scope: International	60 min
E2	Process Automation Engineer	7 years	End-user - Petrochemical Industry	Number of production facilities: 2+ Number of employees: 1000-5000 Scope: International	68 min
E3	Automation Development Engineer	7 years	End-user - Iron and Steel Industry	Number of production facilities: 1 Number of employees: 50-200 Scope: International	65 min
O1	Customized Product Lead	5 years	Original Equipment Manufacturer A	Number of production facilities: 1 Number of employees: 50-200 Scope: International	52 min
O2	Sales Manager	22 years	Original Equipment Manufacturer B	Number of production facilities: 1 Number of employees: 10-50 Scope: International	75 min
EPC1	Instrument Supervisor	7 years	Engineering Procurement and Construction Company	Number of employees: 5000-10.000 Scope: International	58 min
SE1	Company Owner	15 years	Supplier - Engineering Company A	Number of employees: 5-15 Scope: International	46 min
SE2	Company Owner	14 years	Supplier - Engineering Company B	Number of employees: 5-15 Scope: International	52 min

4.1.2. Content Analysis Method

> *"Content analysis is a family of systematic, rule-guided techniques used to analyze the informational contents of textual data"* (Mayring, 2000; cited in Forman, and Damschroder, 2007).

The qualitative and quantitative content analysis enables categorizing textual data in order to make sense of it (Mayring, 2000; cited in Forman and Damschroder, 2007). They differ in the way that they are analyzing and resulting in the data. For example, while quantitative data aims to analyze the data with statistical results, qualitative data aims to provide an understanding of the meaning of data. When we compare the quantitative analysis with qualitative, the qualitative analysis aims to understand a phenomenon, rather than to make generalizations from the study sample to the population-based on statistical inference (Forman and Damschroder, 2007).

The content analysis aims to shape data into meaningful clear categories to make it convenient to understand.

> *"The qualitative content analysis examines data that is the product of open-ended data collection techniques aimed at detail and depth, rather than measurement"* (Forman and Damschroder, 2007).

The qualitative content analysis is implemented in this master thesis to extricate the value co-creation activities and their effect on value-in-use for customized products and services. The data coming from semi-structured interviews are not suitable for quantitative analysis because the value is a terminology that varies from person to person. "*Values are what we care about*" (Keeney, 1996) and they can change according to the owner's or buyer's value system (Neap and Celik, 1999). Therefore, qualitative content analysis was implemented to enhance a detailed analysis of each concept.

On the other hand, despite all of the interviewees being the actors within the industrial automation supply chain, their roles differ from each other. Therefore, the meanings they were expressing were similar but they stated them with synonyms words or phrases. In order to illuminate the hidden meanings of the words and phrases, the latent analysis is implemented in this master thesis. All of the interviewees are recorded in good quality and transcribed into text format with all details. After, each word in the transcripts each word was analyzed in detail, one by one.

4.2. Validity and Reliability of the Research

Consistency and reliability of the content classification is crucial in the content analysis. The extent of stability, reproducibility, and accuracy are the factors that make content analysis more reliable (Krippendorff, 2004).

To make the content analysis more reliable and consistent, the interviewee sample is selected based on their expertise and experience in the industrial automation sector. Also, the diversity of the supply chain actors is taken into consideration to enable the analysis of value co-creation activities in a multi-actor perspective. Therefore, the interviewees were from industrial automation firms, OEMs, EPCs, end-users, and supplier-engineering firms. This wide range of interviewee selection enhanced to analyze the value patterns of each supply chain actor from their own perspective.

When conducting the first interview, we realized that even if the interviewee is informed about the concepts of value co-creation, co-production, coopetition, and value-in-use, the interviewee could not internalize the concepts. Therefore, we asked the questions to each interviewee in a simpler way such as "how your customer's satisfaction increases based on your actions?" or "what do you do to make your job more valuable?" or "process efficiency increases how your supplier behaves" rather than literature-centric questions.

The qualitative content analysis for the coding of the semi-structured interviews is implemented. First, all interviews are transcribed properly. Then, each interview is coded line by line to extract the codes for customization, value, and value co-creation activities in terms of co-production and coopetition. Afterward of the initial coding, a second coding was implemented for each interviewee with linking the similar expressions to make proper data. Thirdly, the codes of each actor from similar supply chain roles (end-user, industrial automation firm, OEM, etc.) are compared to each other to detect the similarities and differences, this process is also implemented between diverse supply chains actors coding. This multi-step coding enhanced the reliability of the qualitative content analysis data. Also, the earlier studies about the determinants of value-in-use (Medberg and Grönroos, 2020; Lemke, Clark, and Wilson, 2011; Pinho et al., 2014) are taken into consideration while grouping the data since we cannot ignore the earlier studies and their proven results (Suddaby, 2006).

Lastly, the author’s industrial automation work experience ameliorated the interviewee selection process while easily understanding the role of each actor.

CHAPTER 5: ANALYSIS AND RESULTS

The semi-structured interview analysis detected five value co-creation activities in customized product supply chains such as co-production, co-design, co-procurement, co-trial, and coopetition. Co-production, co-design, and coopetition activities were mentioned in the literature. Co-procurement and co-trial activities were not mentioned often, therefore, for the multi-actor customized products supply chains, these co-creation of value activities are also present. During the analysis of the data, the semi-structured interviews are coded and the summary of each activity are presented in Table 4. The analysis is conducted in four steps. The first-order codes that possess more details are determined and are embedded in the text descriptions under the relevant headings. Then, second-order codes are created as the summary of the first-order codes. Third-order codes that grouping second-order codes in similar headings are determined followingly. Lastly, the third-order codes are grouped in categories to provide a holistic approach.

On the other hand, interviewees mentioned the factors that negatively effecting the four value co-creation activities as co-production, co-design, co-procurement, and coopetition.

The end-result of value co-creation activities is called value-in-use. The effecting factors of value-in-use are also analyzed with positive and negative aspects.

Each finding – [1] co-production, co-design, co-procurement, co-trial, and coopetition activities in customized product supply chains, [2] negatively affecting factors of co-production, co-design, co-procurement, and coopetition, [3] the determinants of value-in-use- are explained in chapter 5.

Besides, the industrial automation supply chain is drawn based on the semi-structured interviews and shown in Figure 6.

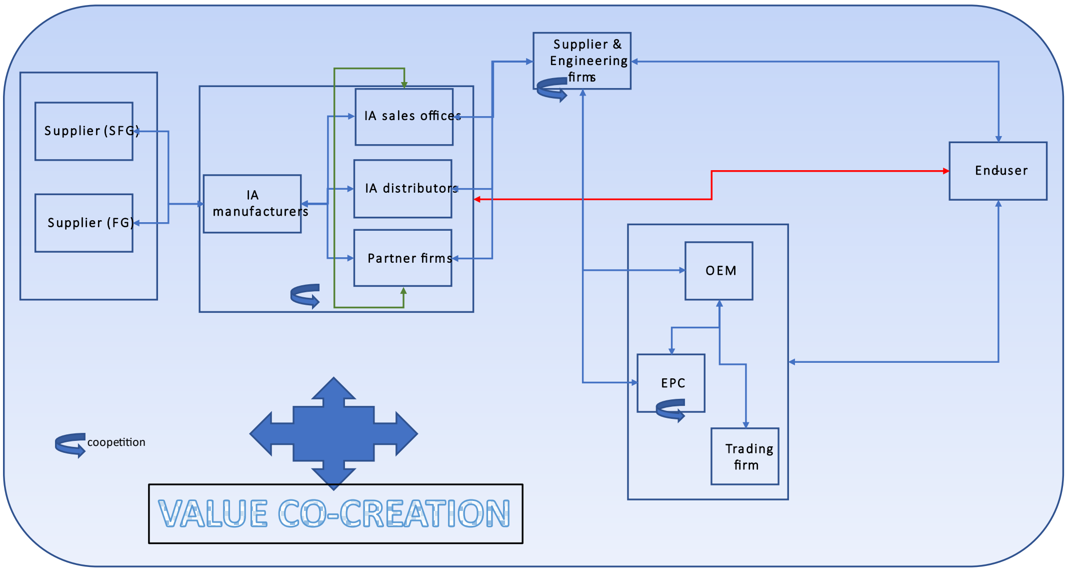


Figure 6. Industrial Automation Supply Chains – Semi-structured-interview

The most important topics in this revision are that supplier & engineering firm is added to the supply chain with connections with industrial automation firms, OEMs, EPCs and end-users based on the interviews with SE1 and SE2. Also, the coopetition activities of EPCs and supplier & engineering firms are mentioned due to SE1, SE2 and EPC1 mentioning. Lastly, industrial automation firms and their sales offices, partners, distributors are mentioned in the same cluster and the coopetition activities are mentioned.

Table 5. The 5 Dimensions of Value Co-Creation Activities in Customized Product Supply Chains

Dimension	**Category**	**Code**	**Illustrative Quotation**
Co-production	After-sales feedback	After-sales feedback to create value for production	*"After-sales support is what makes an automation product and service valuable. We should not leave the customer alone. Let's set up the best system in the world as much as we want, give the best training, but when the customer's starts to work, the problems must be solved in a minimum time. When the customer cannot solve a problem, he should be able to call us and reach us instantly. Because anything the customer does wrong while trying to solve the problem can cost the company millions. That's why after-sales support is an important step." (IA3)*
Co-production	Collaborative production	Collaborative production to create value for production	*"If what the customer needs is a combination of our and another company's products, a partnership or temporary partnership can be established to deliver them to the customer as a single system as a joint engineering product. For example, when we are going to do a job outside of a sector that we are used to, it may be necessary to work with other companies." (IA3)*
Co-production	Continuous control	Control and feedback to create value for production	*"As an end-user, I would like the automation company to follow the product supplied. In other words, even if we do not have any complaints, if it is a new product or if there is an update for the product, I expect the company to call me and ask if you have a problem. I expect the supplier to receive a lot of feedback from us after each new version." (E3)*
Co-production	Interactive Solution	Interactive solution to create value for production	*"When there is a problem caused by the automation product, we ask for support from the automation supplier. They do not solve the problem with a direct remote connection, they direct us for a solution. We manage the solution process with the guidance we receive." (O1)*
Co-production	System (software) integration	System integration to create value for production	*"There is a problem of integration in Industry 4.0 structures. Because these are somewhat more isolated systems. The TP1 company, on the other hand, was able to integrate all systems. It was collecting data by creating infrastructure, transforming data into information, and transforming information into value. And because that value there really benefits the customers, customers were buying from TP1 company by paying 3-4 times the normal price" (IA4)*

Table 5. Continued

Co-production	Training	Training to create value for production	*"If customers learn the details of the product, they will feel comfortable if they can think over the potential troubles and take precautions against possible troubles. You can do this with training. We never leave our customers alone, but there comes a time when they have to be able to make sudden interventions themselves. If you provide this to customers, they will feel more comfortable, have more control over the product, and experience less hassle." (IA5)*
Co-design	Feedback and Brainstorming	Feedback and brainstorming to create value for design	*"Customers also share experiences. For example, he says that he has used something else there before; I used this product here and I could not get any results from it. Or he says he used a product like this and was satisfied with it like this. Thus, we evaluate the negative side of the method we use while designing the system. Or we are trying to evaluate the positive side of it and bring it to a common point." (IA6)*
Co-design	Site visit	Customer site visit to create value for design	*"We can move forward with the information from the customer, but sometimes there are many details such as what kind of system we will put the product in, what is in front of it, what is behind it, whether the space we will put is suitable with the product you will put, whether that product will fit there. Sometimes we can't get information about these, but when we go to the field, when we do it by seeing and examining, and when we talk to the customer, the processes progress much faster. That's why we care about customer site visit in general, especially when it comes to customized product." (IA6)*
Co-design	Testing	Co-testing to create value for design	*"Since customized products are always critical things, they have very detailed tests. After a very long test period, this system is put into use gradually. For this, the customer must always be involved in the process from time to time." (IA3)*
Co-design	Transparent Information Sharing	Transparent information sharing to create value for design	*"The top of everything is that the end-user needs to know what they want, so the end user's role is big. What the process conditions require and the right information should be provided to the supplier company. He is aware of the density, process conditions, and temperature in the line and needs to be conveyed to the automation company accordingly. In other words, if we ignore this and make a request in the form of standard usage, we can never hold any automation supplier responsible at this point." (E1)*

Table 5. Continued

Co-procurement	Information Sharing	Information sharing to create value for procurement	*"The automation company not only gets the necessary details from the project company but also transfers the latest technology in the product to the project company. In this way, the project firm updates its outdated information and puts the new technology in the purchasing specification, and the end-user thus gets the latest technology." (IA2)*
Co-procurement	Inter-functional synchronization	Inter-functional synchronization to create value for procurement	*"Let me talk about the processes when creating a purchase specification. From the DCS system to be used to the instrument in the field, the project investments department consults our opinion on whether they are suitable, whether there will be problems in their supply, ease of use, ease of configuration, ease of supply of spare parts. If this passes our approval, or if there is a situation that will not pass our approval, the process is shaped by our guidance. This is how synchronized business processes between project investments and automation maintenance are realized." (E1)*
Co-procurement	Joint decision-making for procurement	Join-work to create value for procurement	*"In fact, the first thing you need to do is to get immediately involved in that business after the idea of investment comes to the mind of the customer. So this leads to working closely together anyway. If we can convince the customer and put even a word in the purchasing specification at the beginning of the job, our chances of getting that job increase. Because we only put a word, a product feature, no one can bid there." (IA7)*
Co-procurement	One-stop procurement	One-stop procurement to create value for procurement	*"According to the size of the project, if the project to be done will keep the employees of our company busy and prevent the work they need to do, of course, these works are carried out with EPC companies, the procurement goes through EPC." (E2)*

Table 5. Continued

Co-trial	Confirmation of product suitability	Confirmation of product suitability to create value for design	*"Let's give an example of the use of robots for the operations that our customers will perform at very dangerous points, which normally the operators try to do remotely. For example, let the robot be a new technology for us, let's get new references for the robot. Now here we are actually creating value together with the customer. There are certain processes with customers. Customers do not always demand that I want to buy this and sell it to me. In order to be sure that the product they will buy will meet their demands, they demand processes that we call proof of concept, we can call them trial processes. These trial processes are usually processes that create value together, because, as I said, since we already sell customized products, the cases shared by the customer, the trials made with this customer in the field, the solution we will apply for this customer's special problem is of course an experience for us as well. This also contributes to the development of the robot over time. Since we will do such experiments for a certain period of time, it allows us to mutually understand each other and we have the opportunity to experiment with such experiences." (IA3)*
Co-trial	Inter-functional involvement	Inter-functional involvement to create value for product trial	*"When the customer is going to buy a customized product robot, he should not say "I want to try it, I don't buy it without trying, so bring it and show me" and completely withdraw from the business. Here, he has to take some responsibility in financial terms, first of all, we always talk about costs. Apart from that, of course, it needs to allocate resources, it needs to allocate workforce. For example, he needs to create a core team related to robot topics. Because the robot will do the work of more than one department, for example, it will do the work of the maintenance departments, it will do the work of the qhse departments. In that sense, as I said, a team needs to be formed to deal with everything in this project. For this, the customer's allocation of resources is one of the most important issues." (IA3)*
Co-trial	Product demonstration	Product demonstration to create value for education	*"Everyone who graduated from electrical and electronic engineering, electronic communication engineering knows the X brand PLC and sees its software. Because this automation company distributes free demos to universities. In other words, automation equals X brand while graduating in Turkey." (IA7)*

Table 5. Continued

Coopetition	Cooperation for determining design requirements	Cooperation for determining design requirements to create value for coopetition	*"Working with a competitor in the form of buy and sell would be a bit difficult. So let me give an example, in a project we had to buy a product from a competitor. We did not have that necessary product in our portfolio. Well, of course, I must somehow be transferring the process information to them exactly. I must be conveying the information completely so that they can give me the right product. So that I can benefit and they will benefit." (IA1)*
Coopetition	Cooperation for new technologies	Cooperation for new technologies to create value for coopetition	*"Competitor automation companies work together if they have to. In other words, if the direction of technology is moving to a different point, they may have to be a little bit obligated in that sense. In other words, there are points where cooperation has been established regarding these, of course. Not only groups where automation companies come together, but also co-working groups with our customers can be established. Especially for the advancement of technology. But due to competition, this does not happen much." (IA5)*
Coopetition	Cooperation for procurement	Cooperation for procurement to create value for coopetition	*"The first goal of the customer is to be able to progress through a single provider. The customer wants to be comfortable with a single provider without making the job complicated. Taking risks is something the customer does not want. Companies that can solve this problem, that is companies that can handle the part of the other company, provide a great convenience for them. Collaboration with competitors has such value for the customer." (IA3)*
Coopetition	Mutual trust	Mutual trust to create value for coopetition	*"Because the customer looks like this: Brand X is an automation supplier and a larger firm. They never let me down and I can easily reach them. I was moving forward using the power of Brand X, using its relationship with the customer. In the end, because the customer values the rival automation company, we were making a win-win by moving forward together with them." (IA4)*
Coopetition	Resource exhange	Resource exchange to create value for coopetition	*"For example, there were companies that we completed a hospital or steel factory together for a year. We share our resources. Because everything changes on the field. So you want to finish this job on the field properly. So you are sharing your resources. You are already working with competitors that you can share your resources with, so you do not work with every competitor." (SE1)*

5.1. Value Co-Creation Activities

The interviewee sample is carefully selected with actors possessing different roles and responsibilities in the industrial automation sector. Also, the year of experience and expertise in automation practices are taken into consideration. The reason for this action is that the expression of each interviewee is evaluated as part of value since the value is an elusive term (Vargo, Maglio and Akaka, 2008) that is perceived differently by diverse actors due to the multiple possible assessments, including the negative ones (Vargo, Akaka, and Vaughan, 2017; cited in Vargo, Huotari and Vink, 2020). Therefore, each interview is coded three times to illuminate the latent meanings of value and value co-creation activities.

It's known that quantitative analysis is targeting to generalize statistically the study sample while qualitative analysis is extracting the meaning of the phenomenon (Forman, and Damschroder, 2007). This master thesis aims to extract the value judgments of each actor and person by meanings. Therefore, the qualitative content analysis is implemented and each concept was examined under general headings with sub-details.

This master thesis aims to analyze the activities of multiple actors within industrial automation supply chains to examine the effect of discrete actors on value evaluated by the beneficiary. We analyzed the activities and interactions of actors realized from the integration of resources with a multi-actor perspective (McColl-Kennedy et al., 2012).

5.1.1. Co-Production Activities

Etgar (2008) indicates that co-production and value co-creation are intertwined concepts where co-production is dependent on the co-creation of value, based on the work of Lush and Vargo (2006a, 2006b). In other words, co-production is a sub-concept of value co-creation. Co-production is constituted of all forms of cooperation activities within customers and production partners (Etgar, 2008).

According to the foundational premises of the service-dominant logic, we know that enterprises cannot deliver value, instead, they can offer value propositions and this value is always uniquely and phenomenologically determined by the beneficiary (Vargo, Maglio and Akaka, 2008). This determined value by the beneficiary is called value-in-use. It is possible to indicate that customers who purchase industrial automation products actually purchase services from industrial automation providers with a service-dominant logic perspective since service is the fundamental basis of exchange (FP1 of SDL) and all economies are service economies (FP5 of SDL) (Vargo, Maglio and Akaka, 2008). End-users judge the value of the service by using the automation product, in other words getting a service from the industrial automation providers through the use of the product in the end-user field.

