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# VALUE PERCEPTION CHANGE DURING GLOBAL COMPONENT SCARCITY IN INDUSTRIAL AUTOMATION SECTOR



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## PERCEPTION OF VALUE DURING SCARCITY IN INDUSTRIAL AUTOMATION SECTOR

The purpose of the present Master's thesis is to study how value is perceived before and during component scarcity. The goal was to explore how the perception of certain value properties changes when demand exceeds supply. The study was carried out via a quantitative survey with 225 participants. In the survey, the participants gave a score from one to five for the claimed value property before and during scarcity.

The data were analysed with statistical tools to find out if there were statistically significant changes in the perception of value. Out of 19 properties, ten seem to have changed statistically significantly. Three of the properties had changed, but to a limited extent. Six of the properties showed no statistically significant change.

The results show that the perception of value of certain properties is significantly affected by the scarcity. These properties are related to availability and price whereas the perception of value of intangible services did not change. The matters related to the relationship between the seller and the buyer companies changed into both more valued and less valued directions. Personal relationships were valued slightly higher, but long relationship, especially loyalty was valued less during the time of scarcity.

According to the study findings, value perception is multidimensional, time-dependent, and personal. The results also imply that scarcity enhances value and makes the price matter less.

### KEYWORDS:

Value perception, Value proposal, Value during Scarcity, Industrial automation

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## ARVON HAVAITSEMISEN MUUTOS NIUKKUUDEN AIKANA TEOLLISUUSAUTOMAATIOSEKTORILLA

Tämän opinnäytetyön tarkoituksena oli tutkia, miten arvokäsitys muuttui, kun verrattiin aikaa ennen komponenttipulaa ja komponenttipulan aikana.

Tavoitteena oli selvittää, millainen on havaitun arvon muutos, kun kysyntä ylittää tarjonnan. Tutkimus toteutettiin kyselyllä, johon vastasi 225 osallistujaa. Kyselyssä vastaajat antoivat väitetylle arvolle arvosanan yhden ja viiden väliltä. Kyselyssä väitettyä arvoa arvoitettiin ennen komponenttipulaa ja sen aikana.

Kyselystä saatu data tutkittiin tilastotyökaluilla, jotta saatiin selville, onko arvonäkemyksessä tapahtunut tilastollisesti merkittävää muutosta. 19:ssä väitetystä arvosta kymmenessä muutosta oli tapahtunut tilastollisesti merkittävästi komponenttipulan aikana. Kolmessa arvosta muutosta oli tapahtunut, mutta rajallisesti. Kuudessa arvossa tilastollisesti merkittävää muutosta ei tapahtunut.

Tuloksista voidaan nähdä, että tiettyjen ominaisuuksien arvon havainnointiin komponenttipula vaikuttaa huomattavasti. Nämä ominaisuudet liittyivät saatavuuteen ja hintaan. Muutosta ei juurikaan tapahtunut aineettomien palvelujen arvonäkemyksessä. Myyntiyhtiön ja asiakasyhtiön välisissä suhteissa arvonäkemyksessä muuttui molempiin suuntiin. Henkilökohtaiset suhteet arvoitettiin hieman korkeammalle, kun taas pitkän asiakassuhteen, erityisesti lojaaliuden, merkitys laski.

Tulokset antavat ymmärtää, että arvonäkemyksessä on monisäikeinen, aikariippuvainen ja henkilökohtainen. Tuloksista voi myös päätellä, että kun kysyntä ylittää tarjonnan, hinnan merkitys pienenee ja tiettyjen, tutkimuksessa esitettyjen, ominaisuuksien arvostaminen kasvaa.

### ASIASANAT:

Arvon havainnointi, Arvoehdotus, Arvo niukkuuden aikana, Teollisuusautomaatio

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# 1 INTRODUCTION

## 1.1 Background of the study and the commissioner

The COVID-19 outbreak started in December 2019 in Wuhan, China. This led to severe health and safety concerns for the population (Ciotti et al., 2020). The pandemic led to lockdowns of cities and workplaces, and it has been criticized as to whether the countermeasures were too harsh in the beginning (Allen, 2022). The consequence of such lockdowns was a scarcity of many raw materials. The electronics industry has taken a big hit due to scarcity, which by some big electronic company executives say will continue to 2023 (Voas & Kshetri, 2021).

According to commodity theory, scarcity increases value (Brock, 1968, as cited in Lynn, 1991, p. 1). This thesis investigates how scarcity effect increased value in the industrial automation sector from 2020 to 2022.

Following the COVID-19 pandemic, prices increased by 10% to 40%. This is due not only to scarcity, but also to an increase in transportation costs. There is scarcity in every sector of the electronics industry. Scarcity is expected to last at least until 2023 (Jorgensen, 2021). According to the interview in the article, it seems that availability has the biggest value for customers today (Pucci, as cited in Jorgensen, 2021).