Besides, the majority of the participants agree that automation products are customized according to the end-user field requirements. For this reason, before purchasing an automation product, we examined how industrial automation companies, end-users, and other actors taking an active role in that network carry out customization by transferring resources such as knowledge and experience, and how they extract positive or negative value as a result. On the other hand, we have captured that value co-creation activities (co-production, co-design) carried out with the aim of creating positive value-in-use for the end-user can directly or indirectly create both positive and negative value for other actors in the supply chain. We analyzed the co-production activities in the industrial automation sector in detail, with the comments of different actors, in order for the customization to occur. The latent content analysis provided deeply understanding of how the end-users decide whether or not to engage in co-production for the occurrence of customization (Etgar, 2008).

The customized structure of industrial automation products and services are discussed with the participants in the semi-structured interviews. The comments of the interviewees upon the existence of customization are described in Table 6 followingly.

Table 6. Quotes about customization from interviewees

Interviewee	**Illustrative quotes**
E1	"When the analysis side of the chemicals in the process is involved, there are special production demands in terms of both the structure of the chemical and the sensitivity. Customization is required especially for the analysis of compositions in chemical processes, namely analyzers."
E2	"The availability of a product is the most important or most valuable thing. And it should be considered that it requires special production."

E3	"And for this, much more expensive, sensitive devices are purchased, motors are purchased, and these are special production. […] What makes it valuable is the smooth running of this customized product."
IA1	"All of our products are custom-made [...] because when you want to buy a pressure transmitter, you have a lot of alternatives. Because you choose these alternatives according to the process pressure and temperature. You choose it according to how you will connect it there and how you will assemble it. In other words, even our simplest product is a custom-made product."
IA2	"They were custom-made products. Of course, these products were produced in factories in accordance with the demands, wishes, needs, and expectations of the end-users."
IA3	"We can say that 95%-98% of automation systems are special production […] 100% custom-made products on the service and advanced solution side [..] We always do this as a project here is a customization part to adapt it to the end-user field"
IA4	"This automation product was customized for the paper industry, plastics industry, and rubber industry […] We knew what the customer's problem was and created a solution accordingly. We were able to create customer-specific solutions."
IA5	"Now, of course, we have a control system, but you adapt that control system once according to the demands. […] In other words, it may be necessary to think about turning it into a special production."
IA6	"Even the product you call standard production can actually go into special production according to certain standards. [...] That's why even the products we call standard products are not really standard products."
IA7	"Customers need to know exactly what they want when they want something special. Because these are really a wide variety of products."
O1	"Since we buy the same products as standard, we know the product range more or less. The products we will buy are determined. [...] But when there is a special production, we ask for an offer, they send us an offer and then we buy it from them."

SC1	"There are customized products that vary according to the process and the field."
EPC1	"Special production may require more special production. So, the customer can ask for it. Can the automation company offer this?"

Based on the qualitative content analysis driven by the semi-structured interviews, the co-production activities in customized product supply chains are determined and explained in subheadings.

5.1.1.1. After-Sales Feedback

The findings reveal that after-sales feedback is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 7 in summary form.

Table 7. Summary Codes of After-Sales Feedback

Second-Order Code	Third-Order Code	Category	Actors
Instant problem solving through after-sales services for the efficient production process	After-sales feedback to create value for production	After-sales feedback	IA-E SE-E

The importance of instant problem solving through after-sales services for efficient production process is explained by IA7 and SE1 and mentioned followingly. IA7's explanation is that after-sales services through feedbacks by automation firms to solve customer problems instantly to provide continuous efficient production processes for the customer.

"After-sales support is what makes an automation product and service valuable. We should not leave the customer alone. Let's set up the best system in the world as much as we want, give the best training, but when the customer's starts to work, the problems must be solved in a minimum time. When the customer cannot solve a problem, he should be able to call us and reach us instantly. Because anything the customer does wrong while trying to solve the

problem can cost the company millions. That's why after-sales support is an important step." (IA3)

Additionally, after-sales services by the supplier-engineering firms are also addressed the interview of the SE1. After-sales services by supplier-engineering firms can solve customer problems instantly to provide continuous efficient production processes for the customer.

"This job is over, when you say I'm leaving, a problem may arise right after. If you wait 2 days in case there is a problem there, you can solve the problem. The customer really pays attention to these. Regardless of the customer, from the smallest to the biggest, you show the value you give to your business in that way." (SE1)

5.1.1.2. Collaborative Production

The findings reveal that collaborative production is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 8 in summary form.

Table 8. Summary Codes of Collaborative Production

Second-Order Code	Third-Order Code	Category	Actors
Collaborative production of multi-firms for customized production	Collaborative production to create value for production	Collaborative production	IA-P SE-IA IA-EPC OEM-EPC

The analysis revealed that collaborative production activities of multi-firms are observable for customized production. Collaboration of the automation firm with other companies to combine the products for a customized product production are explained by IA3.

"If what the customer needs is a combination of our and another company's products, a partnership or temporary partnership can be established to deliver them to the customer as a single system as a joint engineering product. For

example, when we are going to do a job outside of a sector that we are used to, it may be necessary to work with other companies." (IA3)

Collaboration of the supplier-engineering and automation firm to produce an automated system is mentioned by SE1.

"The mechanic firm arranges the machine, the pneumatic firm places the materials and other equipment, the last automation firm steps in and removes the switch and the machine comes to life in this way. Here, each of them should be very advanced in their own field." (SE2)

Collaboration of EPC and automation firm to establish the production lines for the customer is mentioned by the EPC1.

"The system that the engineer working in the automation company has worked on is certain, it constantly works on the same system and activates that system. The engineer working at the EPC company, on the other hand, controls the installation and wiring of the input output devices with the devices that the DCS system communicates with in the field." (EPC1)

5.1.1.3. Continuous Control

The findings reveal that continuous control is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 9 in summary form.

Table 9. Summary Codes of Continuous Control

Second-Order Code	Third-Order Code	Category	Actors
Provide product control and get customer feedback for customer production processes	Control and feedback to create value for production	Continuous control	IA-E IA-EPC-E IA-OEM
Control and support of the automation firm after EPC for the customer			
Remote control and feedback for production process optimization			

Control and feedback to create value for production are mentioned by several participants in the semi-structured interviews. Remote control of the customized product in terms of continuous collaboration and feedback with the customer to optimize the customer's processes is mentioned by IA3.

> *“Currently, there is a model called "software as a service". There is an exchange of information at first, then an exchange of information while the project is being carried out. It is a model in which the automation company continues to operate the product at the customer site on behalf of the customer. It is a model in which we follow the operations of the customer remotely and provide continuous support for them, and it is a maintenance agreement.. It's not something that is very common right now, it's more of something that is being tried to be developed. After all, we are talking about a model in which we work with the customer continuously. It is connected to the customer's systems, the customer gives us information, we give continuous feedback to the customer. We strive to optimize the customer's production processes. Proper maintenance reduces the time of unexpected maintenance at work, ensures smooth operation of the unit, and increases productivity.” (IA3)*

Remote control of the automation product in terms of continuous collaboration and feedback with the OEM to optimize the OEM's production processes activitiy is also present between OEM and automation firms. IA2 pointed out this issue.

> *“There was something for machine manufacturers to monitor the information about the manufacture of the machine, to monitor the information about its failure, over the web developed by the automation company. After creating the project and selling it to the customer, automation firm was building long-term, long-lasting and sustainable relationships by receiving such feedback and making corrections about it.” (IA2)*

E3 explains the importance of product control and get customer feedback for customer production processes by the automation firm.

"As an end-user, I would like the automation company to follow the product supplied. In other words, even if we do not have any complaints, if it is a new product or if there is an update for the product, I expect the company to call me and ask if you have a problem. I expect the supplier to receive a lot of feedback from us after each new version." (E3)

Regular customer field visits by the automation firm to control the automation products and production processes and give feedback to the customers is important for E1, E2 and E3.

"We look at the companies that we supply automation as partners. As we are partners, we expect constant visits from them. We expect them to periodically inspect our systems at our sites. We are waiting for them to guide us for the products that need to be calibrated." (E1)

The necessity of control and support of the automation firm after EPC assembled the products in the customer field is mentioned by EPC1.

"When the end-user encounters a problem in the production processes of the company after the automation company sells the product to the EPC company and assembles the EPC products, there may be a situation that requires checking in the field. Therefore, the automation company may need to go to the field." (EPC1)

5.1.1.4. Interactive Solution

The findings reveal that interactive solution is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 10 in summary form.

Table 10. Summary Codes of Interactive Solution

Second-Order Code	Third-Order Code	Category	Actors
Automation firm interaction for the customer production processes guided by EPC	Interactive solution to create value for production	Interactive Solution	IA-E IA-EPC IA-EPC-E IA-OEM
Customer interaction in production to solve automation firm's problems			
EPC interaction to solve production problems in customer processes			
OEM interaction to solve product failure through automation firm's direction			

Interaction by the customer, automation firm, OEM, and EPC are explained by the participants for interactive solution to create value for production. Interaction of the customer by solving the problems that automation firm cannot in the customer production processes is addressed by E2.

> *"Our contribution in these matters is usually by solving the things that will make the automation company's job easier. We intervene in things that they cannot or cannot interfere with, and we eliminate their problems. This is not with the automation products they are interested in, but by solving the side events they encounter." (E2)*

Interaction of the EPC to provide solutions in the customer production process during automation product installation is mentioned by E3.

> *"While working in an automation company before, I took part in a project with the end-user customer and EPC company. The EPC we worked with was an incredible fixer and had years of experience. In other words, the problem that we could not solve was immediately solved by EPC. EPC had its own equipment used and found a way to solve it. Because EPC company agreed with the end-user customer to finish the job in a certain time and EPC was solving the problem because it slowed down their work for us." (E3)*

Automation product problem solving by OEM through the remote direction of the automation firm is also an enhancing activity to create value for production.

> *"When there is a problem caused by the automation product, we ask for support from the automation supplier. They do not solve the problem with a direct remote connection, they direct us for a solution. We manage the solution process with the guidance we receive." (O1)*

5.1.1.5. System (Software) Integration

The findings reveal that system (software) integration is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 11 in summary form.

Table 11. Summary Codes of System (Software) Integration

Second-Order Code	Third-Order Code	Category	Actors
System integration through customized software for integrated production processes of customer	System integration to create value for production	System (software) integration	TP-E TP-PF
Co-producing an integrated customized solution for better production processes			

The integration of systems by special software is mentioned only by IA4, as the sole participants experienced in a technology provider firm. This integration realizes through customized automation software to integrate different automation systems to create value for production in the customer field.

> *"There is a problem of integration in Industry 4.0 structures. Because these are somewhat more isolated systems. The TP1 company, on the other hand, was able to integrate all systems. It was collecting data by creating infrastructure, transforming data into information, and transforming information into value. And because that value there really benefits the customers, customers were buying from TP1 company by paying 3-4 times the normal price" (IA4)*

Besides, the partnership with ERP system provider firms is mentioned by IA4 to co-produce an integrated customized system for customer's production processes.

> *"We chose the way of creating value by going together with some companies and this was liked by the customer. We worked together with the ERP manufacturer company and made a suggestion to the customer, ERP would present reports to the customer, but since they could not control the supply chain side and could not see what was produced in the process facility, we would provide this as a technology provider company. We would do this by collecting data from the ERP system and providing integration. In this way, we offered the customer a solution with higher added value." (IA4)*

5.1.1.6. Training

The findings reveal that training is a co-production activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 12 in summary form.

Table 12. Summary Codes of Training

Second-Order Code	Third-Order Code	Category	Actors
Training about the latest automation products and technologies for efficient production processes	Training to create value for production	Training	IA-E
Training for customized product usage in production			

Training is the most frequently addressed co-production activity among the participants. Training about the latest automation products and technologies for efficient production processes is mentioned by IA5, E1, and E2. Training and information sharing about the latest automation technologies to the customers by automation firms to enhance efficient production processes for customers is explained.

> *"We are in the era of digitalization, and industry 4.0 and the innovations it brings have now come to the fore in the automation sector and are being*

implemented. Automation applications are increasing and companies are making conscious investments in this direction, but this is still not the case in most companies. Of course, there are places that progress with the technology left over from the 1980s and 90s, as this is the case, the technical team in the company stays in the 80s and 90s technology era. This subject is important. In other words, companies that offer industrial automation technologies should raise the awareness of the customers and support them at this point." (E1)

Additionally, trainings given to customers to enable them to control their processes efficiently and increase their level by 6sigma implication by using automation products is mentioned by IA5.

"What kind of actions do our customers take to make the process more efficient… Our customers are also trying to increase their level. They receive various trainings. They control their own processes. They are going to renew their own processes. 6sigma is valid everywhere. They apply the requirements of 6 sigma and we do too." (IA5)

Training for customized product usage in production is mentioned by IA5, IA3, IA1, and E2. Trainings given to the customers regarding product specifications for quick intervention in case of the problems is addressed by IA5.

"If customers learn the details of the product, they will feel comfortable if they can think over the potential troubles and take precautions against possible troubles. You can do this with training. We never leave our customers alone, but there comes a time when they have to be able to make sudden interventions themselves. If you provide this to customers, they will feel more comfortable, have more control over the product, and experience less hassle." (IA5)

Trainings given to the customers regarding customized product use in production processes is addressed by IA3 and IA1 followingly.

"Automation products are very critical systems. For example, emergency shut down systems that prevent a refinery from blowing up are one of the products

we train customers. It is very important that this system is used and operated properly. At the beginning of this system, there are operators, engineers, and there are certain managerial levels of those units. And all of this, it is very important for the customer to have at least minimal knowledge about this system. By providing this training, we ensure that the customer learns to use the systems correctly." (IA3)

"After the customized product tests are done, everything is approved and the product is made suitable for field assembly, there are also supervision services. For this, the engineer of the automation company makes product installation and gives training to the customer about how the product will work." (IA1)

5.1.1.7. Factors Negatively Affecting Co-production

The negatively affecting and preventing activities of the co-production are mentioned by the interviewees and explained in this section.

Table 13. Summary Codes of Factors Negatively Affecting Co-production

Second-Order Code	Third-Order Code	Category	Actors
Less control by the automation firm limits effective customer production	Lack of control as an obstacle to create value for production	Lack of control	IA-E
Lack of expertise limits solution and effective production process	Lack of expertise as an obstacle to create value for production	Lack of expertise	TP-E IA-E SE-E
Dependencies caused by working with multi/cross actors for customized production	Multi/cross actor dependencies as an obstacle to create value for production	Multi/Cross Actor Dependency	S-IA OEM-EPC-S

Lack of control of the automation firm for the customized automation product in the customer processes forms limitations for effective production.

"While producing wire, we used a distance sensor to see how many meters of wire was wound around the coil. The device could not see properly because the wires were reflecting on this distance sensor. We purchased a custom-made sensor for this issue. This is what I wanted, I thought it should work, but the

sensor gave an error again. I think that's why the automation company in customized production should follow their devices very closely to see if there is a problem in the customer's production processes." (E3)

Customer's inexpertness to understand the value of customized product for better production processes prevents co-production between the technology provider firm and the end-user. (IA4)

Lack of knowledge about the automation products of the customer forms limitations to solve the problems in the customer production processes. (E3)

Furthermore, lack of experience of the engineering firm forms limitation for effective customer production process. (E3)

Multi/cross actor dependencies are mostly mentioned negatively affecting factor of co-production. The Multi-actor and cross supply chain structure of the industry forms limitations for accurate production through wrong actions of the supplier.

"Except for small projects, we have to work with 3rd party companies in all other works. Of course, that 3rd party's supply chain directly affects ours, their processes directly affect ours. No matter how many partners you work with, how many suppliers you work with, all of these come with certain limitations. This may be related to the cost of the project, it may be related to the delivery time of the project. Therefore, we would be more comfortable in the work to be done independently from them. In that sense, we can say that it affects negatively." (IA3)

According to O1, the multi-actor and cross-supply chain structure of the industry forms limitations for accurate OEM production through unnecessary demand of the EPC's supplier. (O1)

Lastly, as a neither positive nor negative factor, E3 explained the co-production activities between OEM and automation firms. Their firm uses OEM machines in its production processes. They renovate the automation products inside of these machines when maintenance is required. E3 mentioned that they continue to buy the same automation brand's product that the OEM has been chosen in the machine. Therefore, the early collaborative production actions of the OEM affect the buying behavior of the end-user.

5.1.2. Co-design Activities

The co-creation refers to “any act of collective creativity, i.e., creativity that is shared by two or more people” (Sanders and Stappers, 2008). The concept of co-design has a narrow sense to refer to “collective creativity as it is applied across the whole span of a design process” (Steen, Manschot and De Koning, 2011). In co-design, diverse experts such as researchers, designers or developers, and (potential) customers come together for collective design (Steen, Manschot and De Koning, 2011).

Besides, co-design is also entitled in co-production as the production requires a design phase. Customers perform the design activities and use the production partners as consultants providing information (Achrol and Kotler, 1999). The customized products require continuous operant resource transfer such as experience and feedback to shape the design fitting to the end-user expectation. The participants frequently mentioned the co-design activities which require continuous feedback and transparent information sharing.

5.1.2.1. Feedback and Brainstorming

The findings reveal that feedback and brainstorming is a co-design activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 14 in summary form.

Table 14. Summary Codes of Feedback and Brainstorming

Second-Order Code	Third-Order Code	Category	Actors
Feedback and brainstorming for generating ideas and joining forces in design	Feedback and brainstorming to create value for design	Feedback and Brainstorming	IA-EPC EPC-IA-E IA-E OEM-E OEM-IA SE-E S-IA
Feedback and brainstorming for OEM product improvement			OEM-E

Table 14. Continued

Feedback and brainstorming with customers for R&D			IA-E

The resource integration of the beneficiary, service provider, and other actors within the supply chain enables value co-creation (Vargo, Huotari and Vink, 2020). Resources are divided into two as operand and operant resources. Operand resources are natural and physical characteristics that are static and tangible whereas operant resources are embedded knowledge and skills (Vargo and Lush, 2004; cited in Vural Göçer and Halldórsson, 2019).

Feedback and brainstorming activities are the most frequently mentioned activity among the five value co-creation concepts by the interviewees. Feedback and brainstorming are necessary at all stages with the customer to understand their needs and design customized product accordingly.

> *"I can say that advanced solutions are the product group in which we have the most cooperation with our customers. Because we're already trying to do something there that has probably never been tried before. As our company, we have references from the works we have done before and we need to make them suitable for the customer. That's why a commitment from the customer is also required. The customer needs to provide information and work with us. For example, if the customer needs a product for technical safety, the customer has to tell us about work accidents, including fatal work accidents. He needs to tell how much he lost from his production. When we think about it from this perspective, we need to work with customers a lot. It proceeds in a similar way during the pre-project stages and then when the project starts." (IA3)*

Feedback and brainstorming of the automation firm at all stages with the customer to understand their needs and design customized product is mentioned.

> *"After the customer's needs and problems are determined, we work together with the customer. Working environments are created to ask what kind of technology should be produced for the customer's needs and how we can create*

a customized product. This starts at the sales stage. It continues until the project is completed. In other words, there is collaboration at all stages." (IA5)

Feedback and brainstorming with the customers allows transferring their product design requirements to R&D.