Today, manufacturers are investing in advanced services and solutions to create superior customer value (Raja et al., 2020), and Omron Electronics Oy (later, Omron) is not an exception to this. Omron started to put even more effort into value-based selling in around 2018 and this led to the use of value propositions. As Omron has over 200 000 sellable products with added services, there are a very high number of different approaches for value to be proposed. To be able to succeed in value-based selling, it is inevitable to identify value, quantify value, and communicate value to the customer. But most importantly, value needs to be verified by the customer (Töytäri and Rajala, 2015).

Omron's (commissioner company of this thesis) field of business and customer base makes value creation complex as combining the product and service library with different customer industries creates different value for different industry types. It is very different to creating value for the electronics manufacturing industry than, for example, the building automation industry. In electronics manufacturing, accuracy and timing are

usually crucial when it comes to the movement of motors, but in a building, it does not matter if the lights will not go on or off in a microsecond.

During times of scarcity, it is difficult to generate new business through value propositions, whether to new or existing customers. The impact on the supply chain has been enormous. The quantity of non-delivered goods has been increasing month by month. To take on new business would mean risking even more than the deliveries to the current customer base. There are many players in industrial automation in the Finnish markets, and scarcity is seen somewhat differently in the manufacturer's deliveries. As one manufacturer can have product A in their stock while the others do not. With product B, the situation can be the opposite. Markets are constantly changing, and customers are changing their suppliers. As a prediction, judging by the markets, availability should have increased its value in the eyes of customers (J. Saastamoinen, Area Sales Manager at Omron, personal communication, Jan. 5, 2022).

The purpose of this study was to understand what has happened to the value perception in the industrial automation markets during component scarcity. The target was to clarify the properties that have increased in value during scarcity. This study uses a quantitative questionnaire with a set of potentially valuable properties that Omron can offer its customers to clarify the change in value perception.

For research purposes, the proposed value properties have been set to 19 properties to limit the topic to be more manageable. One open question has been left to have a wider view of a potential value that has been missed in the questionnaire. This question was set to have a better perspective for possible later studies on the topic.

## 1.2 Research questions

This thesis answers a question: "How has the perception of value changed in the selected properties due to scarcity?". To support customers to reach their goals it is mandatory to understand the change to offer value.

As a sub-question, the study concludes with an answer to the question "What was seen as a value before scarcity?". This is crucial to understand as sales are preparing to bounce back after scarcity is over.



As a second sub-question which this thesis answer is " What was seen as a value during scarcity?". The answer to this question will help to react to the current situation with resources at hand.

### 1.3 Methods for conducting the study

The method of conducting this research was a quantitative questionnaire that was sent to 1550 emails of people working in the industrial automation sector, and eventually there were 225 responses. The questionnaire was personal and anonymous. It was executed by the Webropol service. Participants were invited to answer via an email invitation.

Result data was organized with Microsoft Excel (ver. 16.0.13801.21072) and then analysed with IBM SPSS software (ver. 28.0.1.0 (142)). Microsoft Excel was used to create tables and graphs to clarify the results.

Result analysis with IBM SPSS included normality tests (Kolmogorov-Smirnov Test), frequency tests, and a Wilcoxon signed pair test for comparing before and during scarcity data.

## 2 PERCEPTION AND FORMATION OF CUSTOMER VALUE

### 2.1 Customer value

Managers and scholars have been paying increasing attention to understanding and communicating customer value since the 1990's when value proposition became a watchword (Eggert et al., 2018). Searching for the words "customer value" in Google scholar shows the topic's fast-growing popularity that took off in the mid-1990's (Eggert et al., 2018).

Customer value has many different types of definitions and concepts. Value concepts have had various forms over the years. Woodruff (1997) presents two factors that are embedded in customer value. The first one is a feature of the product or service that a customer need. Second are the consequences of the use of the product or service and the fact that whether the product or service helps the customer achieve their goals. In Woodruff's model (1997), the basis for the value is the goal of the customer. This goal defines what features are mandatory to have in the product or service to have the wanted consequences and eventually reach the goal (Woodruff, 1997). Eggert et al. (2019) still share this view after twenty years by arguing that value is a customer's perceived preference from use and for achieving goals (Eggert et al., 2019).

#### **Perception of value**

In the business-to-customer sector, earlier and a complex approach to value was introduced by Seth et al. (1991), who argued that value is not formed only around a customer goal but consists of five different parts. These parts are functional value, conditional value, social value, emotional value, and epistemic value. Functional value refers to a functionality, utilitarian, or physical performance. This value on the consumer side is presumed to be the primary driver for the selection of a product or service. Social value is about what the customer will acquire through the selection of a product or service in their stakeholder group. Social value is measured by image. Emotional value is about how the customer perceives the value and is measured by feelings. Epistemic value is a perceived benefit to customer from the ability to arouse curiosity. A conditional value is

a perceived utility for the decision maker that is acquired by an alternative as the result of a set of circumstances or as the result of a specific situation (Seth et al., 1991).