"It is important to understand the problems of our customers and create a better environment for them and create value. In this context, of course, we receive feedback from our customers and receive their needs. We forward these technologies and designs to the units that make them. Those feedbacks go and solutions or new designs emerge from there." (IA5)

On the other hand, feedback by the automation company supplier is a contributor of the design process via the information correction and feedback by the automation firm's supplier to reach accurate automation product design.

"My expectation from the suppliers is to understand my demands correctly, correct my mistakes if necessary, and bring the business to the right point." (IA1)

The supportive actions of the suppliers among the product design provide an advantage to the industrial automation company through feedback and alternative suggestions from suppliers for customized automation product designs.

"The supplier also offers me alternatives, as I do to the customer, and offers suggestions that it might be more appropriate if we proceed in this way. And I share that suggestion to the customer. Thanks to the supplier, I am in a position that offers new alternatives and creates solutions in the eyes of the customer." (IA1)

Feedback and brainstorming of EPC and automation firm enables reaching accurate customized product design for the customer.

"EPC, which provides quality engineering services, can guide us very well and enable us to make better choices. They can manage how to solve the demand by providing information about both the status of the customer site and the course of the business." (IA7)

Co-design of the automation product or solution (i.e., DCS, SCADA, mentioned in chapter 3) is not always carried out with EPC. Withdraw of EPC in detailed stages is required to allow the value exchange as feedback and brainstorming between the automation firm and end-user for customized product design.

"EPC company can construct a new facility, the exact same facility, and the second line of the same line for the end-user customer, on a turnkey basis. In such a case, the EPC company usually withdraws from the point where the details of the work begin. We do the work with the end-user. At that time, EPC only supervises to make sure that the project is delivered properly. But the real exchange of value happens between us and the end user." (IA3)

Supplier-engineering firms do not have adaquate experience as much as industrial automation firms since they learn the challanges case-by-case among the businesses conducted with end-user customers. Therefore, SE1 and SE2 mentioned about the importance of feedback and brainstorming in the design phase.

"We are talking about whether the customer is doing this for the first time or is it something he has done regularly before. If it is the first time, both parties are novices in this regard. Because somehow they are the owners of the business, they have to explain it to us correctly so that we can choose the right products. If they have done this before, we are sure to receive information such as "Yes, we did this job with this brand, but we had such problems" or "It worked very well", but if this is the first time, the engineer working on the customer side should know this very well." (SE2)

"For customized production, we usually expect specifications from our customers, or we discuss the product requirements through contact or in writing. While presenting a customized product, we tell our customers what the

product does. Of course, know-how is important here. If we do not have process experience, the customer should guide us, if there is, we can guide the customer ourselves." (SE1)

Brainstorming among capable customers and OEM in the pre-product design stages enhances accurate OEM product design.

"Some of our customers provide us with process and technology know-how guidance. These customers can direct us on what they want or they can request applications in different parts of the world. They force us by giving feedback that the product should be like this or an instrument should have the following features. This motivates us to produce better and do better." (O2)

5.1.2.2. Site Visit

The findings reveal that site visit is a co-design activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 14 in summary form.

Table 15. Summary Codes of Site Visit

Second-Order Code	**Third-Order Code**	**Category**	**Actors**
Site visit to check the challenges in the customer processes for allowing accurate customized product design	Customer site visit to create value for design	Site Visit	IA-E EPC-IA-E

Customer site visit followed by the industrial automation firm allows the verification of the information given by the customer for accurate design of the customized product.

"We are talking about a process in which we progress in cycles, with both internal control mechanisms and approval mechanisms from the customer. There may be an error in the drawing we made, we will meet with the customer and then carry out a site visit. When a site visit is made, we have the opportunity to check on site whether the information given to us by the customer is correct.

Of course nothing is 100% correct, our customers are not at that level. If the information given is incorrect, the design can be changed.” (IA3)

Besides, customer site visits to check the challenges in the customer production processes allows customized product design with accurate process information.

“For example, when we choose an analyzer for a furnace in an iron and steel plant, we need to know the chemical reactions that take place in that furnace. In addition, we need to know the situation in the field and how the oven is positioned. In such things, we go to the customer's site and see the place because we need to know the challenges in the customer's production process while designing the analyzer. In this way, we need to tell the customer how we can offer a solution to the challenge he is facing. For example, maybe the place is narrow, we need to give the most suitable product there.” (IA1)

Customer site visit by the supplier-engineering firm is mentioned too in the interviews to check the customer production process conditions for accurate design of the customized product.

“We conduct field visits and make reconnaissance. It doesn't happen with an online meeting, we need to see it. Sometimes we need to see a distance, sometimes the humidity and temperature of the ambient conditions. Or we need to examine the place where it will be used.” (SE1)

On the other hand, EPCs have contributor role between the customer and automation firm through engineering studies and controls in the customer field for automation product design.

“EPC actually understands the customer's needs. They go to the field, talk with the customer, complete the engineering work there. What I mean by engineering work is to determine how the customer's process can work most efficiently. In other words, EPC engineering determines the measuring instruments and control mechanisms that should be used in the customer's

field. And then it becomes a bridge between the customer and the automation company by supplying products from automation companies." (IA1)

5.1.2.3. Testing

The findings reveal that testing is a co-design activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 16 in summary form.

Table 16. Summary Codes of Testing

Second-Order Code	Third-Order Code	Category	Actors
Co-testing of customized product with customer for accurate design	Co-testing to create value for design	Testing	IA-E

Co-testing of customized products with the customer in certain stages are conducted for the accurate design. Automation firms invite customers to their production field to test the product together.

"Since customized products are always critical things, they have very detailed tests. After a very long test period, this system is put into use gradually. For this, the customer must always be involved in the process from time to time." (IA3)

"In some cases, functional tests are carried out to ensure that the product is working properly. Our engineer and, if they wish, a representative of the customer go to the field and do the control tests of the product together. They check and confirm whether the product works. After these stages, the product is placed on the customer site." (IA1)

5.1.2.4. Transparent Information Sharing

The findings reveal that transparent information sharing is a co-design activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 17 in summary form.

Table 17. Summary Codes of Transparent Information Sharing

Second-Order Code	Third-Order Code	Category	Actors
Transparent information sharing for accurate customized product design	Transparent data sharing to create value for design	Transparent Information Sharing	IA-E EPC-IA OEM-IA OEM-EPC SE-E

Transparent information sharing by the end-user customer is required for identifying customized product specifications. The same requirement is also valid for OEM.

"First of all, the customer's demand should be very clear. They have to provide me with all kinds of resources. They should be able to answer me when I want information about their process. Because the customized product I designed by making assumptions may or may not be suitable for the customer's processes. If we cannot get the information we need from the customer, unfortunately, customization cannot be provided. The source of this problem may be that the customer has low technical competence, does not know the process in their own production processes, company records are not kept completely, or does not want to share process-specific information." (IA1)

"OEMs make a hundred of one machine and they are all the same. They already know the automation product they want to buy to use on that machine. If they can also provide me with process-related information, I can easily choose the product. The product that OEMs will buy is simple, in fact, they do not have too many problems". (IA1)

EPC also has a significant role in transferring information to the automation firm for identifying customized product specifications.

"EPC company needs to do engineering work. It would be absurd if they said 2 flowmeters from here as if he wanted from the grocery store. He should be

able to do an engineering study and be able to say clearly that he wants a flowmeter of exactly this or that diameter." (IA1)

In addition, transparent information sharing by the customer for identifying OEM customized product specifications is mentioned by the O1.

"If it is a customized product, the customer has to specify which product they want to use and where. For this reason, the customer is asked questions about what features they want, and then the equipment is selected. For example, equipment is not selected in standard production, the standard is clear. There are certain specs, and the equipment is determined according to how many m3 the device will produce. But customized production equipment requires selection. After the equipment is determined, its automation is determined and its features are determined." (O1)

5.1.2.5. Factors Negatively Affecting Co-design

The findings revealed the negatively affecting factors of co-design.. Table 18 demonstrates a summary followingly.

Table 18. Summary Codes of Factors Negatively Affecting Co-design

Second-Order Code	Third-Order Code	Category	Actors
Automation firm inexpertness limits the accurate customized product design	Automation firm inexpertness as an obstacle to create value for design	Lack of expertise	IA-E
Consultancy firm inexpertness forms limitations for product design	Consultancy firm as an obstacle to create value for design		OEM-Consulting firm-E
Customer inexpertness forms limitations for product design	Customer inexpertness as an obstacle to create value for design		IA-E OEM-E OEM-EPC
Less expertise by customer and supplier-engineering firm limits the product design	Lack of expertise as an obstacle to create value for design		SE-E
Less transparent data among multi-actors limits the customized product design	Lack of transparent data as an obstacle to create value for design	Lack of transparent data	SE-IA

Table 18. Continued

Non-transparent sharing data limits the customized product design	Lack of transparent data sharing as an obstacle to create value for design	sharing and feedback	IA-E
Non-transparent data and less feedback limits the customized product design	Lack of transparent data and feedback as an obstacle to create value for design		IA-E
Non-transparent data and less feedback limits the OEM product design	Lack of transparent data sharing and feedback as an obstacle to create value for design		OEM-E

Inexpertness of the customer forms limitations to determine the required automation product specialties.

> *"So, when they want something special, they definitely need to know what they want. The process becomes very difficult for us if the customer does not know what he wants when it comes to custom-made products and solutions. Because you are giving something, he says it makes sense, he wants it, then he says this feature is unreasonable, let's remove it. When he behaves in this way, it disrupts the work and the issue can go up to the cancellation of the job. Or he may find the price of the product too high after requesting many features. Because he doesn't know the value of what he wants, what it's worth, or what he can do. That's why we should be able to get the necessary information from the customer as much as possible so that we can do a more solid job." (IA7)*

Besides, the inexpertness of the consulting firm forms limitations to design contemporary product.

> *"Customer's consulting firm sometimes required outdated things. We were trying to explain to the customer that this is a solution from the 1980s and we were talking about the automated system with today's technology to be used, but the customer preferred to trust the consultant firm and we could not convince them." (O1)*

On the other hand, lack of transparent data sharing and feedback of the customer forms limitations for customized product design.

> *Some details are overlooked or employees in the automation company may not be able to see those details. After all, we will make a measurement and we need to consider external environmental factors and operating factors. For example, if the automation firm employee missed an important detail in an ex-proof area (in the area where there is an explosive atmosphere), a product selection is made that does not have ex-proof properties, can make the same measurement, but is not suitable for the process conditions. [...] therefore, the products received are malfunctioning and the maintenance department where I work is requested for help in solving the problem. [...]. These problems happen a lot, and I believe that environmental factors are ignored in most of them by the automation firm engineer. (E1)*

Lastly, the lack of transparent data sharing and feedback of the customer forms limitations for OEM product design.

> *"The job is finished, the device is operated at the customer site, and then we receive comments from the customer such as "but we did not expect this, we would like to do this, it should have been like this". In other words, they have no contribution to the process, they did not provide guidance at the beginning of the work, and they complain after receiving the work. Unfortunately, some customers do not direct and then complain." (O2)*

5.1.3. Co-procurement Activities

The collaborative approach that the procurement decision is made by a group of buyers in terms of a shared decision rather an individual one is called co-procurement (Rezaei et. al., 2020). The aim of co-procurement is to increase the bargaining power of the buyer and find scope economies by buying different products using the same resources (Díaz et. al., 2004)

5.1.3.1. Information Sharing

The findings reveal that information sharing is a co-procurement activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 19 in summary form.

Table 19. Summary Codes of Information Sharing

Second-Order Code	Third-Order Code	Category	Actors
Information sharing about latest automation technologies from automation firm to the project firm to procure the latest automation technologies to the customer production processes by the guidance of the project firm	Information sharing to create value for procurement	Information sharing	IA-PF-E
EPC information sharing for alternative product procurement			EPC-E
Customer information sharing for procurement by supplier-engineering firm			SE-E

Automation firm shares information about latest automation technologies with the project firm to enhance the procurement the latest automation technologies to the customer production processes by the project firm.

> *"The automation company not only gets the necessary details from the project company but also transfers the latest technology in the product to the project company. In this way, the project firm updates its outdated information and puts the new technology in the purchasing specification, and the end-user thus gets the latest technology." (IA2)*

Customers collaboratively work with EPC firms in procurement of automation product to enable alternative product suggestions of the EPC.

"I think it's a good thing the EPC intervened. Because we have the opportunity to benefit from the experience of EPC. In other words, everyone's way of doing business is different in the automation sector, as in every sector. So maybe EPC company has different solutions for what I know is right or what I think has only one solution. That's why it's always good to have an EPC company every once in a while. But in a very small project, of course, it is not necessary, but in large projects it is definitely necessary." (E2)

Supplier-engineering firms requires adaquate information sharing about the products they would like to procure from the supplier-engineering firms.

"Either the biggest problem starts here, so the customer has to decide which player to move forward with. We must proceed accordingly. Now some companies send us a list on the pneumatic side. It does not write any brand information. Of course, we don't know which one to give as we are selling a lot of things right now. Then we return to the customer again. We ask what kind of quality the product should be. We make an offer according to the response we get from here. On the pneumatic product side, yes, there is a wide variety of brands, a wide variety of price scales, so it is important for the customer to share information about what they want." (SE2)

5.1.3.2. Inter-functional synchronization

The findings reveal that inter-functional synchronization is a co-procurement activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 20 in summary form.

Table 20. Summary Codes of Inter-functional Synchronization

Second-Order Code	Third-Order Code	Category	Actors
Inter-functional synchronization of the customer for customized product procurement	Inter-functional synchronization to create value for procurement	Inter-functional synchronization	End-user's different departments

According to E1, the synchronization of the inter-departments of the customer has an effect on the procurement process too.

> *"Let me talk about the processes when creating a purchase specification. From the DCS system to be used to the instrument in the field, the project investments department consults our opinion on whether they are suitable, whether there will be problems in their supply, ease of use, ease of configuration, ease of supply of spare parts. If this passes our approval, or if there is a situation that will not pass our approval, the process is shaped by our guidance. This is how synchronized business processes between project investments and automation maintenance are realized." (E1)*

5.1.3.3. Joint Decision-Making for Procurement

The findings reveal that joint decision-making for procurement is a co-procurement activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 21 in summary form.

Table 21. Summary Codes of Joint decision-making for procurement

Second-Order Code	Third-Order Code	Category	Actors
Joint decision-making for determination of product specialties to procure	Joint decision-making to create value for procurement	Joint decision-making for procurement	IA-E EPC-E

Close work of automation firm and customer is carried in the pre-procurement stage for determining the automation product specialties to procure.

> *"In fact, the first thing you need to do is to get immediately involved in that business after the idea of investment comes to the mind of the customer. So this leads to working closely together anyway. If we can convince the customer and put even a word in the purchasing specification at the beginning of the job, our chances of getting that job increase. Because we only put a word, a product feature, no one can bid there." (IA7)*

Additionally, EPC and customers collaboratively work in the automation product procurement if the customer has limited knowledge.

> *"But at certain times, an EPC really helps, especially if investments are to be made in which the know-how does not exist." (E1)*

5.1.3.4. One-Stop Procurement

The findings reveal that one-stop procurement is a co-procurement activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 22 in summary form.

Table 22. Summary Codes of One-Stop Procurement

Second-Order Code	Third-Order Code	Category	Actors
Joint-work for convenient procurement and project control	One-stop procurement to create value for procurement	One-stop procurement	IA-E

Interviewees mentioned that working with EPCs provide one-stop procurement since EPC firms get quotations from multiple automation firms and submit all the details to the customers by a single channel. Besides, the customer purchases products of multiple firms from single channel and this facilitates the cost control.

> *"According to the size of the project, if the project to be done will keep the employees of our company busy and prevent the work they need to do, of course, these works are carried out with EPC companies, the procurement goes through EPC." (E2)*

5.1.3.5. Factors Negatively Affecting Co-procurement

The findings revealed the negatively affecting factors of co-procurement. Table 23 demonstrates a summary followingly provides an insight into the topic.

Table 23. Summary Codes of Factors Negatively Affecting Co-procurement

Second-Order Code	**Third-Order Code**	**Category**	**Actors**
Lack of inter-functional synchronization for customized product procurement	Lack of inter-functional synchronization as on obstacle create value for procurement	Lack of inter-functional synchronization	IA-E
EPC inexpertness forms limitation for efficient procurement process	Intermediary as an obstacle to create value for procurement	Intermediary as an obstacle	IA-EPC
EPC existence in knowledged customer limits the quick procurement			EPC-E
Cost-oriented EPC limits the procurement process			IA-EPC

Lack of inter-functional synchronization of customers to manage the customized product procurement negatively affects co-procurement.

> *"For example, getting offers from 3 companies, or sending a request for proposals to 8 companies and executing the processes. There are a ton of issues, such as different units within the customer firm not being synchronized with each other. These create problems in solutions or products that require customized production. In other words, we expect customers to manage procurement processes very accurately. Otherwise, it's a bit of a hassle if they try to buy a customized product with standard purchasing methods. Then a true added value may not have been created. This is true for us and for all technology companies." (IA5)*

Lack of experience of EPC forms limitations for efficient procurement of the automation product for the end-user customer an EPC existence forms limitations if the end-user customer possesses adequate knowledge and prevents quick procurement. (IA7, E1)

Lastly, EPC being cost-oriented forms limitations for automation product procurement.

> *"EPCs often want to keep prices to the lowest level. That's why EPCs don't like automation companies because they think they sell their products too*

expensive. Therefore, they complicate some work in the purchasing process." (E3)

5.1.4. Co-trial Activities

Based on the analysis of the semi-structured interviews, multi-actor product trial activities have significance for customized product supply chains. This terminology is mostly used in medicine (i.e., McEniery et. al., 2005; Tollefson, et.al., 1997). Therefore, this thesis brings a definition to the co-trial as “Collaborative trial of the product by multiple actors as proof of the accuracy and suitability”. Also, the sub-co-trial activities are determined and explained followingly. Besides, none of the interviewees mentioned negatively affecting factors of co-trial activities.

5.1.4.1. Confirmation of Product Suitability

The findings reveal that confirmation of product suitability is a co-trial activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 24 in summary form.

Table 24. Summary Codes of Confirmation of Product Suitability

Second-Order Code	Third-Order Code	Category	Actors
Co-trial of customized product with customer for proof of design and experience sharing	Confirmation of product suitability to create value for design	Confirmation of product suitability	IA-E
Co-trial with customer for new product designs			OEM-E

Collaborative trial of the customized products into the customer's field provides mutual benefit as proof of the design for the customer and as experience for the industrial automation firm. IA3 and IA2 addressed this issue followingly.

“Let's give an example of the use of robots for the operations that our customers will perform at very dangerous points, which normally the operators try to do remotely. For example, let the robot be a new technology for us, let's get new references for the robot. Now here we are actually creating value together with the customer. There are certain processes with customers.

Customers do not always demand that I want to buy this and sell it to me. In order to be sure that the product they will buy will meet their demands, they demand processes that we call proof of concept, we can call them trial processes. These trial processes are usually processes that create value together, because, as I said, since we already sell customized products, the cases shared by the customer, the trials made with this customer in the field, the solution we will apply for this customer's special problem is of course an experience for us as well. This also contributes to the development of the robot over time. The customer can also choose to rent the robot rather than buy it. Since we will do such experiments for a certain period of time, it allows us to mutually understand each other. It also reduces the customer's costs. While we still provide financial income, we may have had the opportunity to experiment with such experiences." (IA3)

"Since the customer is the party that uses it, he knows best how this product works in practice. The added value of this to the automation company is that there are people who try a product for free for you, which has not been tried, in daily life, so this is an advantage. It is a plus in terms of improving the automation product production processes, it is an advantage to be working with the customer and to be involved in your processes in such a way." (IA2)

The collaborative trial activities are also present between OEM and end-user customers through the trial and R&D studies of new products by OEM and customer for proof of product suitability on customer processes.

"Apart from this, another cooperation can be R&D, and we can realize this in our pilot facilities. In these pilot plants, some of our customers make new product studies or new process trials, and we provide technological and financial support to them. In other words, we do not demand the rental costs of the products. We follow up the business in engineering and technology and we do work together." (O2)

5.1.4.2. Inter-functional Involvement

The findings reveal that confirmation of inter-functional involvement is a co-trial activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 25 in summary form.

Table 25. Summary Codes of Inter-functional Involvement

Second-Order Code	**Third-Order Code**	**Category**	**Actors**
Co-trial of customized product with customer for harmonious management of customer inter-functions	Inter-functional involvement to create value for product trial	Inter-functional involvement	IA-E

Trial of the customized robot with the customer through resources allocated to establish a core robot team by the customer allows harmonious management of the customer's inter-functions.

> *"When the customer is going to buy a customized product robot, he should not say "I want to try it, I don't buy it without trying, so bring it and show me" and completely withdraw from the business. Here, he has to take some responsibility in financial terms, first of all, we always talk about costs. Apart from that, of course, it needs to allocate resources, it needs to allocate workforce. For example, he needs to create a core team related to robot topics. Because the robot will do the work of more than one department, for example, it will do the work of the maintenance departments, it will do the work of the quality health and safety departments. In that sense, as I said, a team needs to be formed to deal with everything in this project. For this, the customer's allocation of resources is one of the most important issues."* (IA3)

5.1.4.3. Product Demonstration

The findings reveal that product demonstration is a co-trial activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 26 in summary form.

Table 26. Summary Codes of Product Demonstration

Second-Order Code	Third-Order Code	Category	Actors
Demo-product trials to the universities for creating brand awareness and product knowledge	Product demonstration to create value for education	Product demonstration	IA-Universities

Product demonstration activity has difference since it is not reffering an activity between two actors, contrary it is possibily covering all the actors in the automation supply chains since it addresses to the university students. Free trials through a demo-product distributed to the universities enable engineering students to learn about the automation product attributes, besides they become aware of that automation brand. This is mentioned by IA7 and E3 for the same automation brand's actions.

> *"Everyone who graduated from electrical and electronic engineering, electronic communication engineering knows the X brand PLC and sees its software. Because this automation company distributes free demos to universities. In other words, automation equals X brand while graduating in Turkey." (IA7)*

5.1.5. *Coopetition Activities*

> *"Coopetition is a strategic and dynamic process in which economic actors jointly create value through cooperative interaction, while they simultaneously compete to capture part of that value"* (Bouncken et al., 2015).

The coopetition activities in the customized supply chains based on industrial automation sector are mentioned in this section.

5.1.5.1. Cooperation for Determining Design Requirements

The findings reveal that cooperation for determining design requirements is a coopetition activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 27 in summary form.

Table 27. Summary Codes of Cooperation for Determining Design Requirements

Second-Order Code	Third-Order Code	Category	Actors
Coopetition through information sharing for accurate product design	Cooperation for determining design requirements to create value for coopetition	Cooperation for determining design requirements	IA-IA

It should be highlighted that IA1 is the sole interviewee that mentioned close cooperation of the competitors for determining the design requirements. Thus, this activity should be respected as rare. Cooperation among the automation competitors with the transfer of information are conducted to provide accurate product to the customer.

> *"Working with a competitor in the form of buy and sell would be a bit difficult. So let me give an example, in a project we had to buy a product from a competitor. We did not have that necessary product in our portfolio. Well, of course, I must somehow be transferring the process information to them exactly. I must be conveying the information completely so that they can give me the right product. So that I can benefit and they will benefit." (IA1)*

Additionally, competitors cooperate with close working and meetings to understand each other's processes for accurate product design.

> *"We did not work closely with the competitors, but we also hold meetings with the competitors. We try to understand each other's process, we try to understand our mutual demands and the products we can give." (IA1)*

5.1.5.2. Cooperation for New Technologies

The findings reveal that cooperation for new technologies is a coopetition activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 28 in summary form.

Table 28. Summary Codes of Cooperation for New Technologies

Second-Order Code	Third-Order Code	Category	Actors
Coopetition for new product technologies	Cooperation for new technologies to create value for coopetition	Cooperation for new technologies	IA-IA-E

Working groups of industrial automation competitors and end-user firm enables the solution customization for the end-user and encourage technological development. IA5 addressed this issue but he also mentioned that it is rare in the sector.

"Competitor automation companies work together if they have to. In other words, if the direction of technology is moving to a different point, they may have to be a little bit obligated in that sense. In other words, there are points where cooperation has been established regarding these, of course. Not only groups where automation companies come together, but also co-working groups with our customers can be established. Especially for the advancement of technology. But due to competition, this does not happen much." (IA5)

5.1.5.3. Cooperation for Procurement

The findings reveal that cooperation for procurement is a coopetition activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 29 in summary form.

Table 29. Summary Codes of Cooperation for Procurement

Second-Order Code	Third-Order Code	Category	Actors
Coopetition for exiting automation product renovation in customer facility from a single channel	Cooperation for procurement to create value for coopetition	Cooperation for procurement	EPC-IA-IA-E

Table 29. Continued

Coopetition for convenient procurement of customer from a single channel			IA-IA-E

Industrial automation competitors sometimes procure products from each other to provide one-stop procurement to the end-user. This brings convenience for the end-user since not work with multiple industrial automation firms. Also, coopetition decreases the degree of responsibility of the end-user and minimize the risk of wrong product selections in multiple procurements. This is mentioned by IA2, IA3 and IA6.

> *"The first goal of the customer is to be able to progress through a single provider. The customer wants to be comfortable with a single provider without making the job complicated. Taking risks is something the customer does not want. Companies that can solve this problem, that is companies that can handle the part of the other company, provide a great convenience for them. Collaboration with competitors has such value for the customer." (IA3)*

The early effect of EPC firms has a direct effect on coopetition. EPCs procure different automation firms' products and provide one-stop-procurement to the end-users. Then, if the end-user wants to renovate the industrial automation system, they expect the industrial automation firms to coopete and provide one-stop procurement too. This brings convenience for the end-user. So, the past actions of EPC affect the activities between industrial automation firms and end-users in the future too.

> *"There are 2-3 distinct players in the industry for automation products, and the products of these 2-3 players are intertwined at customers' facilities. Because these are the systems they bought through certain EPC companies in certain periods. As such, there are products from these 3 companies in the customer's field. When the customer wants to renovate the facility, he thinks about his own convenience and wants to proceed from a single channel. For this, the customer writes a specification sheet and goes out to tender. And there we need to be able to read our competitor's system, to benefit from our competitor's engineering. There is a situation that you cannot do with your own*

engineer and you have to get the engineering service of your competitor. The same is true for other companies. There are situations where you need to get offers from each other at the same time while making offers to each other for the same job. Obviously, this is one of the things that makes the job difficult". (IA3)

5.1.5.4. Mutual Trust

The findings reveal that mutual trust affects coopetition for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 30 in summary form.

Table 30. Summary Codes of Mutual Trust

Second-Order Code	Third-Order Code	Category	Actors
Coopetition to take advantage of the competitor's relationships with customer and build trust	Mutual trust to create value for coopetition	Mutual trust	IA-TP-E

This issue is only addressed by IA4 as the collaboration and competition of the technology provider firm with the automation firm for the end-user. Cooperation among competitors to produce customized products enables automation firms enables to take advantage of competitor's relationships with the customer and build trust.

"Because the customer looks like this: Brand X is an automation supplier and a larger firm. They never let me down and I can easily reach them. I was moving forward using the power of Brand X, using its relationship with the customer. In the end, because the customer values the rival automation company, we were making a win-win by moving forward together with them." (IA4)

5.1.5.5. Resource Exchange

The findings reveal that resource exchange activity for customized product supply chains. Second and third-order codes and between which actors the relevant activity is carried out are demonstrated in Table 31 in summary form.

Table 31. Summary Codes of Resource Exchange

Second-Order Code	Third-Order Code	Category	Actors
Coopetition through close co-working for customer production processes	Resource exchange to create value for coopetition	Resource exchange	SE-SE
Coopetition among EPCs to create value for production			EPC-EPC

Cooperation among the supplier-engineering competitors with close working for customer's production processes is mentioned by SE1.

"For example, there were companies that we completed a hospital or steel factory together for a year. We share our resources. Because everything changes on the field. So, you want to finish this job on the field properly. So, you are sharing your resources. You are already working with competitors that you can share your resources with, so you do not work with every competitor." (SE1)

Also, joint ventures between EPC firms are also visible. This is explained by EPC1. They cooperate if the work of one EPC firm cannot fulfill all the required jobs in the end-user field. Their cooperation knowledge sharing, and feedback. As a result, more knowledgeable, more experienced employee contribution to the work occurs, the project lead time decreases the project efficiency increases.

5.1.5.6. Factors Negatively Affecting Coopetition

The findings reveal that factors negatively affecting the coopetition exist in customized product supply chains. These activities tabulated and summarized in the table 32 followingly.

Table 32. Summary Codes of Factors Negatively Affecting Coopetition

Second-Order Code	Third-Order Code	Category	Actors
High level of competition in coopetition for gaining the customer	Competition as an obstacle to create value through cooperation	Competition obstacle	IA-IA

Table 32. Continued

Coopetition with limited information sharing			IA-IA OEM-OEM
High product cost due to coopetition prevents customer satisfaction	High product cost as an obstacle to create value for coopetition	Cost obstacle	IA-IA
Indifferent attitude of customer for coopetition	Indifference of customer as an obstacle to create value for coopetition	Customer indifference	IA-IA

Low level of cooperation occurs due to fierce competition between automation rivals to gain the customer.

"There is no working environment with the competitor, the business usually does not reach that level. Because there is some fierce competition here. Those who do not go to one go to the other, so we are not talking about companies that can be so tolerant towards each other. Therefore, there is no high level of cooperation, there is not much meeting and information exchange with the rival." (IA3)

Also, cooperation among competitors sticks in limited information sharing.

"When working with a competitor, we stay away from each other. It usually stays at the limit. In other words, no one shares their knowledge, technology, every point, but generally works very limitedly. So, you don't share all your information at every point." (IA5)

Lastly, we would like to emphasize that majority of the interviewees indicated that the coopetition activities are indifferent to the end-users in terms of value-in-use. For instance, IA5 mentioned that there are limitations in the industrial automation sector to generate cooperation between the competitors due to the high competition structure. He said that the coopetition activities are very rare and realized if the end-user forces them. IA3 supported IA5's expressions. IA3 mentioned that the cooperation of competitors for low-cost Industry 2.0 products is not tough but the competition for the industry 4.0 solutions is extremely tough due to the consequence of high profitability. On the other hand, he added that they also coopete for Industry 4.0. solutions if the end-user would like to replenish its existing automation system. In that situation, industrial automation firms cooperate to understand each other's systems to provide a new customized automation system to the end-user.

> *"I don't think customers care that we work with our competitor. Because in their eyes, what we do is not a difficult job. It doesn't matter much to them what I do, they look at whether the customer's demand is met or not." (IA1)*

5.2. Determinants of Value-in-use

The value-in-use is the evaluation of the service experience through individual judgments of the sum of all the functional and emotional experience outcomes (Sandström et al., 2008). The factors affecting the value-in-use are analyzed as the empirical dimensions of value-in-use with the analysis of the semi-structured interviews. Figure 7 shows all the detected determinants of value-in-use.

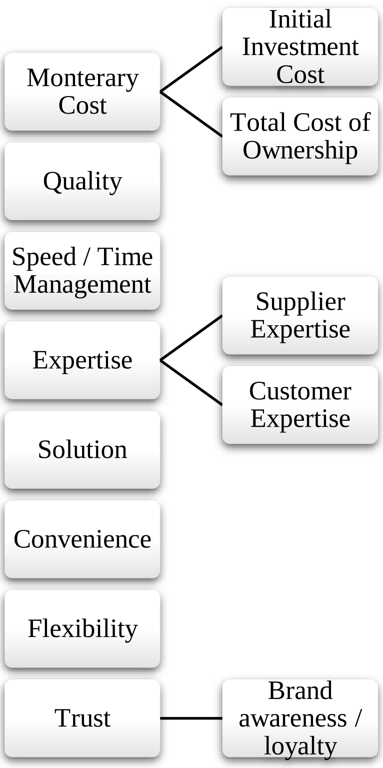


Figure 7. Determinants of Value-in-use based on analysis

5.2.1. Monetary Cost

Medberg and Grönroos (2020) describe the monetary cost as the perception of the customer for the product or service provider's fees, charges, or interest as advantageous or unfavorable (Medberg and Grönroos; 2020). Their study emphasizes the monetary cost as one of the empirical dimensions of value-in-use. In other words, this term is a determinant of how the customer perceives the value, as positive or negative.

5.2.1.1. Initial Investment Cost / Low Cost

The following table 33 provides an insight into the initial investment cost by demonstrating its determinants.

Table 33. Determinant of Value-in-use - Initial Investment Cost

Initial Investment Cost		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	low-cost	IA1 IA7 IA3 IA5 IA6 IA2 E3 E2 O2 O1 S1
2	no extra charge for the changes in the project preserve initial investment cost	IA3 IA7
3	discount privilege	E3 O2
4	no volatile prices	O1 O2
5	production of end-by-products	E3
6	number of people to be employed	E2

The majority of the interviewee thinks that the customers intend to procure low-cost products. The initial investment cost defines the initial price that customers pay to purchase the product or service.

> "*In Turkey, everything proceeds exactly on cost. The cheapest always gets the job. It is very rare for factors such as product quality or delivery time to come into play." (IA1)*

IA1 describes that she constitutes customer satisfaction by providing low-cost alternatives to the products. What Interviewee IA7 says also supports the low-cost argument.

"Customers have, I'll buy the cheap one and pass attitude." (IA7)

"When comparing similar solutions, it is important for the customer that a solution is inexpensive so that the customer does not spend a lot of money investing in it in the first place" (IA3)

IA3 adds that the customers don't want to pay extra for the unexpected changes in their purchase order. They would like to preserve their initial investment cost.

Interviewee IA5 expresses his idea about quality and cost perceptions of the customers as

"*Of course, the importance given to quality in our country has not yet fully settled. In other words, of course, we have developed to a large extent because as Turkey, we attach great importance to quality now, our standards have gradually improved. We didn't have standards before. Such standards and regulations have emerged. In this framework, of course, everything is slowly falling into place now. However, we still have customers who prioritize their initial investment costs. What matters there is the total cost of ownership. It's not just the initial cost. It is necessary to calculate all the costs of this for all years together. At these points, we cannot say that we have risen to the European level yet." (IA5)*

IA1 supports IA5's argument with the following statement;

"*If customers put the quality of each company in one bucket while making comparisons, they would see that the prices do not vary much" (IA1)*

Thus, the interviewees who worked in several industrial automation companies commonly think that the customers do not intend to a conscious comparison of the sacrifice they give as money to get the desired value captured from quality.

IA7's expression indicates the importance of the initial investment cost in certain end-user sectors more than the total cost of ownership principle:

“*This does not happen in customer sectors where we work constantly. However, in the sectors we have just entered, we encounter the following situations; some customers ask why they can buy it for 25 euro when they can buy it for 10 euros. He thinks that 10 euros can equally get what he wants. We tell the customer that if he buys the product from us, he can use it for 5 years, but if he buys the other product, it will break in 1 year. The customer also says that it is very easy and fast to supply spare parts for that product, so he does not want to buy our product.” (IA7)*

On the other hand, EPC firms are also mentioned as intended to low-cost products by the IA5.

“*EPCs are generally money-oriented. They don't care much about the value, that is, they don't care about the added value it brings, the concept I just said is the total cost of ownership. It is necessary to calculate a cost for many years. In addition, your solution may have a specific added value. EPCs don't care much about it. That's why doing business with EPC is not something we like very much.” (IA5)*

Industrial automation firm products and services aim to increase the productivity of the end-user with the use of automation technologies. EPC is an intermediary firm between the end-user and the industrial automation firm and is entrusted with the procurement of automation solutions to the end-user field. So, their attitude toward low-cost product or service procurement negatively affects the industrial automation firms to provide quality solutions to the end-user. Despite that, the interviewee EPC1 has not mentioned any subject about the importance of monetary cost for the EPC firms.

Interviewee E3 from the end-user firm indicates the importance of monetary cost as they have discount privileges from their main industrial automation supplier and none of the other industrial automation firms are capable to provide these prices. E3 is also aware of the quality of their main industrial automation supplier is low. E1's interpretation, on the other hand, allows looking at the subject from a slightly different angle. He states that the quality of by-products in the chemical industry is less important than the quality of the main product, and therefore, the automation product used pays attention to low cost rather than quality.

Lastly, O1 thinks that industrial automation firms should not have volatile prices due to exchange rate changes and O2 strongly upholds that industrial automation firms should decrease their production costs with the use of technology and provide a low-cost product to OEMs.

5.2.1.2. Total Cost of Ownership

The following table 34 provides an insight into the total cost of ownership by demonstrating its determinants.

Table 34. Determinant of Value-in-use - Total Cost of Ownership

Total Cost of Ownership		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	return on investment degree of sacrifice - return on profit	IA3 IA5 IA4 E1
2	quality tendency	IA3 E3 SE1

"*Most firms do not utilize the total cost concept in purchasing."* (Ellram, 1993)

Only a few interviewees believe that the total cost of ownership is a determinator of cost for the customers. Ellram's definition of the total cost of ownership

"is a phrase used to describe "all costs associated with the acquisition, use, and maintenance" of a good or service." (Ellram, 1993)

This term is the opposite of the initial investment cost idea, which a high amount of the interviewees believe in.

According to IA3's experiences, customers would like to know the return on investment of industrial automation products. In other words, the sacrifice made in terms of procurement cost of the automation product and the degree of its contribution to increasing productivity affect the value they obtain in the use of that automation product.

SE1 has several roles as the supplier of industrial automation firms and an engineering firm, mentions that the customers choose a little more expensive products if the quality is high to prevent frequent service costs. E1 as an end-user supports SE1's argument,

> "*we tend to prioritize the total cost of ownership if the quality of our end-product is critical. We choose to purchase quality automation products to increase our productivity by decreasing our error and accordingly our cost.*" *(E1)*

5.2.2. Quality

Service quality is emphasized as an outcome, in form of value-in-use, by Medberg and Grönroos (2020), and has not been mentioned as an empirical dimension, in other words affecting factor of value-in-use. They reinforce this argument by referring to Zeithaml (1998) that service quality is a term meaning an assessment of the customer of the overall performance of service.

The following table 35 provides an insight into the quality by demonstrating its determinants.