Sweeney et al. (2001) developed a multiple item scale for measuring perceived value called PERVAL. The foundation for such a scale was provided by the earlier mentioned Seth et al. (1991). Sweeney et al. (2001) argued that value is perceived in four distinct dimensions. These dimensions were the emotional dimension, the social dimension, the quality and performance dimension, and the value for money dimension. Compared to Seth et al. (1991) research, Sweeney et al. (2001) left out the conditional dimension and epistemic dimension since these were not found to be as important as the other dimensions. Sweeney et al. (2001) saw that value as a whole is more about how the different dimensions of value are highlighted together in different circumstances. As seen in Table 1, the description of the value dimensions differs a little from Seth et al. (1991) research.

Table 1 Value dimension descriptions. (Sweeney et al. 2001, p. 9)

Value type	Value definition
Emotional value.	The utility derived from the feelings or affective states that a product generates.
Social value (enhancement of social self-concept).	The utility derived from the product's ability to enhance social self-concept.
Functional value (price/value for money).	The utility derived from the product due to the reduction of its perceived short term and longer-term costs.
Functional value (performance/ quality).	The utility derived from the product's ability to enhance social self-concept.

Although leaving out conditional and epistemic value dimensions, Sweeney et al. (2001) refer to Zeithaml (1988) that in some certain product groups and customers there are deviations. These deviations are not mainly relevant to the study that this thesis concentrates on. Deviations are more in business-to-consumer related matters. Zeithaml (1988) also created four groups for value, but with a narrower approach. According to

their research, the price is the most important factor for one customer, while the function of the product is the most important factor for the other. The third perceived value dimension is about the combination of price and quality of the product or service. The fourth value dimension combines the expectations of received benefit in relation to all the sacrifices made for it. These can be, for example, money, time, and effort (Zeithaml, 1988).

Sánchez-Fernández and Iniesta-Bonillo (2007) had a different approach to value. They divided customer value definitions into two groups: one-dimensional and multidimensional. For one-dimensional value definitions, the common factor is that the value is seen as one clear concept. As a simplified example, this kind of one-dimensional value could be the relationship between price and quality of the product or service. Multidimensional value by them is a remarkably complex concept. As the name states, it consists of several different dimensions that all need to be considered when forming the idea of what constitutes value to a certain customer (Sánchez-Fernández and Iniesta-Bonillo, 2007).

### **Value creation frameworks**

Later research was done by Lindic et al. (2011) in which they conducted research and argued that all individual novelties generate, add, or diminish value through at least one of the five perspectives (PERFA). As a result, the PERFA framework was introduced, and it is a combination of multiple studies done about value (Lindic et al., 2011).

PERFA stands for Performance, Ease of Use, Reliability, Flexibility, and Affectivity. Performance refers to how an organization functions with the goal of providing the best possible service to its customers while remaining profitable (Barnes et al., 2009). Ease of use is defined as the degree to which users believe the usage of a system or product will be effort-free (Lindic et al., 2011). Reliability is the ability of a product or a system to function as specified (Van Raaij and Pruyn, 1998). The definition of flexibility is the selling company's ability to reconfigure and reallocate its organizational capabilities like resources, strategies, and processes as a response to changes in the environment (Sanchez and Perez, 2005). Affectivity is defined as the feelings and emotions that arise from using the products and services of the selling company (Lindic et al., 2011). The PERFA framework offers managers, the decision makers, guidance on what aspects to improve or innovate to generate more value for their customers (Lindic et al., 2011).

## **Value creation**

Frameworks done by researchers or consultants concentrate on customer value, but their concentration is more on how the value is offered to a customer. From the customer's perspective, value is often seen as benefits deducted with costs. Proposing value, includes capability and impact as well as costs. Both of these should benefit the customer. As by Lindic et al. (2011), capability refers to what a company can do for a customer, and this is how value is created. When proposing a value, the main issue is the value itself. Too often, the seller makes a mistake with the value offered to the customer. As "it is customers who decide whether or not to purchase a certain product; therefore, innovations must be based on what customers truly value" (Lindic et al., 2011, p. 11).