Table 35. Determinant of Value-in-use – Quality

Quality		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	effect on the quality end-product	E1
2	effect on productivity / efficiency	IA3
3	effect on safety	IA3
4	enhance autonomy decrease dependency on human work	IA3
5	effect on customized end-product	E3 E1
6	effect on environment	IA3 IA6 IA5
7	effect on be in line with government regulations	IA6
8	effect on risk minimization	IA5

Prior, Keränen and Koskela (2019) extended the value-in-use goals as *risk minimization, quality, efficiency, and reputation maintenance.* The interviewee E1 aims to produce quality end-product with the use of industrial automation solutions too.

“*while producing the main product in a chemical plant, you must meet high-quality standards.” (E1)*

On the other hand, based on the analysis of the interviewees, the use of quality industrial automation products redounds to increase the productivity and profitability of the end-user. Therefore, the product itself has the attribute of creating another positive value-in-use. Vice and versa, we should accept the quality of an automation product or service as an affecting factor of value-in-use. It does not mean that the findings of this thesis confute Medberg and Grönroos (2020). The finding expands the role of quality by referring to it as both outcome and factor of value-in-use.

For instance, according to IA3's, *it is very important for customers that the automation product and system provided work with very high accuracy. Therefore, the design, engineering stages of the product and the subsequent service stage are important for customers.* IA3 explains the benefits of quality automation products as follows;

“*With high-end automation solutions, customers are actually buying "efficiency". The main purpose is to reduce costs and therefore increase efficiency. They also aim to make their processes work cleaner and work more safely, but of course, since the main purpose of all companies is to create a sustainable economy and reduce costs, they use high-end automation products to serve this purpose.” (E1)*

As a result, the fact that the product they use works with accuracy, which is an issue included in product quality, is a factor that shapes the customer's perception of value in use. If the quality of product and service triggers the value-in-use as efficiency and productivity, ipso facto the quality should be counted as an empirical dimension of value-in-use.

E3 gives an example about the importance of the quality of automation products as;

“*I think what makes a customized automation product valuable is its quality and smooth operation. If the customer demands a customized product, he wants a product that will give him something good as a result. For example, we need to buy very special and expensive devices to pass a 0.05 mm wire without breaking it, and the specially produced sensors* (automation product) *inside the device need to work smoothly. There is no other company that can produce such fine wire in the market. If we are demanding a special production automation product and we are paying high prices for it, it is because we will make much more profit from it. For this reason, the smooth operation of the automation product is the most important thing for us.” (E3)*

So, the quality of the industrial automation product directly affects the quality of the end-product and provides a value-in-use in terms of profitability of the end-user.

IA6 explains the importance of the quality and accuracy of the automation products with the following statements,

“*Customers use automation products to improve their processes and increase their efficiency, such as sustainably making their process move in the long term, measuring with the right precision, or transferring the data correctly, storing the data correctly. […] These customized products are generally used in critical process stages. I will go with the example of the analyzer, for example, the gas needs to be analyzed at a very critical point in the field because it will take that gas from there and it has to keep it at certain standards to be able to throw it out of the chimney to press it elsewhere... The content in it, such as carbon monoxide, carbon dioxide, methane, must all remain below certain limits by the rules. The data coming from this analyzer are reported to official institutions. So, it's vital for the customer. We can look at it from the process side, the automation product ensures that the customer's process progresses sustainably with high precision. It provides higher efficiency to work with the data coming from here. Or, if you think about it in an environmental sense, it has advantages such as less damage to the environment and being able to follow the rules more. Therefore, the quality of the automation product is critically important to the customers to provide an accurate analysis.”*

Thus, the quality of the automation product directly affects other forms of value-in-use such as efficiency, environmental impact, and obeying the regulations.

IA5's argument supports IA6 about the effect of product quality on the environment, and also adds the process risk.

"*The issue that makes the automation of industrial facilities different is that we work in risky processes. […] It involves process risk, may create environmental effects. The areas we work in are always like this. And the quality of our products is high. They create high value. In particular, we have products and solutions that are less likely to make mistakes. Because the mistake you have made can cause great consequences for you. May cause environmental effects. It can cause human death and create great economic losses. That's why the sector we work in is very sensitive. It's risky, and it has its own products and solutions.*" (IA5)

That is all to say, product quality as an empirical dimension gives rise to the forms of value-in-use.

IA1 indicates that for some end-user sectors, the quality of the industrial automation product is very important.

"*In sectors such as chemistry, oil and gas, and refinery, high-quality products that have long product life and high sensitivity must be used. Customers in these sectors prefer to work with us because we have high-quality products."(IA1)*

E3's statement highlights the importance of quality customized automation products to produce their customized wire (end-product) in desired quality standards. They used a sensor (process control instrument, automation product) to measure the amount of wire that goes into the coil. But the existing sensor fails in measuring, therefore, they decided to procure a customized sensor for better measurement, as a result, efficient production process. Also, he adds that he didn't control the measurement quality of the customized sensor since he thought that this sensor cannot make an error due to its tailor-made attributes. Then he noticed that the measurement error also occurred in the customized sensor, but this time the error was less frequent. For this reason, he thinks that industrial automation companies should pay close attention to the design phase of the product and check whether the product is working properly. As a result of what E3 said, we can understand the impact of a quality automation product on the customer's production processes.

O2 as an original equipment manufacturer uses automation products to produce its end-product. In other words, OEM makes mounting of the automation product to their own machinery.

> "*We are an expensive company and we should work with smooth equipment to not have a customer complaint. Our target is not to have any customer constraint thanks to the quality and long-life machinery. Therefore, we choose automation products that will serve this purpose." (O2)*

His statement mentions that the quality of the automation product has a direct effect on the OEM product. For this reason, the quality of the supplier's supplier also determines the outcome of value-in-use as positive or negative.

Lastly, the maintenance quality of the existing products in the customer's field is explained by IA3 as:

> "*Proper maintenance reduces the time of unexpected maintenance at work, ensures smooth operation of the unit, and increases productivity."*

It means that the quality of the service provided for the industrial automation products has a direct effect on productivity.

5.2.3. Speed / Time Management

The following table 36 provides an insight into speed/time management by demonstrating its determinants.

Table 36. Determinant of Value-in-use - Speed / Time Management

Speed / Time Management		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	quick action / solution	IA5 IA6 IA4 IA1 IA7 O2 O1 SE1
2	project completion time	IA3 IA2 IA1 EPC1
3	product delivery time	O1 O2 IA7 EPC1 IA2 E3

“*We are trying to offer a quick solution. In particular, the speed of service is the issue that we pay attention to the most. [...] we provide production and service [...] that is, a production emerges as a result of the work we do. Maybe as a result of automation costing 100 TL, the customer makes a turnover of 100 TL in 1 hour. Therefore, stopping a machine from 3 to 4 a.m. due to automation or stopping production due to automation can be very costly. That's why fast service is one of my top priorities. In the projects we do, we pay attention to working with companies that can solve problems by using their personnel in the production facility so that things go fast even if we are not there. We are also trying to provide the solution quickly. This is our top priority.” (SE1)*

Since the automation products enable the customers to make productivity increment in their processes, the speed to fix the product breakdowns is critical for the users. Therefore, the action taken by SE1 is to increase customer satisfaction.

The issues for time management regarding customers’ expectations are explained by IA3:

“*Of course, now [...] we are talking about long-term projects. If it's three months, being able to finish it in three months and being able to finish it in two and a half months, customers usually have time pressure in such projects. For example, the unit is stopped for 2 months, the project has to be done within these two months. It is important for the customer that we can show the flexibility that enables this.” (IA3)*

O1 explained that they work with both local and global industrial automation suppliers but mostly they prefer to work with local ones since the product delivery time is shorter in this way. The necessity of short delivery time is raised by the demand of the end-user; since the end-user demands a short delivery time from OEM, OEM also demands appropriate delivery from the industrial automation supplier. O1 explains their concern about automation product delivery time as:

“*They recently gave us a 44-week lead time for a very standard product that we want to buy. 44 weeks is almost a year, so we need to place the order now so that* *we can make next year's devices. This is an incredibly high time. The highest possible periods are actually 8 weeks in our sector. It should be 8 weeks or so at the latest because we usually finish the devices within 1-2 months. If the design of a custom-made device is finished, our production process is already 2 weeks. Even 8 weeks is too much for us, while our customers demand 6 weeks and 4 weeks, when there is a 44-week lead time, you will be wow, but I guess there is a crisis in the world." (O1)*

So, the industrial automation firm's speed directly affects the value-in-use of the end-user.

O2's speed expectations match up with O1's expressions;

"*Our expectation from our automation suppliers is speed as a priority. Because our customers expect speed from us. […]* He also attaches importance to *being able to design and select products online, make pricing, and access documentation over the web. opening an order if necessary, controlling the supplier's stocks."* (O2)

These statements mean that O2 aims to co-design the product and demands access to information about its automation supplier. He also mentions that since his customers expect a quick response for their sales offers, the OEM also needs the automation supplier's offer quickly, which includes price and product information. Therefore, he would like to actively make the design and procurement/selling activities to not wait for the automation supplier.

When we ask the most important issues in the industrial automation sector, EPC1 answers as *timely delivery*. He mentions that the EPC firm comes to terms with the industrial automation firm about the delivery time according to the end-user project deadline. He also emphasizes that the fast way of doing things shapes the value perception of the customers.

5.2.4. Expertise

The empirical dimension model of Medberg and Grönroos (2020) covers only the expertise of the supplier. The findings of this thesis emphasize the role of customer expertise for the construction of positive value-in-use too. The research of Macdonald, Kleinaltenkamp and Wilson (2016) claimed the value-in-use arises with value co-creation activities, therefore the integrated resources – in this case expertise is an operant resource [operant resources, such as knowledge and skills, are capable of acting on other resources to contribute to value creation (Vargo, Huotari and Vink, 2020)]- between the actors should affect the positive or negative value-in-use. Macdonald, Kleinaltenkamp and Wilson (2016) explain their findings as,

"Overall, these findings suggest a very different view of value from that which predominates among both scholars and practitioners. A solution's value proposition is not proposed by the supplier alone but is jointly designed by the supplier and the customer; it depends on the quality not just of the supplier's resources and processes but also of the customer and joint ones; and the value that arises is not predetermined and simply verified (Storbacka 2011) but is, rather, continually optimized by both parties."

The findings of this thesis cover both results and are detailed under two headings.

5.2.4.1. Expertise of the Supplier

The following table 37 provides an insight into the supplier expertise by demonstrating its determinants.

Table 37. Determinant of Value-in-use - Supplier Expertise

Supplier Expertise		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	employee expertise	E3 E2 E 1 IA4 IA1 EPC1
2	risky process expertise	E3 E2 E1 IA5
3	directing end-user for the sustainability of the existing product in the field	E1 E3 IA1 IA4 SE1
4	expertise in new automation technologies	E1 O1 O2 SE1 IA3 IA2 IA7 IA5
5	process expertise	E2 O2 IA4 IA6 IA7 SE1 SE2
6	expertise to fix customer mistakes	E1 E3 IA6

E3 indicates the effect of the expertise on value by mentioning the vital importance of automation systems by these statements:

"*If the logic is not written to the automation systems correctly, it can cost human life. There are explosions from excess pressure, which have happened in the past. Even if it is not very visible, automation directly affects human life. That's why every logic added to the written content should be carefully thought through." (E3)*

Note that, the logic is customized by the industrial automation certified engineers according to end-user's operations. So, the expertise of the engineer is vitally important and a strong denominator factor of the value-in-use.

E2's statement supports E3 as:

"*Especially in refineries and petrochemical plants, it is used at very high pressure and very high temperature. Employees in ESD (emergency shut down systems) systems must have certain certificates. [..]You are intervening in a very critical system and a person without experience can intervene that can cause both material and moral problems. Therefore, it is necessary to work with people who have experience, not only those who have experience, but who have proven this experience with certain certificates. […] Especially when working in ESD systems, it is working in very high-pressure furnaces or boilers. A wrong intervention here can easily cause the furnace to explode and then cause accidents with loss of life. So, it is a very critical and very stressful job. I always worry about making a mistake when I am at the computer every time, either in the automation company I worked for or in the end-user company I work at, when clicking with the mouse or when you write logic and load it. [...] Because my mistake could cause something to explode and people to get hurt. As a result of the mistake made by the automation authorized engineer, loss of life may not have occurred, but property damage may have occurred. The process may be working incorrectly or there is a loss of production and the production may be stopped. Of course, if you are an automation responsible working for the end-user, it will cause a loss of reputation, if you work and serve in an automation company, it will cause a loss of reputation of that company and even a job loss in that company or the customer it serves." (E2)*

E2's expressions are examples of negative value-in-use such as fatal accidents, loss of production, and loss of reputation. When we ask about the role of EPC firms in terms of expertise;

"*I think it's a good thing the EPC intervened. Because we also benefit from the experience of EPC companies. EPC company also has different solution proposals for the issue that I know correctly or think there is only one solution. That's why it's always good to have an EPC company every once in a while. But in a very small project, of course, it is not necessary, but in large projects, it is definitely necessary." (E2)*

In conclusion, EPC increases the positive outcome of value-in-use by directing the end-user firm based on its experiences too.

"*We look at our automation suppliers as partners. Since we are partners, we always expect visits from them. We expect them to periodically inspect our systems at our sites. We expect them to guide us when they say that calibration needs to be done or that the calibration period is taking this long. In general, we expect them to direct us at points such as the products that need to be checked or changed after this long period. Or, if there are newer technologies and more effective methods, we expect them to inform us at this point. Because we are end-user here, and we are not an automation product manufacturer, we cannot know all the developments in the market. The things we are a foundation can only develop in line with the work we do with our partners" (E1)*

In brief, E1 would like to take advantage of the expertise of the industrial automation firms in terms of newer technologies that can enhance the effectiveness (value-in-use); control, and directions about the existing products' maintenance and change. He adds that since their role in the supply chain is the end-user, they cannot be as knowledgeable on the subject as automation companies. Based on E1's previous work experience as an engineer at an industrial automation firm, he mentions that there are still end-user companies using old-fashioned automation solutions from the 1980s and 1990s, which is far from today's Industry 4.0.

"*In other words, companies that offer industrial automation technologies also need to increase customer awareness. [...] There is a situation in Turkey and at this point, they often need to give support." (E1)*

IA3, as an engineer in the high-end automation solutions department, mentions that "*As an automation company that provides solutions in this field, it is necessary to follow these trends closely so that we can offer these solutions to customers at the right time. As I said, this is one of the challenges of the industry, as the rate of advancement of technology is very high right now." (IA3)*

Concerning E1's statements about the existence of outdated automation solutions in the customers' field, IA3's argument for difficulties makes sense.

The guiding role of industrial automation companies was also emphasized by the interviewees working in various industrial automation companies. For example, IA1 indicates that customers seek advice on whether implementation is possible before purchasing. In addition, customers expect additional solution suggestions from the automation company. Then, the industrial automation company shows alternative solutions to the customers at the meetings and the customer decides on the application. Or customers sometimes want to learn about the products and solutions of the industrial automation company, so the company provides training accordingly.

IA2 and IA7 mention that industrial automation firms advise their customers according to their previous experiences. IA7 says that industrial automation firms have a role to inform the customers of the latest automation technologies, which is coincide with E1's expectations. IA7 states that

"Sometimes we recommend other companies that we have worked with and know before to our customers. We direct you to get this job done here, they will serve you better, and we are working with this company. Because we do not want to include everything in our scope, we do not want to be a contractor (work as an EPC) *in some works." (IA7)*

So, industrial automation companies share their expertise about other firms' solutions with their customers too.

IA4 explains the effect of expertise on trust as;

"People who had master's and doctorate degrees abroad were working in this department. At the same time, these people knew the sector in which we designed that customized product due to their previous work experience, and they also had experience in R&D and maintenance departments. Their relations with customers were very good due to their knowledge and experience. Customers tend to work with people and companies they feel close to. For them to feel close, in my opinion, there should be intense technical information sharing. So technically, if the customer can get information from you on the scale they want, their trust in you will increase." (IA4)

In other respects, E1 mentions the negative impact of less expertise automation engineers on value-in-use as follows:

"*Some details are overlooked or employees in the automation company may not be able to see those details. After all, we will make a measurement and we need to consider external environmental factors and operating factors. For example, if the automation firm employee missed an important detail in an ex-proof area (in the area where there is an explosive atmosphere), a product selection is made that does not have ex-proof properties, can make the same measurement, but is not suitable for the process conditions. [...] therefore, the products received are malfunctioning and the maintenance department where I work is requested for help in solving the problem. [...]. These problems happen a lot, and I believe that environmental factors are ignored in most of them by the automation firm engineer." (E1)*

IA5 thinks that the industrial automation firms' local branches should increase their expertise to provide better service to their customers. Also, he indicates that due to the pandemic situation, automation companies are not able to provide engineering solutions from their abroad headquarters. Therefore, the local engineers' expertise and know-how should be increased. In short, what IA5 says is also a suggestion to the problems highlighted by E1.

According to EPC1's statement, we can ascertain the importance of expertise for EPC firms too.

> *"Of course, technical ability is also very important. Whether the technical competence of the supervisor from the automation company or the quality of the service and product offered will meet the expectations, these are important issues for the end-user and EPC*" (EPC1)

O1's expectation from the industrial automation firm is the ability to follow technological trends. If OEM's customer (end-user) asks for a new digitalized solution, an industrial automation firm needs to search and find it. On the other hand, O1 mentions that OEM firms should have expertise and know-how to direct the customer if the demand is problematic. For instance, O1 says that customers sometimes demand extra unnecessary product attributes which provide high costs.

> *"In fact, the customer needs a small device, but according to the specification he sent, we have to install equipment and send it in such a way that it can lift the plane. It is expensive to the customer, unnecessary, and the customer gives a lot of money." (O1)*

To prevent such a situation, O1 highlights that the expertise of the OEM is also necessary for positive value-in-use.

> "*If we know very well what we are selling to the customer, we provide equipment accordingly" (O1),*

SE1 indicates the importance of expertise as;

> "*The customer pays attention to whether the company from which he receives automation service has the most process experience and whether he has done this job before. For example, if there has been a problem in the previous work,*

attention is paid to this. Obviously, the customer pays attention to the cost of the job later." (SE1)

SE2 explains that the customers expect alternative solutions from automation providers, therefore expertise is needed. According to SE2, customers ask these questions to themselves before the selection of the automation supplier to get the desired outcome:

"How will supplier support me?", "How will he fill my gap?", "How will he find me an easy solution?" (SE2)

5.2.4.2. Expertise of the Customer

The following table 38 provides an insight into the expertise of the customer by demonstrating its determinants.

Table 38. Determinant of Value-in-use - Customer Expertise

Customer Expertise		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	ability to provide accurate data/documentation	E1 E2 E3 IA1 IA3 IA6 IA7 O1 O2
2	ability to understand customization requirements	IA1 IA3 IA4 IA5 IA6 IA7 O1

Industrial automation products have customized specialties according to the end-user field. For this reason, the data provided by the customer according to the field shapes the product selection and design phases. E2 explains the role of the customer:

"*The most important thing at this point is to provide proper documentation on our part to the supplier. In other words, it is to give the data that it will use in the work it will do, in a very nice and very regular way. This is the only thing required by the supplier. It is the only thing desired in the automation industry. Because after proper documentation, every job is solved very easily." (E2)*

IA1 supports the argument of E2 by explaining the importance of accuracy of the information provided by the customer as;

"*You need to make sure that you are given correct information about the customer process, because if you do not know that process, you cannot offer the right product and the system you provide to the customer will not work.*" (IA1)

The statement of IA1 is a keynote that the industrial automation firms must ensure that the customer does not make any mistake in the provided data to reach the optimum desired automation solution. E1 also thinks in this way;

"*After this information we have given, they should come and visit the field and see the conditions themselves. If there is anything they want, rather than our guidance, which we cannot see, they should also get that data." (E1)*

IA6 mentions the importance of double-checking customer-supplied data through customer field visits to avoid negative value-in-use (wrong product selection) due to customers' lack of expertise:

"*You can proceed with the information given to you by the customer, but sometimes there are many details such as what kind of system will that automation product be put in, what is in front of it, what is behind it, whether the space you will put is suitable with the product you will put, and whether that product will fit there. Sometimes you may not be able to get information about where the lines come from, where they go, but when you go to the field and see and examine them, the processes progress much faster. That's why we care about seeing the customer field in general, especially when it comes to customized production." (IA6)*

However, IA6 thinks that customer field visits are not possible for each automation product selling, this double-check process is only possible for high-cost and customized products.

On the other hand, E1 thinks that end-user companies correct the mistake of the industrial automation firms too. The non-expertise of the automation firm engineers provides negative value-in-use as mentioned in the previous topic. To avoid this undesired situation, the expertise of the customer is an asset. E1 expresses this situation:

“I have witnessed many situations where the products offered by automation companies do not perform very well in the field. When this happens, the customer's feedback and the customer's expertise in that field come into play, and this enables the determination of products that are suitable for their purpose through information sharing. With the guidance of the customer, suitable products are determined and products suitable for their purpose are produced in the field. On the other hand, if the automation company you are working with cannot supply this product, we also exchange ideas with other companies and another supplier establishes products suitable for the field.” (E1)

IA5’s argument supports E1 as;

“It's all about competence. In other words, if the customer is more competent, of course, they will direct the situation, but if the competence is in the automation company, we will guide the customer as well. But what should happen in the end, these two mutual competencies should be able to agree in an environment and come to the right point. Any trouble experienced in these processes ultimately leads to a negative environment.” (IA5)

Hence, the integration of the expertise of the customer and industrial automation firm creates positive or negative outcomes. Therefore, we should take into consideration of both customer expertise and the industrial automation firm expertise, and embrace the integration of the operant resources.

Interviewees that work in industrial automation firms think that some customers’ expertise is not sufficient enough to manage the procurement of the automation product. They explain that such situations cause some problems for appropriate automation solution selection.

“For example, getting offers from 3 companies, or sending a request for proposals to 8 companies and executing the processes. There are a ton of issues, such as different units within the customer firm not being synchronized with each other. These create problems in solutions or products that require customized production. In other words, we expect customers to manage procurement processes very accurately. Otherwise, it's a bit of a hassle if they try to buy a

customized product with standard purchasing methods. Then a true added value may not have been created." (IA5)

"*So, when they want something special, they definitely need to know what they want. The process becomes very difficult for us if the customer does not know what he wants when it comes to custom-made products and solutions. Because you are giving something, he says it makes sense, he wants it, then he says this feature is unreasonable, let's remove it. When he behaves in this way, it disrupts the work and the issue can go up to the cancellation of the job. Or he may find the price of the product too high after requesting many features. Because he doesn't know the value of what he wants, what it's worth, or what he can do. That's why we should be able to get the necessary information from the customer as much as possible so that we can do a more solid job." (IA7)*

Consequently, we can understand that the degree of expertise of the customer among automation solutions directly affects the value-in-use. For example, if the customer is not capable to decide what is needed as automation product attributes for their processes, the automation firm may face serious problems for an appropriate solution selection and this may create customer dissatisfaction. So, the lack of expertise of the customer negatively impacts the automation firm, and the customer cannot get its desired solution. In other words, the customer directly affects the value that will be released in terms of value-in-use with their own activities.

A supporting argument about this issue is remarked by the OEM firms too. For instance, O1 explains that if the customer does not provide sufficient data about the existing products in their fields, OEM companies may propose a standard product rather than a customized solution. This standard product may not fit with the process conditions and some changes in the field should be required. Hence, a negative value-in-use in terms of wrong product selection occurs. O2 supports this argument as some customers are saying that

"*we didn't expect it like this or we would like to do this itshould be like this." (O2)*

O2 also mentions that this type of customer has a lack of expertise to direct the OEM at the beginning of the job with accurate data provision. He adds that they take risks while providing products and solutions to these customers.

On the other hand, interviewees mention that customers which possess expertise in automation can enhance the created value. For example, O2 explains that end-user companies with a global identity have a high degree of expertise in automated processes. Thus, these end-users demand high technology OEM solutions (the OEM products need automation technology).

> "*Working and cooperating with these companies takes us forward. Because such customers motivate us to do better. Their demands force us, which makes our way of doing business better*." (O2)

Therefore, the high degree of expertise of the customer increases the quality of the solution provided by the OEM. EPC1 also thinks that the customers have know-how and experience in their own processes and these are enhancing the processes in the customer field.

E3 that works in an end-user firm and has previous work experience in several industrial automation companies thinks that the customers should have enough knowledge and expertise to understand the reason for the product breakdowns. To explain in more detail, the automation products may cause provide a breakdown, and this situation provides negative value-in-use. If the customer does not have enough degree of expertise to analyze and understand the source of the problem, the customer becomes dependent on the industrial automation company. Therefore, the customer waits till an automation company engineer comes and fixes the product. If the customer can analyze the problem and solve it on its own, or describe the problem to the automation company remotely and apply the solution explained by the automation supplier, the time it takes for the product to recover is reduced. Thus, the negative impact of product malfunctions on the value-in-use is reduced.

Lastly, IA4 mentions that the customers' degree of expertise to understand high-quality automation solutions can provide efficiency and effectiveness positively affects the value-in-use. But IA4 adds that companies are more tend to choose the cheapest solutions rather than high-quality ones.

5.2.5. Solution

The following table 39 provides an insight into the solution by demonstrating its determinants.

Table 39. Determinant of Value-in-use – Solution

Solution		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	solution-oriented	E3 IA1 IA3 IA4 O1 EPC1 SE1
2	solution capability	E1 E3 IA3 IA4 IA5 EPC1 SE2
3	quick solution	IA5 IA6 IA4 IA1 IA7 O2 O1 SE1

According to the interviewee statements, solution provision has a role in value-in-use. IA3 mentions the importance of being solution-oriented:

"*The important thing for the customer is that we are solution-oriented. The customer has more bargaining power because they pay money to us. In other words, customers do not want to deal with too many problems. The more solution-oriented I am, the higher the customer satisfaction." (IA3)*

Since the customers have more bargaining power, they expect the automation firms to provide solutions for the problems.

IA1 explains that a moderate problem-solving approach is necessary for a long-term relationship:

"*We try to solve the problem as moderately as possible. In other words, whether the blame is on the customer or ours, we try to be moderate at the end of the day and find a middle way because we want to work with this customer again in the future." (IA1)*

Moderate problem solving is also important for OEM's customers too.

"*Normally, configurations are made at the initial stage, and progress is made after receiving approval from the customer. But even if the customer approves,* *there may be complaints in the field such as "it was supposed to be like this but you didn't do it that way". Of course, we help as much as we know to find the middle way. We support as much as we can for customer satisfaction." (O1)*

E1 mentions that if the automation firm cannot solve the problem, customers tend to switch to another supplier:

"*When there is a problem, we expect the company to produce a solution. We direct the automation company about the problem, they come here to inspect. If they still can't find a solution after these reviews, there is of course a shift towards alternative suppliers. After all, you can't work that way." (E1)*

For this reason, the ability to understand the customer's problem and provide the appropriate solution accordingly is important to co-create the value. The importance of understanding the customer's problem and looking from the customer's point of view is explained by IA5:

"*We need to learn about their problems by looking through the eyes of the customer. Only in this way, the right communication environment is created. Otherwise, you're just a regular seller making an offer only when there's a demand. You do not add value to the process. You simply become a name on the client's supplier list. This is called a vendor jail. When you enter the Vendor jail, you become a company that does not add value and cannot solve the issue. Instead, we need to communicate more and reach a more accurate point by meeting the expectations of the customers". (IA5)*

So, to not to be in vendor jail, automation firms as a supplier should provide solutions to the customers.

Interviewees also mention that a quick solution approach is necessary for the automation sector since these products provide productivity to the customers, and the continuity is this productivity is expected by the customer. Also, if the automation company cannot provide quick actions, the customer may try to fix the problem on their own and accidents can occur. For instance, IA7 mentions that:

"*You set up the best system in the world, give the best training to the customer as much as you want, but when the customer gets to the screen and starts working, the problems they experience must be resolved in a minimum time. Now, if you put yourself on the other side and think, for example, you say that this system is better, they say, let's buy this system. Maybe they give more money than other suppliers' products. Then the customer sits down at the computer, may even have received training from the automation company on the subject, but still cannot solve the problem. There is a big difference between reaching an authorized engineer from the automation company by phone and asking "how can we solve this?" or calling someone from the automation company and can't reach him and making an extra effort to solve it yourself. Maybe the customer is doing something wrong while trying to solve that problem and some mistakes here can cost the companies millions. So, if you print the wrong recipe, it will explode. That's why after-sales support is an important step. I sold it, my job is done, it won't happen in our sector. Companies that behave this way will fail." (IA7)*

So, the pieces of training sometimes cannot be sufficient, the automation firm engineers should always help the customer. EPC1 also emphasizes that the EPC firms should be quick in problem-solving as:

"*Delays that should not occur should also be prevented. For example, when something unplanned happens, it should be dealt with as soon as possible and work should be resumed as soon as possible." (EPC1)*

SE1 supports the necessity of quick actions as:

"*As a special challenge in our business, you marry with the job, in other words, this job will follow you for many years. The customer may call suddenly one night, 5 years after the job is done when there is a breakdown." (SE1)*

E3 explains that if an industrial automation firm provides sufficient support for a solution, customers perceive it as a non-problematic product:

"*I think the most important thing for non-problem is to manage the process together with the supplier company. Every device can cause problems, but if I can get support from the supplier company when I have that problem, if it solves my problem, I think we can call it a non-problem. If a part can be replaced immediately when it fails, I can evaluate it as a non-problem." (E3)*

So, in order to increase the positive value-in-use with sustainable products, a quality solution must be provided by the automation firms. Also, E3 adds that the automation firms should concern the customer feedback for new products even if there is no problem:

"As an end-user, I would like the automation company to follow the product supplied. In other words, even if we have no complaints, if it is a new product or if there is a software update for an existing product, I expect the automation company to call me and get plenty of feedback from me to see if I have a problem." (E3)

The ability to offer solutions according to customer demand is mentioned by several interviewees as EPC1:

"*When the customer requests special production, he thinks about whether the automation company can offer it and whether it gives the necessary knowledge and confidence. That's why it's important to be able to provide the solutions they demand." (EPC1)*

IA4 adds that:

"*The company I worked for was able to offer quality integration solutions to customers. One day I sent an offer to a customer. The customer said your product is great, but we've had offers from similar competitors and they claim they're doing the same thing as you. He said that 4 companies offered twice the price of the meeting. But in the end, he purchased it from us." (IA4)*

As we mentioned in the previous heading, the expertise of the automation firms has a direct effect on value-in-use. Also, the importance of being able to offer solutions even for problems that the customer does not know in their own processes is explained by IA4. The industrial automation company he used to work for produces customized products for customer groups in certain industries. The automation company employed very knowledgeable and well-equipped engineers in that sector, and they had a great command of the solutions. He explains how they offer solutions with their knowledge to create customer satisfaction as follows:

> "*My added value here is that although the customer does not know such a problem, my company knows that problem. And it offers solutions with customized products for that problem. The customer learns about a problem that he does not know about his own processes from the automation company and his satisfaction increases*." (IA4)

The supplier and engineering companies SE1 and SE2 comment on solution ability too. For instance, SE1 explains that even if the customer has a problem, the engineering companies that provide automation services should not go without solving the job as follows:

> "*We do not leave any work unfinished, even if the customer makes us tired, does not fulfill the promises, or causes us financial losses. Because something happens, when that job is not finished, our company cannot do this job. That's why we don't leave without solving our work." (SE1)*

SE2 mentions that the ability to solve unsolvable problems provides them a competitive advantage as;

> *"We can get somewhere by solving problems that cannot be done, rather than with standard works, we can move ourselves to a different point. There are many substitutes for pneumatic products* (automation companies purchase the products also from these types of companies) *in the sector, therefore providing solutions to customers is very important." (SE2)*

In conclusion, the statement of IA4 summarizes the importance of problem-solving as follows:

"*The more solutions you can create according to the needs of the customer, the more your relationship with the customer develops." (IA4)*

5.2.6. Convenience

"Convenience represents the overall easiness and smoothness of the service process for the customer" (Medberg and Grönroos, 2020).

The following table 40 provides an insight into the convenience by demonstrating its determinants.

Table 40. Determinant of Value-in-use – Convenience

Convenience		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	procurement convenience	E1 E3 IA2
2	one-stop shopping	E1 E3 IA2 IA3 SE1 O2 SE1
3	ease of use	E1 E2 E3
4	less responsibility for the customer	E1 E2 E3 IA2 IA7
5	co-production enhancing convenience	E3 O2

Interviewees mentioned frequently how convenience increases customer satisfaction, therefore the positive value-in-use.

For instance, E3's main industrial automation supplier is well known in the sector. The supplier's products and their attributes are known by every engineer since the automation firm provides product demos to the universities. Also, the product supply is very easy due to several distributors in the automation firm's supply chain. Therefore, convenience through knowledge and procurement creates customer loyalty for E1's firm through the automation supplier.

E1 mentions important values for industrial automation supplier selection as;

"*Whether there will be problems in the supply, ease of use, ease of configuration, ease of supply of spare parts"* (E1)

Interviewees mentioned procurement convenience too. For example, IA2 says that if automation companies can provide one-stop procurement to customers, customers find the procurement process more convenient and would like to work with the supplier:

"*The customer is usually looking for a company that can offer a solution and take the responsibility as a whole, rather than buying the products one by one. Because the end-users do not have many employees, they will be able to evaluate everything with plus and minus. Therefore, they want to put a few key employees and throw all the rest of the responsibility on such contractors. In this way, they both take less responsibility and can perform cost control more easily from a single source. Therefore, if automation companies offer solutions outside of themselves and act like EPC companies, customer satisfaction will increase even more.* He also adds that *one-stop procurement is a good thing for the customers because this decreases their responsibility." (IA2)*

The desire for convenience is one of the things that most of the interviewees' common deduction. E2 explains the co-created value with EPC as:

"*If the project to be done is big enough to keep the employees of the end-user company busy and prevent the work they need to do, of course, these works are carried out with EPC companies." (E2)*

The resume of what IA7 says about EPC convenience is While customers are going to install a new control system, they already have EPC companies do the pre-engineering. With the information that came out of that preliminary engineering, the customers were purchasing services by assigning tasks to different companies, with the contracting side to one company, the electrical side to another company, and the automation side to another company. Of course, this was an extra burden for the customer and the customer was thinking, why should I do all this work? EPC can do it for me. In this way, it is easier for the customer to follow up, talk to a single place and increase his bargaining power.

IA3 explains that EPC firms provide one-stop procurement for end-users, and sometimes procure automation products and services from different industrial automation firms. When the end-user would like to make changes in the automation system provided by the EPC firm, they should procure the products from different industrial automation suppliers. Of course, procurement from different suppliers makes the job of the customer difficult, and herewith the customer also expects one-stop procurement from the automation firm too. So, this situation pushes industrial automation competitors to cooperate.

"*when bidding each other for the same job, there are situations where you need to get offers from each other at the same time. Obviously, this is one of the things that makes the job difficult." (IA3)*

O2 as an OEM mostly mentions convenience while selecting the automation supplier they will work with. He says that working with the same automation supplier and learning their products facilitates their job. Long-term relationships with automation suppliers make their job more practical. Since their main automation product portfolio is wide, O2 can procure all the necessary products from them, this provides procurement convenience for them. O2 is the most supportive of co-production among the interviewees. For instance, he says that they select the automation product that they will procure online through a tool that their automation supplier provides. They also open a sales request online via the tool and do not wait for the actions of the automation supplier. O2 comments for co-production as:

"*This is a win-win. Since we are constantly preparing offers, if I ask my automation supplier for a quote for every job, it would be a waste of time. So, I will have to wait for the supplier to prepare and not submit an offer. Therefore, we systematically standardize the products we work with and we do not ask for offers for the products we standardize." (O2)*

5.2.7. Flexibility

"Flexibility refers to the willingness of the service staff to adjust and tailor their services to meet the individual needs of the customer" (Medberg and Grönroos, 2020).

The following table 41 provides an insight into the flexibility by demonstrating its determinants.

Table 41. Determinant of Value-in-use – Flexibility

Flexibility		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	flexibility of payment	IA3
2	flexibility of procedures	IA4
3	flexibility of doing extra jobs	IA3 IA4 IA5 IA7 O2 EPC1
4	flexibility to meet all the demand	IA3 IA7 O1 EPC1
5	flexible product to extend	IA2

The interviewees working in industrial automation firms mentioned the importance of flexibility for customer satisfaction. The interesting part is that any of the end-users didn't mention flexibility. The reason may be since customers think that their demands are reasonable, they cannot perceive that the automation company shows flexibility. On the other hand, interviewees possessing supplier identity explain the importance of flexibility as;

"*Here, of course, since we are in the supplier position, we are usually in the lower position that tends to solve the problem. We try to show the changes and flexibility we can. [...] for example, the information provided by the customer is not correct and we may need to buy 100 more from a simple piece of hardware that we envisioned for 200. We foresee that such risks may arise in the light of our experience before the project. In the end, we don't increase the project price." (IA3)*

"*Customer asks we can't pay in in this month, can we do the payment in the next month." (IA3)*

"*For example, the customer says, let's do this work within the scope of our maintenance agreement. Under normal circumstances, the contract we have does not require us to do this, but the customer says, here I am paying you X Euros a year, come do this, why don't you do it, what will happen one day." (IA3)*

"*Since we cannot overcome some procedural issues, we cannot create alternative solutions. […] Since we cannot provide flexibility in the contracts, a question mark arises among the customers: "I am working with this supplier today, but if there is* *a problem tomorrow, will this company let me down because of the contract?"" (IA4)*

"*There may be additions as the project continues. It is not acted upon with an offer or order from scratch for those additions. It's just an addition to the bottom of that project. This is called a change order. We are not a company that makes a lot of change orders. That's why customers prefer to work with us in complicated places that they do not have control over and they think will cause problems in the future. Because we do not charge additional costs. But, for example, we know that our competitors charge extra. We say, let's remove this and give this instead, we provide flexibility." (IA7)*

"*customers expect us to meet all their demands" (O1)*

"Of course, since the field is constantly changing, it is necessary to adapt to these changes. […] Perception of value, as I said, how flexible is it when things are being done." (O1)

Lastly, IA2 mentions the importance of product flexibility. He says that if the customer can expand the automation system they are using in their plant after a certain time, the customer is satisfied. Because if they change the whole automation system for a new design of automated processes, this is very expensive. But if the product is flexible to expand and integrate with other systems it's very valuable for the customer.