The value proposition and the relevance of value should be co-created together with the seller and the buyer. The seller may propose a value, but it must be recognized by the customer. Therefore, mutuality is the cornerstone of value co-creation (Baumann et al., 2017). Lindic et al., (2011) agree on this and note that a value proposition describes how a company's offer differs from those of its competitors and explains why customers should buy from the company. They continue by saying that customers do not buy a product's characteristics; rather, they buy the benefits that a product provides. Lastly, Lindic et al. (2011) emphasize that buyers are the ones that ultimately decide on the purchase, and therefore, it is crucial for sellers to shift to their viewpoint. So, for a company to gain an advantageous foothold in the market it serves, it must first fully understand the customer's needs. Töytäri and Rajala (2015) agree with this by claiming that superior value creation is central to a company's ability to succeed in a competitive market. Mishra et al. (2019) make a similar point by arguing that the selling company must make it clear how the customer gains benefits, cost savings, and earns profits with the offered value.

## **Value is co-created**

Anderson et al. (2006) claimed that in the business-to-business sector, customers have a pressure to keep costs down. This behaviour may lead to a situation where a customer only looks at the price of the product or service and will not listen to the seller's sales pitch. A sales representative needs to help the customer understand and believe in the

superior value of one's offerings (Anderson et al., 2006). Mishra et al. (2019) support this view by claiming that customers in business-to-business markets are usually more rational than end users and driven by profit and usually efficiency goals, so they tend to focus more on the price and performance of the products that they buy (Mishra et al., 2019). There is, however, a study done by Mencarelli and Riviere (2015) where they point out that this may not be the case and raise the question about who the beneficiary of the value creation is in the end (Mencarelli and Riviere, 2015).

Research shows that in business-to-business, customers have options and, therefore, companies are forced to differentiate their offerings from the next best alternative. This involves a deep dive into the customer value research to be able to recognize what the target customer truly accepts as value (Anderson et al., 2006; Barnes et al., 2009; Lindic et al., 2011). Anderson et al. (2006) state after their research that after a careful examination of what is a value for the customer, the value proposition should be designed around three principles: being distinctive, measurable, and sustainable. A value proposition is about the customer's experience in terms of their needs and wants, not about a company's features or offerings (Barnes et al., 2009; Lindic et al., 2011).

Baumann et al. (2017) conducted in-depth interviews with 31 people, including customers and salespeople, from a total of six professional service organizations. Through their interview, they divided value dimensions into episodic and relational. In their study, there were both business-to-business and business-to-consumer companies. As a result, they found out that even though the co-creation process is initiated by both parties articulating a value proposition, there are some surprising disparities in the value dimensions offered by the salesperson compared to buyers' expectations (Baumann et al., 2017). Mishra et al. (2019) conducted similar kind of research, and in their research, there were over 30 in-depth interviews done with both buyers and sellers. The conclusion was the same; the value proposed by the seller did not always accord with what the buyer was giving value for. Findings like this, in the difference between how the value is seen by both parties, indicate a notable misalignment between the value proposition and actual co-creative behaviour (Mishra et al., 2019). This kind of discrepancy can lead to customer dissatisfaction and, in the end, potentially to even service failure (Baumann et al. 2017). According to Baumann et al. (2017), marketing scholarships in and around 2015 emphasized that an organization cannot unilaterally deliver services or products that have value embedded. An organization can only provide resources that potentially have value for the customer, in

other words, value propositions. Throughout and after the service or sales process, provided value propositions are converted into actual value (Baumann et al. 2017).

Going in to selling value and choosing the value to propose involves careful assessment of the customer's needs and decision and determination of how well the seller organization can satisfy those needs. Satisfying needs must be clearly differentiated by benefits relative to price when value is compared to competitor offerings (Payne et al. 2020). The focus of the value proposition should always be to describe the business from the customer's point of view. It should never be a description of a series of internally oriented functions. According to Payne et al. (2020), a value proposition consists of three steps. First is choosing the value, where the seller needs to understand the desired value, select the target, and define benefits and price. In the second step, value is provided through product process design, production and manufacturing, and distribution and service. The third step is communicating the value with price, sales message, possible advertising and promotion, and public relations (Payne et al. 2020).

### **Value proposition**

Payne et al. (2017) conducted research, and they claim that the concept of customer value proposition developed more than a hundred years ago. Payne et al. mention multiple selling methods that are strongly related to value-based selling. According to Baumann et al. (2017) research, there is very little published research on the topic even though the concept of the value proposition has been interpreted from different perspectives and the term value proposition is widely used in theory and practice. Mishra et al. (2019) make the same note that the term "customer value proposition" is being widely used in the literature, but especially in the business-to-business markets, the effects of incorporating customer value proposition into corporate strategy are largely unexplored and undocumented.

According to Baumann et al. (2017), the first value proposition statement was introduced by Lanning and Michael (1988), and it was regarded as a statement of benefits offered and delivered to customers along with the price, they were willing to pay (Lanning and Michael, 1988, as cited in Baumann et al., 2017). Payne et al. (2020) agree with this research and note that the term "Value Proposition" was developed in 1983 by Michael Lanning and it was first used in an internally circulated McKinsey staff paper in 1988 (Lanning, 1983, as cited in Payne et al., 2020).

Despite the claims of value proposition being an old invention, Payne et al. (2020) say that even as one of the most important organizing principles, value proposition is still poorly understood and executed in business-to-business companies. The statement continues with the argument that scholarly research provides only limited guidance on how to develop and implement value propositions in business-to-business markets (Payne et al., 2020). Mishra et al., 2019 come to a similar conclusion as their research shows that marketing offerings in business-to-business markets are undoubtedly more challenging than in consumer-segment markets (Mishra et al., 2019).

Mishra et al. (2019) conducted a case study in the United States for U.S.-based companies selling products or services in the business-to-business market. The study was conducted as a text analysis by searching for customer value proposition associated words from business-to-business firms' annual reports in the period of 2004 – 2017. Through their study, they found out that companies that emphasize customer value propositions tend to invest more in their brands. In such cases, it was shown that these companies also improved their sales performance after adopting the value propositions. Another noticeable finding was that adopting a customer value proposition led to a smaller number of customers in the customer base. According to them, this is because customer value proposition tends to attract more long-term loyal customers, the ones who care about customer value proposition. The third finding was that firms that run customer value propositions as part of their strategy are likely to spend less on promotional expenditure such as advertising (Mishra et al., 2019).

Despite the importance of the value concept in understanding purchasing and marketing decisions in business markets, a lack of clarity surrounding the conceptualization of value in business-to-business markets persists (Eggert et al., 2019). Marketing scholars and practitioners both agree that value is a central concept of the discipline in selling in the business-to-business market (Eggert et al., 2019). Communicating the value proposition involves the key marketing activities needed to inform customers that the value offered by the organization exceeds that of competitors. (Payne et al. 2020).

As mentioned, Anderson et al. (2006) claimed that there is no agreement on what constitutes a customer value proposition. In comparison to Anderson et al. (2006), many other studies argue that most of the value propositions make claims of savings and benefits, but these claims are not backed up (Anderson et al., 2016; Barnes et al., 2009; Lindic et al., 2011). If the supplier fails to demonstrate the claimed benefits, the proposition will usually be kept more as a marketing puffery (Anderson et al., 2006).



After a two-year study in the U.S. and Europe, Anderson et al. (2006) wrote an article where they classified three types of ways suppliers use the term "Value Propositions." These three ways were named "all benefits", "favourable points of difference" and "resonating focus" (Anderson et al., 2006, p. 4).

The all-benefits value proposition simply lists all of the benefits without performing any calculations. This listing is done by the seller and has rarely nothing to do with the actual value to the customer. The favourable points of difference value proposition is created by the seller and has rarely nothing to do with the actual value for the customer. The Resonating Focus value proposition acknowledges that the managers who make the purchasing decisions have major and increasing levels of responsibility and are pressed for time.

Anderson et al. (2006) recommends using only resonating focus as a basis for the value proposition and the other two should be discarded. Value proposition methods are shown with better detail in Table 2 (Anderson et al., 2006).

Table 2 Three types of Value propositions (Anderson et al., 2006, p.4).

<b>Value proposition</b>	<b>All benefits</b>	<b>Favourable points of difference</b>	<b>Resonating focus</b>
<b>Consists of:</b>	All benefits customers receive from market offering.	All favourable points of difference a market offering has relative to the next best alternative.	The one or two points of difference (and, perhaps, a point of parity) whose improvements will deliver the greatest value to the customer for foreseeable future.
<b>Answers the question:</b>	“Why should our company buy your offering?”	“Why should our firm purchase your offering instead of your competitor’s?”	“What is most worthwhile for our firm to keep in mind about your offering?”
<b>Requires:</b>	Knowledge of own market offering.	Knowledge of own market offering and next best alternative.	Knowledge of how own market offering delivers superior value to customers, compared with the next best alternative.
<b>Has the potential pitfall:</b>	Benefit assertion.	Value presumption.	Requires customer value research.

Later, Barnes et al. (2009) share the view with Anderson et al. (2006) that the value proposition needs to be constructed around customer wants and needs. As mentioned earlier, Lindic et al. (2011) had the same view on the value proposition, describing the differences from other companies and explaining why customers gain more value from buying from the company in question. They also noted that the customer makes the purchasing decision, not the seller. Examining these viewpoints together with value

propositions by Anderson et al. (2006), we can see that the research by Lindic et al. (2011), after nine years of Anderson et al., came to the same conclusion about "resonating focus" being the best option for the basis of a value proposition.