5.2.8. Trust

The following table 42 provides an insight into the trust by demonstrating its determinants.

Table 42. Determinant of Value-in-use – Trust

Trust		
	Sub-determinant	**Actors mentioned the sub-determinant**
1	bilateral relations	E2 IA4 IA7
2	transparency	IA5 IA7 O2 SE2
3	trust to the person	O2

Table 42. (Continued)

4	trust to the company	IA1 IA4 O2 SE2
5	brand awareness and loyalty	E1 E2 IA2

E2 mentions the importance of bilateral relations in the industrial automation sector:

"*In our country, the situation is a little different. Let me tell you how things work in our country if you are working with a company and your relationship is good, whether your job is good or bad, it doesn't matter much. After the job is done for good or bad, there is no problem, but if your relationship is good, you leave a good impression. It is important to have good bilateral relations on the basis of Turkey." (E2)*

Also, IA7 mentions that it is more comfortable to work with customers with whom they have good bilateral relations so that customers tend to give extra information and gain business.

IA5 explains the importance of transparency and ethical behaviors:

"*We need to create an honest environment [...] we must never deceive our customers. We must always take an ethical stance in the right direction [..] We must honestly state whether we can do the job or not. In that sense, we should not come to a point with any hidden agenda." (IA5)*

SE2 thinks similar to IA5;

"*First of all, we need to be honest. So "Yes, I can do this job." "I can answer this job." "No, I can't do this job. This is beyond me. I won't waste your time, this is something outside of me." [...] So we should be able to get a job that we can do. On the other hand, if we said yes we can, we should be able to keep our promise. If we say that we will do this job on that date, we need to be able to do that job on that date." (SE2)*

Trust upon people and companies is explained by O2:

"*Trade in Turkey is still largely based on trust. There is no such thing in Europe. You give the offer to the companies in Europe, you get it or you don't. [...] In Turkey, on the other hand, there is trust based on the person. There is also the trust based on companies. This is how we trade over 50%. It takes years to build this trust and create the perception of a trusted person and company. You have to do business with the customer by standing behind your product and process for years. Sometimes you will lose money, but you will build up a sense of trust over time. After that, it is easier and the basis of our way of doing business in our customer portfolio is based on such trust." (O2)*

O2 also explains how they constitute trust as;

"*You have to spend money to get the feeling of trust. You need to create a sense of trust in people's eyes by spending money in different ways. By standing behind this product, you create a sense of trust with fast delivery and fast problem resolution. Or to give cheaply or to make a loss, sometimes you create a sense of trust by losing money in this way." (O2)*

IA7's statement totally coincides with the above argument of O2.

"*So, you need to convince, you need to be sincere. But the customer really needs to believe in our sincerity. I really need to be sincere, that is, we can't do what we can't do, we do what we can do, and we need to be able to stand behind every information we give. This may make us lose business at first, but it provides confidence in the long run and provides much more positive contributions in the coming years. It also promotes the development of good relations. The development of the bilateral relationship may also provide much more profitability to the automation company in the coming years." (IA7)*

IA4 mentions trust in companies:

"*In other words, a company that can be behind, support, maintain and trust is important for customers. So, it's not trusting to the person. There is person X today,* *he may not be tomorrow, but the reliability of the company and its support are very important. As long as the company gives support, as long as does its best, as long as gets back to you quickly, these are very, very important. To create a solution for him, to trust, to return quickly. These three are very important for companies." (IA4)*

IA7 highlights that even if the product does not fully meet the demand of the customer, if the customer trusts the automation firm, the customer still works with the automation firm:

"*There is a feature that we cannot provide in a product group, but customers still continue to buy products from us. The reason for this is that our company can offer them much higher quality in the remaining areas. The customer knows that the equipment he bought there will not give him any trouble. The solution we provide is sufficient for him for now, and he thinks that in three to five years, the supplier will improve it as well. And he thinks that I can integrate this system here and eliminate the problem." (IA7)*

5.2.8.1. Brand awareness and brand loyalty

E1's statement highlights that customers may have a mutual idea as an organization about the quality of an automation brand. That is, the ideas of the end-user employees affect each other as an organization and this provides a mutual trust towards the automation supplier:

"*The Z brand is seen as a certain class, a certain value in the factory, its products are considered durable. It is at the forefront with its product sensitivities and generally suitable products for process conditions and purposes. And if an investment is to be made, if something new is to be purchased, Z is always a preference with the effect of trust from the past." (E1)*

E1 also mentions that they are afraid to purchase another automation supplier's products because they are used to the quality of brand Z, they know how the product of Z works but they are a bit stranger to other firms' products:

“*Getting to know the supplier closely is what I'm trying to explain. As a result, people generally react against the “new”, and the new product is a product within certain standards, but [...] If we buy it while Brand X is available, I wonder if this product will fail after 3 months, 5 months later? If something happens, will the constant device add extra workload to us? At this point, the feeling of staying safe at work actually brings Brand X to the fore. Otherwise, what I want to talk about here is not that other companies' products are of poor quality.” (E1)*

Additionally, when we ask E1 about his biggest expectation from the automation firm, he answers as “trust”.

Lastly, E2 explains that the end-user firm he is working for is a global firm, therefore, they have international quality standards. He mentions that they are working with global brands that possess a reputation in the industrial automation sector in order to meet these standards.

5.3. Value Co-creation Activities and Their Effect on Value-in-use for Different Actors

The analysis reveals that the value co-creation activities create value for the end-user and for the other actors in the supply chain too. These activities are explained in detail in the subheadings of co-production, co-design, co-procurement, co-trial, and coopetition. According to service-dominant logic, the value is co-created and evaluated by the end-user customer. Looking from another perspective, the findings of the thesis propose that the other actors also benefit from these activities and have a share of value-in-use. These value-in-use shares are shown in detail in table 43.

Table 43. Value co-creation (VCC) dimensions and their effect on different actors' value-in-use (VIC)

VCC dimension	**Activity**	**Actors contributing VCC**	**VIU Actor 1**	**VIU Actor 2**	**VIU Actor 3**
Co-production	Interaction of the EPC to provide solutions in the customer production process during automation product installation	IA-EPC-E	VIU-IA -Know-how increase	VIU-EPC: Does not exceed the deadline promised to the end-user	VIU-E: -Accurate production in the field -Speed solution
Co-production	Trainings about the correct usage of automation products and latest automation technologies given by automation firm to customer	IA-E	VIU-IA -End-user trust to IA firm increases	VIU-E: -Awareness about IA technologies and Industry 4.0 -Productivity increase	
Co-production	Collaboration of technology firm with a partner firm to co-produce an integrated customized system for customer's production processes	TP-P	VIU-TP: -Gaining customer trust	VIU-PF: -Integrated solution ability through technology provider	VIU-E: -Developed processes through integration

Table 43. Continued

Co-design	Feedback and brainstorming with capable customers in the pre-project design stages to generate ideas and join forces for mutual benefit	IA-E	VIU-IA: -Know-how of the IA firm increases with feedback and new experience	VIU-E: -Accurate product design for the end-user -Quality product solution	
Co-design	Feedback and brainstorming of the customer and supplier-engineering firm for accurate project design	SE-E	VIU-SE: -Know-how increase	VIU-E: -Know-how increase -Appropriate product/solution selection	
Co-design	Feedback and alternative suggestions from suppliers for customized automation product designs	S-IA	VIU-IA: -End-user perceives the IA firm as an alternative solution provider	VIU-E: -The product/solution quality increase	
Co-design	Feedback and brainstorming with capable customers in the pre-product design stages for accurate OEM product selection	OEM-E	VIU-OEM: -End-user pushes OEM to make better -OEM know-how increases	VIU-E: -Better quality product design and production	

Table 43. Continued

Co-procurement	Information sharing about latest automation technologies from automation firm to the project firm to procure the latest automation technologies to the customer production processes by the guidance of the project firm	IA-PF-E	VIU-IA: -Ability to sell latest automation technologies -Profit increase	VIU-PF: -Know-how increase	VIU-E: -Efficient production processes through automation
Co-trial	Trial of the customized robots in the customer's field for mutual benefit as proof of the design for the customer and as experience for the industrial automation firm	IA-E	VIU-IA: -IA firm gains experience -IA understand the requirements and customize the solution accordingly	VIU-E: -Exact and accurate customization	
Coopetition	Cooperation among competitors to produce customized products enables automation firms to take advantage of competitor's relationships with the customer and build trust	IA-TP	VIU-IA: -Increase the quality of the solution through technology provider firm	VIU-TP: -Take advantage of the competitor's relationship with the end-user -Gaining trust	VIU-E: -Quality integrated solution

CHAPTER 6: CONCLUSION

6.1. General Discussions and Theorethical Contributions

In this study, multi-actor customized product supply chains are examined through the value co-creation activities and their impacts on the value-in-use among industrial automation sector. Value co-creation is the integration of resources during practices between actors linked together within a service ecosystem (Frow et al., 2016), whereas value-in-use is the extent to which a customer feels better off (positive value) or worse off (negative value) through experiences (Grönroos and Voima, 2013). The purpose was the clarification of the value co-creation within a multi-actor complex supply chain made up of industrial automation companies, suppliers, intermediaries, and end-user firms and their effect on value-in-use for customized products and services. Since supply chains are complex networks with a high number of interactions and inter-dependencies among different entities, processes, and resources (Surana et al., 2005), the collaborative creation of value is an issue that needed to be addressed. The industrial automation sector was eligible for this study due to the existence of highly customized Industry 4.0 products and solutions for several industries.

Fifteen semi-structured interviews were conducted to answer the research questions

RQ1: How value is co-created among customized product supply chain actors through coopetition, coproduction, and codesign activities?

RQ2: What are the value co-creation elements enhancing value-in-use for customized products?

RQ3: What are the factors affecting value-in-use in customized supply chains?

After the realization and transcribing phases of the interviews, then, all the interview transcripts were coded. All interview transcripts were coded four times to minimize the margin of error, as there was no definitive judgment as to the “best” way to encode qualitative data (Saldaña, 2021). The latent meanings of the interviewee expressions were illuminated. Thus, the value co-creation activities in terms of co-production, co-design, co-procurement, co-trial, and coopetition; and the effect of these activities on customization and value-in-use within customized product supply chains became evident.

The factors affecting the value-in-use were determined through the analysis. One of the contributions of the results was that the quality of the product was both a denominator and a result of value-in-use. Macdonald et al. (2011) analyzed service quality and value-in-use in their studies and defined the value-in-use as “A customer’s outcome, purpose or objective that is achieved through service”. This is because, through the use of industrial automation products, end-users are achieving profitability, process efficiency, productivity, environmentally friendly production, quality end-product production, and customized end-product production. On the other hand, Medberg and Grönroos (2020) defined the empirical dimensions of value-in-use but did not add quality as a dimension and indicated that

> “*in the minds of service customers, value defined as value-in-use and service quality may represent the same empirical phenomenon”*.

This master thesis expanded the research of Medberg and Grönroos and contributed to the literature as “End-users obtain a value from the product through the usage stage. We can call the product usage stage as; a stage in which the product serves. If the industrial automation product has quality attributes, the provided services through the product such as profitability, process efficiency, productivity, environmentally friendly production, quality end-product production, and customized end-product production are enhanced. Therefore, the quality of the product directly affects the service quality, and consequently, value-in-use.”

Other results of value-in-use empirical dimensions were in line with the study of Medberg and Grönroos (2020) such as speed, solution, convenience, and flexibility. We expanded the expertise as “customer expertise” and “supplier expertise” (industrial automation provider) and highlighted the importance of the expertise of customers within the positive or negative result of value-in-use. In short, the lack of customer expertise to provide required data or feedback prevents customization while the high degree of expertise of the customer enhances customization, and increases the service quality since they are able to fix product breakdowns on their own with the remote help of the industrial automation company. This result coincides with the study of Lemke, Clark and Wilson (2011) since they highlighted the role of the customer in facilitating the problem-solving process as the participation in the formulation of the value proposition. Also, Pinho et al. (2014) highlighted the importance of self-interdependency as defending that the value creation depends on actor's own actions.

Similar to the findings of Medberg and Grönroos (2020), this master thesis emphasized the importance of monetary cost on value-in-use too. Medberg and Grönroos (2020) explained the monetary cost as the sacrifices the customers make to get the desired service. If the sacrifice is more than the value they get, negative value-in-use arises and vice versa if the sacrifice is less than the value obtained, positive value arises. Our master thesis expanded the monetary cost as "initial investment cost" and "total cost of ownership" since the interviewees mentioned both of the concepts a lot. The results show that some customers care a lot about the initial investment cost, in other words, low-cost products, and they are indifferent to confining themselves with low-quality products whereas some customers care to use the product for long years with low frequency of breakdowns, and they are willing to sacrifice more in terms of higher costs.

Another interesting contribution of this master thesis is adding a new empirical value-in-use dimension as "trust". Some interviewees mentioned that the bilateral relations with the customers highly affects the value-in-use: if the work is done somehow, it is sufficient for the customer if their bilateral relationship with the supplier is very well. On the other hand, the "brand awareness and loyalty" became the subheading of the trust since interviewees from end-user firms mentioned frequently about their attachments to the industrial automation brands. This result supports the argument of Porter and Donthu (2008);

> "*Trust motivates customers to behave relationally toward the sponsoring firm by sharing information with, co-producing new products with, and granting loyalty to, the sponsoring firm*."

Additionally, the brand awareness suggestion can be supported with the argument of Rubio, Oubiña and Villaseñor (2014) as;

> "*Quality conscious consumers are more brand conscious and place more trust in the performance of recognized and advertised brands*."

On the other hand, this master thesis deeply emphasized the co-created value to reach customization objectives in terms of value-in-use among multiple actors within the industrial automation supply chains with co-production and coopetition activities. As a result, we find out that both co-production and coopetition activities have a positive and negative influence on customization. For instance, if the end-user provides an accurate amount of data, gives feedback, participates in the product design phase, participates in the product test phases; the risk of product mismatches decreases and the customization enhances. On the contrary, if a less expertise end-user intervenes to the product without the directions of the industrial automation employees', as a result, fatal accidents, loss of money, loss of productivity, and loss of reputation may occur.

The findings also vary from a dyadic perspective to a multi-actor perspective too. For example, the intermediary role of the EPC between end-user and industrial automation suppliers increases customer satisfaction since EPC is additional know-how in the supply chain that is capable to provide alternative solution suggestions and decreases the workload of the end-user, in other words, provides convenience.

The results of this master thesis show that the temporal interdependencies are significant in multi-actor supply chains while co-creating the value. These temporal interdependencies were mentioned in the study of Pinho et al. (2014) and defined as "the interactions that occur sequentially in different times". More recently, these temporal interdependencies are examined in the actor engagement research. In actor engagement research, the temporal interdependencies are mentioned as "actor connections" which are defined as;

> "*the connections which have emerged in the past, and currently continue to influence the actors' engagement"* (Li, Juric and Brodie,2017).

Li, Juric, and Brodie (2017) defines the engagement platforms as;

> "*a physical or virtual touch points to offer structural support for the exchange and integration of resources and actors are engaged with one another on different platforms."*

They also emphasize that there can be certain phases that actors are present or not and explain this as “actor-network intensity”:

“*the number of actors or groups of actors engaging in the network during certain phases.”*

We have two examples of co-production activities which contributes to the existence of actor connections or temporal interdependencies: Pre-activity: IA firm purchased a product from its supplier that will work with the automation product, then the product breakdown occurred frequently because of supplier product failure. We see the effect of early non-accurate product selection by the supplier and its effect on end-user satisfaction. Another example is that, end-users continue to purchase from the same industrial automation brand which is sold to them inside of the OEM equipment by the OEM firm earlier. So, in that case the early industrial automation brand selection activity of the OEM has a direct effect on new industrial automation brand selection in present.

On the other hand, co-trial and co-procurement activities were not have adequate place in the literature. This master thesis illuminated these activities in the customized product supply chains. Besides, the looking from another perspective, the findings of the thesis propose that the other actors also benefit from these activities and have a share of value-in-use.

This master thesis contributed to the literature by analyzing the coopetition activities within a high degree of competition industrial automation supply chain. The results show that working groups of industrial automation competitors and end-user firm enables the solution customization for the end-user and encourage technological development. On the other side, we could not find adequate evidence to support that coopetition activities enhance customization and value-in-use since the end-user interviewees mention that they are indifferent about coopetition. We also figured out the existence of actor connections or temporal interdependencies in the coopetition activities such as; the early effect of EPC firms has a direct effect on coopetition. EPCs procure different automation firms’ products and provide one-stop procurement to the end-users. Then, if the end-user wants to renovate the industrial automation system, they expect the industrial automation firms to coopete and provide one-stop procurement too. This brings convenience for the end-user. So, the past actions of EPC affect the activities between industrial automation firms and end-users in the future too.

Taking into account all of these value co-creation activities in terms of co-production, co-design, co-procurement, co-trial and coopetition, positive and negative forms of value-in-use within the customized industrial automation supply chains are determined through the analysis of the interviews. For instance, while the positive value-in-use examples are quality service through quality automation product, productivity increase, profitability increase, environmentally friendly production , and customized end-product production; the negative value-in-use examples are fatal accident, extra cost, non-productivity, wrong customization, and inaccurate product. These results are contributed to the value co-creation and service-dominant logic literature since the examination of the industrial automation sector with value perspective has never been examined before.

To sum up, the value co-creation activities as co-production and coopetition, the resources shared within these activities, their driven effect on customization and value-in-use, the dimensions and results of value-in-use are mentioned in the Figure 7.