### **Evolvement of value proposition**

Newer studies are stepping forward from the resonating focus. Current research is more around the definition of value. Value is seen as the basis of business-to-business marketing (Eggert et al., 2018). Also notable is that the value literature seems to have evolved from a focus on resource exchange and value in exchange to an emphasis on resource integration and value in use (Eggert et al., 2018).

In a case study by Snelgrove & Anderson (2016), rather than selling products, the studied company, SKF, a leading global technology provider, shifted its focus to proposing superior value in use. This is a good example of change happening in value propositions (Eggert et al., 2018).

### **2.2 Customer perceived value and scarcity impact**

Ueda et al. (2009) state that the value of an artifact is not purely determined by its functionality. Recognizing this in the 21st century has become ever more important as the globalization of markets has increased and information due to networking and available information has exploded. Some products have become more commoditized; in other words, they have become ordinary products with massive numbers of similar products offering the same functionality (Ueda et al., 2009). As a result, many manufacturers are shifting towards offering value through product and service combinations (Ueda et al., 2009; Huttu and Martinsuo, 2015). In their study, Huttu and Martinsuo (2015) recognized multiple service-based benefits that add to how value is perceived. As an example, in industry-based businesses, value-adding can be based on installation service or, for example, easiness of installation. In other words, adding service alongside a product is seen as adding value to the customer (Huttu and Martinsuo, 2015).

Running a Google search with the popular phrase "people buy from people" gave approximately 8 490 million search results. The phrase is widely used on the internet

with the additions of "who they trust", "who they like", and "who they know". This type of view is supported by Raval and Grönroos (1996) and Sheth and Sharma (1997), who argue that value may also be relationship related.

Scientists, however, have developed parallel approaches for perceived value for business-to-business and business-to-consumer. This has engendered theoretical confusion about the topic of perceived value (Mencarelli & Riviere, 2015). In their research, Mencarelli & Riviere (2015) gathered a vast amount of information from previous studies and frameworks to analyse. First, they clarified and compared theoretical approaches about the nature of perceived value in business-to-business and business-to-customer to identify the main points of convergence and divergence. Their second objective was to propose a research agenda on how to improve the way researchers analyse perceived value between business-to-business and business-to-customer (Mencarelli & Riviere, 2015).

In their study, Mencarelli & Riviere (2015) cite multiple studies and frameworks on customer perceived value in business-to-customer and business-to-business markets. From the findings, they created a table to compare the differentiating factors of perceived value in these two market areas. As a result, they pointed out that in both markets, the value is multidimensional. From the result, it is worth indicating that, generally, in business-to-customer, the work of conceptualization is implemented on value connected with the development of various measurement models. In business-to-business, the aim is to move away from a commercially focused selling method and toward relational visions having forms of value co-creation (Mencarelli & Riviere, 2015).

### **Scarcity impact**

Scarcity is the situation where demand exceeds supply. The scarcity principle has been expressed in many ways, but they all have a common meaning. By Chen (2020, para. 1), "The scarcity principle is an economic theory in which a limited supply of a good—coupled with a high demand for that good—results in a mismatch between the desired supply and demand equilibrium". Scarcity has proven to be a driver of value but also of behavioural change. Lockdowns led to people working from home, and there was an enormous peak in electronics purchases during the pandemic (Voas & Kshetri 2021).

Marketers sometimes create artificial scarcity in order to generate higher demand for it (Chen, 2020). But after the COVID-19 pandemic, an artificial scarcity was not the case. As an example, the COVID-19 pandemic led to lockdowns, and the outcome of lockdowns led to scarcity. This resulted in a 5 million laptop shortage in the United States alone (Voas & Kshetri, 2021).

According to Cialdini (1985, as cited in Lynn, 1991, p. 1), scarcity effects on value by enhancing it, and scarcity enhancing value is supported by commodity theory (Brock, 1968, as cited in Lynn, 1991, p. 1). Commodity theory (Brock, 1968, as cited in Lynn, 1991, p. 2) is very much like the scarcity principle (Chen, 2020). Commodity theory has three criteria for a subject to be a commodity. A commodity must be useful, transferable from owner to owner, and it must have the potential to be possessed (Lynn, 1991). In their study (Lynn, 1991), they showed that the commodity theory is highly reliable.

According to Sanchez-Fernández and Iniesta-Bonillo (2007), perceived value is situational and context-dependent. The COVID-19 pandemic has changed the world and numerous CEO's and managers from various electronics manufacturers are reporting component and source material scarcity (Stoten, 2021). According to the interview by Stoten (2021), the scarcity will last a long time, and new orders placed within a year may be impossible to deliver. According to Langley (1999), value perception is also time dependent. During scarcity, companies have started to put more effort into their supply chains and information sharing for the customers about the deliveries (Stoten, 2021). In addition to information sharing, as prices will increase, the value created from service is a must to maintain the customers (Stoten, 2021).

### **Value categories**

In their study, Lapierre (2000) conducted research about customer value and concurred with other research about the definition of customer value in terms of get and give (benefit and sacrifice) components. In their research, they interviewed 16 individuals, 8 buyers and 8 suppliers. The interviewees were asked to talk about customer value and the differences between the perceptions of value between supplier and customer. Results showed that in the industrial sector, the two dimensions of value are benefit and sacrifice, with thirteen value-based drivers. Lapierre (2000) categorized value properties to three main categories, service-related, relationship-related, and product-related but also to combinations of these (Lapierre, 2000).

### 2.3 Summary of the theory for this study

This study concentrated on the valuation of certain pre-selected properties. The selected properties were seen as possible value to the customer by Omron.

This thesis studies whether certain value has changed from time to time (before and during scarcity) as Langley (1999) suggested.

This study also concentrates whether information sharing will be valued by customers as it should be by Stoten (2021). From the PERFA (Lindic et al., 2011) and PERVAL (Sweeney et al., 2001) framework point of view, there will be no conclusive research made in this thesis since this part of the data was left for further studies. The reader can, however, make observations if value really is multi-dimensional, as Sánchez-Fernández and Iniesta-Bonillo (2007) suggested, supported by Sweeney et al. (2001), Zeithaml (1988), and Seth et al. (1991).

In this study it will be discussed how scarcity affects the perceived value of certain properties of the product or service (Brock, 1968, as cited in Lynn, 1991; Chen, 2020). In the thesis, conclusions will be made of whether some of the claimed values combined could create more value to the customer as suggested in theory (Ueda et al., 2009; Huttu and Martinsuo, 2015). The combination of services and products was not the target of this research, and it needs to have a study of its own.

This study uses three value categories introduced by Lapierre (2000) for arranging the results to easily readable format. The main categories are service-related, relationship-related, and product-related. There are also combinations of properties like product and service-related properties.

### 3 METHODOLOGY

#### 3.1 Data collection and the target group

Data from the industrial automation products' users was collected to research the impacts of component scarcity on value in the field of industrial automation. The questionnaire was anonymous, and it was conducted with the Webropol tool. The quantitative questionnaire method was selected as the research method as Farrelly (2021) claims that a quantitative approach gives the capability of researching the studied phenomenon without being influenced by itself. This makes the study more objective (Farrelly, P. 2012). For the quantitative questionnaire, the Likert (1932) scale was selected. Likert (1932) uses a psychometric scale to capture personal feelings. The total number of questions in the questionnaire was 25, including respondent background questions. Five step scale was used. One being lowest or no value and five being most of value to the customer. The questionnaire was reviewed by two sales representatives from Omron and the thesis supervisor, and it was seen as clear enough to avoid misunderstanding in questions and value claims.

The sample group for the study respondents was taken from the Omron Customer Relationship Management database. Initially, there were over 3000 names on the list of possible participants. The list was reduced by cutting out some contacts by geographic location. The list was kept as open as possible to include participants throughout the field of multiple industries and working positions to get a better overall quality of answer with a wider spectrum. Eventually, the questionnaire was sent to 1550 recipients, all working in companies somehow related to Omron and therefore also related to the industrial automation sector.

The list of subjects consisted of 471 contacts that had been contacted by an Omron representative during the last 12 months. 1079 of the recipients were not contacted during the last 12 months. 1255 of the questionnaire recipients were working for a company that had made a purchase from Omron during the last 12 months. 295 were working for companies that had no direct purchases. This type of customer is usually working for an end-user or similar where the purchase channel is through a machine builder, system integrator, or distributor. As the questionnaire was anonymous, it was

not possible to see who had answered, and nor did the sample size match with the original ratio of buying and non-buying customers.

From the sent 1550 invitations, there were 362 bounce-back emails received, leaving a total of 1188 email invitations presumably gone through to the recipient. The questionnaire was opened on March 18th, 2022 and closed on April 4th, 2022. It was open for 18 days. During the 18-day period, there were 225 answers collected to the questionnaire. The response rate was 18.9%. All the questions were mandatory, so there were no missed answers.

For future research, there were some additional questions for each participant. These questions were related to job properties. These properties include job position (C-level, R&D, assembly, purchasing), customer type (machine builder, system integrator, or engineering office), possible company ownership, decision-making status, and the number of decision makers in the company. The possible effects of these differentiators are not studied in this thesis, but the sample is presented for the reader to make conclusions about what the dominant properties of the respondents have been.

From the answerers, 169 were business owners, which represents 75.1% of the participants. 210 people, or 93.3%, were taking part in the decision-making. Most companies had two (35.6%) or three (31.1%) decision makers, and 26 (11.6%) answered that the decision was made by their customer. There is a small discrepancy seen in the results of decision making. Customer types are presented in Table 3 Customer types that answered to questionnaire. The answerers job positions are presented in Table 4.