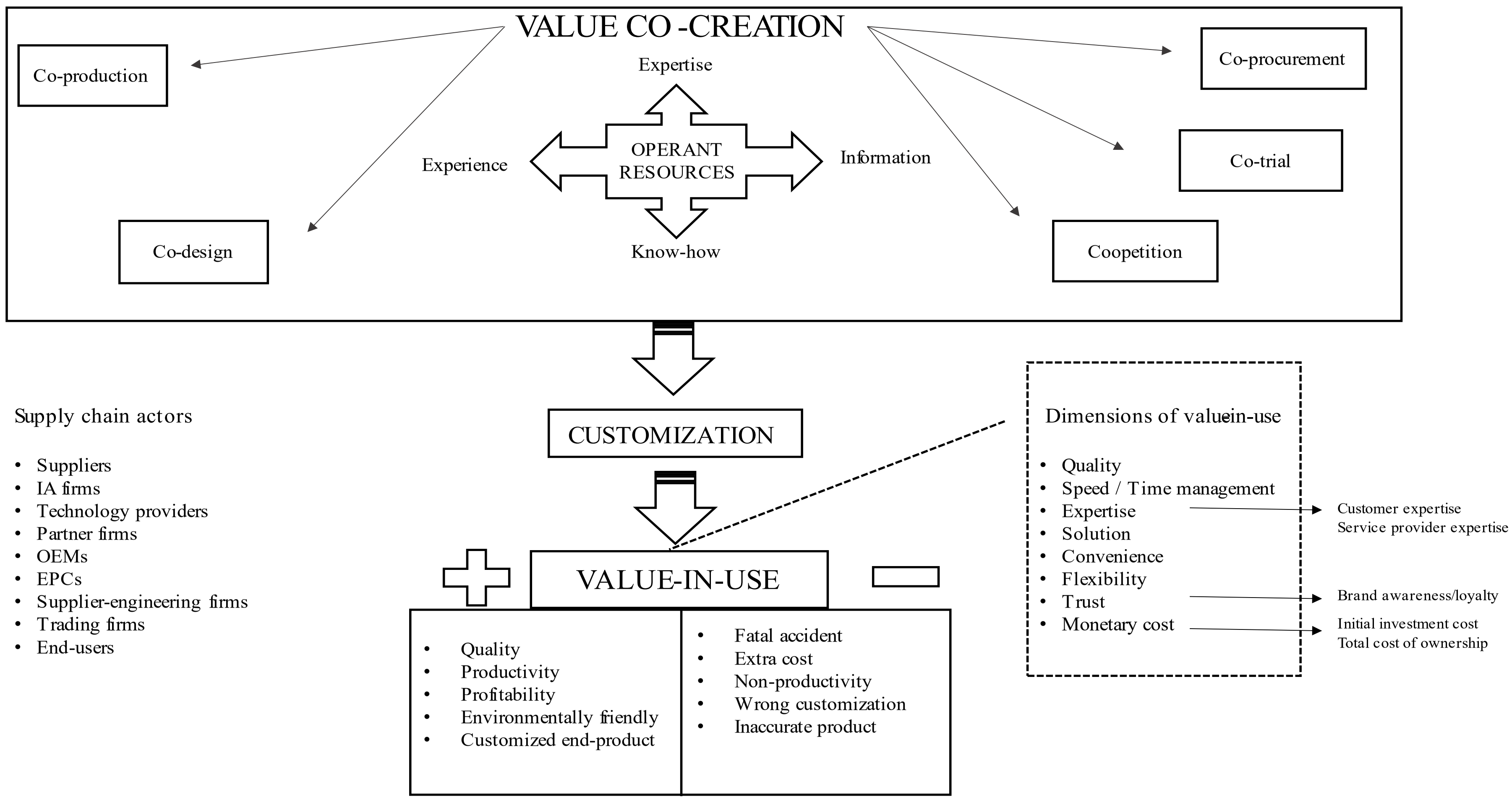


Figure 8. The Value Co-creation Activities and their effect on value-in-use within customized IA SC

6.2. Practical Implications

The findings of this master thesis serve directly to the customized supply chains and specifically to the industrial automation sector, the technology companies that innovate solutions for the end-users, and several industries that provide customized products and services to their customers.

The findings of this thesis provide an insight on the management of co-production, co-design, co-procurement, co-trial and coopetition activities to enhance the positive value-in-use and prevent the negative value-in-use outcomes.

It will be also useful to care the emprical dimensions of value-in-use while starting a business with a new customer, selecting/ assessing the supplier, or managing the activities within a multi-actor supply chains.

Besides , the managers of the companies may give attention to the shared value-in-use to get more advantage while generating value co-creation activities. They may also avoid the negative aspects of value co-creation by paying regard to the examples in this thesis.

6.3. Limitations and Directions For Further Research

Our research was limited with thirteen companies and fifteen interviewees. Therefore, in order to find out the another aspects of the effect of value co-creation activities on customization; and to produce more empirical dimension of value-in-use, the sample size should be extended.

Our study showed the mutual effect of expertise on value-in-use as customer expertise and supplier expertise. New researchs can be implemented to examine if there is determinant customer effect on other empirical dimensions too.

Further studies may also pay attention to extract and address more co-creation activities than co-production, co-design, co-procurement, co-trial, and coopetition.

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APPENDICES

APPENDIX 1: INFORMATION FORM

1. Değer (value):

Değerler önemsediğimiz şeylerdir. Kullanıcıların değer sistemine bağlı olarak, bir ürün ve hizmetin değeri değişkenlik gösterebilir. **Olumlu** veya **olumsuz** değer olarak nitelendirilir.

2. **Değer yargısı (value judgement):** Değer yargısı, müşterinin, belirli bir kullanım durumunda ilgili tüm faydalar ve fedakarlıklar arasındaki ödünleşmeler göz önüne alındığında, bir tedarikçi tarafından onlar için yaratılan değere ilişkin değerlendirmesidir.

3. **Kullanımdaki değer (value-in-use):** Müşterinin kaynakları kullanımı sırasında ortaya çıkan, yarattığı veya gerçekleştirdiği değer. Bir müşterinin deneyimler yoluyla daha iyi (pozitif değer) veya daha kötü (negatif değer) hissettiği düzey.

DEĞER	
Pozitif değer	**Negatif değer**
daha kullanışlı	daha kullanışsız
daha iyi	daha kötü kılan
daha verimli	daha verimsiz
daha memnun edici	daha memnuniyetsizlik verici
daha istek uyandıran	daha istek azaltıcı

Daha önceki akademik çalışmalar göz önüne alındığında kullanımdaki **değeri etkileyen kavramlar** için aşağıda örnekler verilmiştir. Soruları yanıtlarken fikir oluşturması için incelemenizi rica ederiz. Aşağıdakilerden farklı değer örnekleriniz var ise soru sırasında paylaşmanız önemlidir.

Değeri etkileyen kavramlar	
Problem çözme kabiliyeti	**solution**
Firmanın tutumu	**attitude**
Hizmet sürecinin genel kolaylığı ve sorunsuzluğu	**convenience**
Firma çalışanlarının uzmanlık derecesi (hizmet personeli tarafından gösterilen yeterlilik, beceri ve bilginin derecesi)	**expertise**
Hizmet hızı (hizmet sunum sürecinin ne kadar hızlı ve hızlı olduğu ile ilgilidir)	**speed**
Tedarikçi firmanın esnekliği (hizmet personelinin, hizmetlerini müşterinin bireysel ihtiyaçlarını karşılayacak şekilde ayarlama ve uyarlama istekliliğini ifade eder)	**flexibility**
Maliyet (müşterinin hizmet sağlayıcının ücretlerini, ücretlerini veya faizini avantajlı veya elverişsiz olarak algılamasını ifade eder)	**monetary costs**

4. Kaynak (resource):

Bir aktörün (firma) daha fazla yaşayabilirlik için yararlanabileceği herhangi bir şey.

- Somut kaynak (operand resource): hammadde, makine gibi üretim faktörleri olan maddi varlıklardır.
- Soyut kaynak (operant resource): bilgi, tecrübe, beceri, teknoloji gibi hareket eden, görünmez ve soyut kaynaklardır.

Örneğin, uygun otomasyon ürün ve hizmetini seçerken karşılıklı paylaşılan bilgiler ve tecrübeler birer kaynaktır.

5. Birlikte değer yaratma (value co-creation): Collaboration, iş birliği

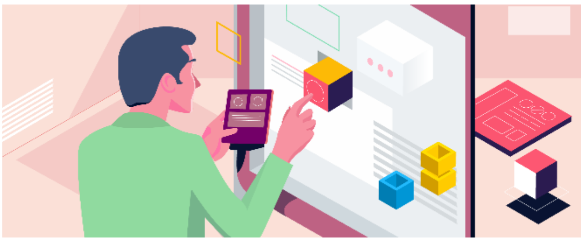
Birlikte yaratma, firmaların birlikte çalışmaları sırasında ortaya çıkan kaynak bütünleştirme sürecini tanımlar. **Birlikte değer yaratma** ise müşterinin hizmet ağındaki işbirlikçilerle etkinlikler ve etkileşimler yoluyla **kaynakların entegrasyonundan elde edilen fayda** olarak tanımlanır

6. Birlikte üretme (co-production):

Üretim ve üretim sonrası süreçlerde yer alabilecek müşterinin üretim/tasarım faaliyetlerinde etkin rol oynaması aktivitesi.

- Örnek1: Dell'in web sitesi üzerinden müşterilerin talep ettikleri konfigürasyona göre bilgisayar seçebilmesi.
- Örnek2: Endress+Hauser web sitesi üzerinden online ürün seçme ve çaplandırma yapılabilmesi.
- Örnek3: İkea'dan alınan ürünü müşterinin evde kurması.
- Örnek4: Tedarikçiden alınan ürün ile kendi ürününün montajını gerçekleştirmek.
- Örnek5: Ürünün doğru kullanımı için müşterilere eğitim vermek ve teknik destek sağlamak
- Örnek6: Müşteri ürünü sahasında kullanırken ürün içinde değişiklik yapabilmesi, kalibrasyon vb.
- Örnek7: Müşterinin ürün seçilmesi ve tasarlanması konusunda sürece dahil olması.

7. Özel üretim ürün (customized product):



Son kullanıcı sahasının ihtiyacına göre tasarlanan ve üretilen özel ürün veya hizmet.

Örn: DCS, gaz kromatograf, servis hizmeti

8. İş birliği içinde rekabet (coopetition):

Rakiplerin rekabet ve iş birliği faaliyetlerini aynı anda gerçekleştirmesi. İşbirliği içinde rekabet, ekonomik aktörlerin işbirliğine dayalı etkileşim yoluyla ortaklaşa değer yaratırken, aynı zamanda bu değerin bir kısmını yakalamak için rekabet ettikleri stratejik ve dinamik bir süreçtir.

APPENDIX 2: SEMI-STRUCTURED INTERVIEW QUESTIONNAIRE

Giriş:

1. Mesleğiniz, eğitim durumunuz ve sektördeki tecrübeniz (yıl olarak) hakkında bilgi verebilir misiniz?
2. Bugüne kadar çalışmış olduğunuz firmalar nelerdir ve hangi rolde çalıştınız?
3. Çalıştığınız firma hangi alanda hizmet vermektedir? Firmanızın sektördeki konumu nedir?Ulusal mı uluslararası mı bir firmadır? Firmanızda çalışan sayısı kaçtır?

Otomasyon Sektörü hk.

4. Otomasyon sektörünün tedarik zincirinden bahsedebilir misiniz?
   - 4.1. Otomasyon ürünü satın almak/satmak için hangi partnerler (firmalar) ile çalışmaktasınız? (sektör olarak)
   - 4.2. Söz konusu partnerler ile aranızda nasıl bir ilişki var ve süreç akışı nasıl işliyor?
   - 4.3. Satın aldığınız/sattığınız otomasyon ürünleri nelerdir?
   - 4.4. Satın aldığınız/sattığınız otomasyon ürünlerini hangi amaçlara hizmet etmektedir?
5. Sizin firmanız otomasyon tedarik zincirinin hangi halkasında? Çalıştığınız firmanın otomasyon sektöründeki rolü nedir? (otomasyon ürün üreticisi, otomasyon ürün sağlayıcısı, otomasyon ürün/hizmet kullanıcısı, OEM, vb)
6. Firmanızın tedarik zinciri partnerleri kimdir? Firma adı vermeden sektörel bazlı açıklayabili? (Müşterileriniz, tedarikçileriniz, lojistik hizmet sağlayıcılarınız, vb.) Aranızdaki iş süreçlerinden bahsedebilir misiniz?
7. Otomasyon sektörü ve sektöre özel dinamiklerden bahsedebilir misiniz?
   - 7.1. Bu sektörü diğerlerinden daha farklı kılan konular nelerdir?
   - 7.2. Bu sektöre özel zorluklar nelerdir? (ürün, hizmet gibi alanları düşünebilirsiniz)
   - 7.3. Bu sektöre özel konular nelerdir?
8. Sizce otomasyon sektöründe en dikkat edilmesi gereken/en önemli konular nelerdir?
9. Müşterilerin endüstriyel otomasyon sektöründeki teknolojileri hakimiyeti ne düzeydedir? Teknolojik trendleri takip etme konusunda ne noktadalar?

Otomasyon Sektörü ve Özel Ürün Üretim hk.

Tüm dünyada petrol ve gaz, rafinaj ve petrokimya endüstrilerinde endüstriyel proseslerin gaz fazındaki kimyasal bileşikleri ayırmak ve analiz etmek amacıyla kullanılan gaz kromatograflar müşteri sahasındaki gazın bileşimine göre özel dizayn edildiği için özel üretim ürün olarak tanımlanabilir. Gaz kromatograf örneğinde olduğu gibi otomasyon sektöründe müşteri sahası gerekliliklerine göre özel üretim gerçekleştirilen ürünler bulunmaktadır. Bu alandaki soruları yanıtlarken özel üretim gerektiren ürünler hakkındaki bilgi ve tecrübelerinizi esas almanız önemlidir.

10. Otomasyon sektöründeki ürünler müşteri talebine istinaden özel olarak üretilen ürünler midir yoksa standart olarak üretilen ürünler midir, açıklayabilir misiniz?
11. Otomasyon sektöründeki standart ürün ve müşteri talebine göre üretilen özel üretim ürünler arasında ne gibi farklar oluyor?
    - 11.1. Bu farklar tedarik zincirindeki süreçlerde (hammadde, üretim, dağıtım, müşteri desteği vb) ne gibi farklara yol açıyor?
12. Satın aldığınız/sattığınız özel üretim ürünlere örnek verebilir misiniz?
    - 12.1. Hangi ürün gruplarında özel üretim daha yoğundur?
    - 12.2. Özel üretim ürünler söz konusu olduğunda hangi aktörler (firmalar) arası iş birliği (ortak değer yaratma) içinde çalışmalar daha yoğunluk kazanmaktadır?
    - 12.3. Özel üretim ürünler söz konusu olduğunda müşteri ürünün tasarlanması/üretilmesi noktalarında sürece dahil oluyor mu?
    - 12.4. Özel üretim ürünler söz konusu olduğunda tedarikçi (3rd party) ürünün tasarlanması/üretilmesi noktalarında sürece dahil oluyor mu? (otomasyon firmasına yönelik soru)
13. Özel üretim gerektiren bir otomasyon ürün veya hizmetini değerli yapan şey sizce nedir? Tedarik zincirindeki ilgili paydaşlar açısından açıklayabilir misiniz?
14. Özel üretim ürün söz konusu olduğunda, otomasyon sektöründe aktörler (firmalar) arası karşılıklı beklentiler ve değer algıları nelerdir?
    - 14.1. Firmanızın birlikte çalıştığı firmalar ile birbirlerinden beklentilerinden ve sürece katkı sağlayacak/ değer yaratacak noktalardan bahseder misiniz?
    - 14.2. Otomasyon ürünü satın aldığınız firmalardan beklentileriniz nelerdir? Değer yaratan bu beklentileri karşılamak için hangi aktör ne kadar katkı sağlamaktadır?

14.3. Otomasyon ürünü sattığınız firmalardan beklentileriniz nelerdir? Değer yaratan bu beklentileri karşılamak için hangi firma (aktör) ne kadar katkı sağlamaktadır?

Birlikte Değer Yaratma

15. Otomasyon sektörü tedarik zincirinde özel üretim ürün geliştirilmesi, üretilmesi ve müşteriye (son kullanıcıya) teslim edilmesine kadar aktörler ortak değeri nasıl yaratıyor?

    15.1. Paydaşlarınızla beraber yürüttüğünüz birlikte değer yaratma faaliyetleri nelerdir, açıklar mısınız? Hangi paydaşlarla ne çeşit faaliyetler detayında yapılmaktadır?

    15.2. Hangi aktör ne şekilde katkı sağlayarak değer yaratıyor? Bu yaratılan değerler nelerdir?

    15.3. Firmanızın tedarikçisi/müşterisi ile ortak değer yaratma çabasında kim hangi kaynaklarını paylaşıyor?

    15.4. Değer yaratma hangi faaliyetlerde ne şekilde yoğunlaşıyor/önem kazanıyor?
    (örn: ürünün tasarlanması ürünün son kullanıcı sahasına uygun olarak seçilmesi /üretilmesi)

    15.5. Bu faaliyetlerde en çok role sahip aktör/aktörler kimdir? Hangi aktörler arası değer yaratma faaliyetleri yoğundur?

    15.6. Bu faaliyetleri özel ürün üretiminde müşteri tarafına değer yaratmak için nasıl kullanıyorlar?

Birlikte Üretme

16. Özel üretim ürünlerde ortak üretim ve ortak tasarım faaliyetleri gerçekleştiriliyor mu? Bu faaliyetleri sizin firmanızın tedarik zincirindeki rolünü düşünerek açıklar mısınız?

    16.1. Paydaşlarınızla beraber yürüttüğünüz birlikte üretme/tasarlama faaliyetleri nelerdir, açıklar mısınız? Hangi paydaşlarla ne çeşit faaliyetler detayında yapılmaktadır?

    16.2. Ortak üretim ve ortak tasarım faaliyetleri hangi amaçla yapılmaktadır? Bu faaliyetler aktörlere ne kazanç sağlamaktadır? Bu faaliyetlerin dezavantajları nelerdir?

16.3. Sizin ve tedarikçilerinizin/müşterilerinizin bu ortak üretim ve ortak tasarım faaliyetlerinde sürece kattığı değerler nelerdir, örnek vererek açıklayabilir misiniz?

16.4. Otomasyon sektörü tedarik zincirinde özel üretim ürün geliştirilmesi, üretilmesi ve teslim edilmesi noktalarında aktörler müşteri tarafında hangi değeri (kullanımdaki değer) yaratmak için birlikte üretme/tasarlama faaliyetlerini sürdürüyorlar?

16.5. Özel üretim ürünlerde müşteri-tedarikçi arasında bilgi paylaşımı yüksek ölçüde sağlanıyor mu? Sağlandığı ve sağlanamadığı durumlarda süreç nasıl etkilenmektedir?

17.6 Birlikte üretimde aktörlerin birbirlerinden beklentileri nelerdir?

İş Birliği İçinde Rekabet

17. Otomasyon sektörü tedarik zincirinde özel bir ürün geliştirilmesi, üretilmesi ve müşteriye teslim edilmesi noktalarında iş birliği içinde rekabet yapılıyor mu?

17.1. Rekabetin yoğun olduğu bir sektörde iş birliği içinde rekabet neden gerçekleşmektedir?

17.2. Rakiplerinizle beraber yürüttüğünüz iş birliği içinde rekabet ettiğiniz faaliyetler nelerdir, açıklar mısınız? Hangi paydaşlarla ne çeşit faaliyetler detayında yapılmaktadır?

17.3. Rakip firmalar ne şekilde katkı sağlayarak iş birliği içinde rekabet gerçekleştirmektedir, tecrübelerinize dayanarak açıklayabilir misiniz?

17.4. Bu noktada rakipler arası karşılıklı değer yaratan beklentiler nelerdir?

17.5. Rakiplerin iş birliği içinde rekabet yapması sırasında hangi değer yaratılmak istenmekte ve bu değer için hangi faaliyetleri yoğunluk göstermektedir?

17.6. Otomasyon sektörü tedarik zincirinde özel bir ürün geliştirilmesi, üretilmesi ve teslim edilmesi noktalarında rakipler müşteri tarafında hangi değeri (kullanımdaki değer) yaratmak için birlikte üretme/tasarlama faaliyetlerini sürdürüyorlar?

Kullanımdaki Değer

18. Otomasyon sektörü tedarik zincirinde özel bir ürün geliştirilmesi, üretilmesi ve teslim edilmesi noktalarında aktörler müşteri tarafında hangi değeri (kullanımdaki değer) yaratmak için ortak değer yaratma faaliyetlerini sürdürüyorlar?
19. Müşterilerin değer algılarını şekillendiren beklentileri nelerdir?
20. Müşterilerin değer algısını oluşturan ve etkileyen faktörler sizce nelerdir?
21. Müşterilerin değer algılarının şekillenmesinde otomasyon ürünü satın aldıkları firmaların rolü bulunmakta mıdır? Bulunuyorsa örnek vererek açıklayabilir misiniz?