Table 3 Customer types that answered to questionnaire.

Customer type	N = 225	% of respondents
Machine builder (OEM)	119	53%
System Integrator	59	26%
End user type	33	15%
Engineering office	11	5%
Others	3	1%



Table 4 Job position type of the answerers

Job position	N = 225	% of respondents
R&D type position	94	42%
Procurement or purchasing	68	30%
C-level managing position	38	17%
Maintenance department	10	4%
Others	8	4%
Installation department	7	3%

The main questionnaire had 20 properties that were presented as a possible value for customers, and respondents needed to give a score for the property before and during scarcity. In addition to the 19 possible value properties, there was one open question for value property to be filled and scored by the respondent. This property has been left out of the result review as the answers varied a lot and included multiple properties under one score. Therefore, the results for this question were inconclusive.

The questionnaire was divided into four sections, each with properties that could create value for the customer's experience. This division was made to possibly combine and have a larger number of properties as one value-adding set to study. The division was set only for statistical purposes, and it was not shared with respondents. The service-related section had five properties. Relationship-related had four properties and feature-related had eight properties. The fourth category was product and service related, and it had two properties. Finally, this thesis leaves one open question for the possibility of a customer to fill in a property that was not mentioned in the questionnaire. The model for partitioning quotations into different categories comes from Lapierre (2000). The claimed value properties are listed in the questionnaire in Appendix 1.

### 3.2 Data analysis

Data was analysed using IBM SPSS (ver. 28.0.1.0 (142)) computer software. The data was first arranged to be analysed with Microsoft Excel. Graphs and tables later in this study were produced with Microsoft Excel and IBM SPSS.

IBM SPSS was used to measure whether the data was normally distributed or not. For this measurement, the Kolmogorov-Smirnov Test was run. The same software was used to calculate other descriptive statistics for variables like median, mode, standard deviation, and skewness for before and after scarcity data. Also, the frequencies were measured with IBM SPSS.

The Wilcoxon signed rank test was used to analyse how the change has been in value perception before scarcity versus during scarcity.

## 4 RESULTS

### 4.1 Before scarcity

Initial tests for the data were done to check whether the results in both cases before and during scarcity would be normally distributed. The Kolmogorov-Smirnov test of normality was used in this study to test normality, as the sample size of 225 was high enough to run this test. All of the asked properties gave  $p < .001$  in the normality test. Therefore, we could reject the null hypothesis of the data for the properties' being normally distributed. This result was the same for every property in the questionnaire.

The skewness value represents how the peak is positioned in the data curve. In an ideal normally distributed system, the peak is in the centre and the value of skewness would be zero or close to zero. A negative value for skewness means that the curve is leaning right and there are more data points on the right. For positive values, this is vice versa (Foster et al., 2005). Data was considered skewed if it was not between  $-.5$  to  $.5$ .

The Kurtosis value represents the height of the tails of the curve, meaning whether the presented data curve is flat or peaked. A positive value for kurtosis means that the curve is peaking. A negative value means that the curve is flattening (Foster et al., 2005.). Kurtosis had a standard error of  $.32$ . Data was considered peaking if the value was over  $.5$  and flat if the value was below  $-.5$ .

In the data, valuations of 1 and 2 did not bring any value to the customer. A valuation of 3 was seen as at least wanted value, but not necessity, and therefore not a blockage for buying. 4 and 5 were seen as having higher value. Valuation of 4 was used for property that was wanted and possible block for a deal. Valuation of 5 was seen as mandatory property, also a valuation of 5 could result in being a blockage for the deal if it was missing. Results also present mean value ( $M$ ), standard deviation ( $SD$ ), statistical significance in difference ( $p$ ) and how effective the change has been ( $r$ ).

Before scarcity, the two most valued properties were reliable delivery confirmation and technical specification / performance. Other highly valued properties were, price, fast delivery, and known and reliable brand. Results are presented later in this chapter with their key figures. The results are divided to smaller groups for readability of the results.

In Figure 1 there are service-related properties. Stocking by the seller ( $M = 2.96$  and  $SD = 1.01$ ) was valued very high with valuation of 4 or 5 (69) or as wanted with valuation of 3 (76) by over half of the subjects. The deviation was symmetrical (Skewness: .13) and flat (Kurtosis:  $-.61$ ).

Stocking by the customer, invoicing by usage was the least valued property ( $M = 2.29$  and  $SD = 1.05$ ). Only 6 (valuation 5) respondents saw this as a high value and 27 (valuation 4) as a value. This was a somewhat wanted and possibly valued property for 50 (valuation 3). Deviation was skewed (Skewness: .56) but otherwise normally distributed (Kurtosis:  $-.35$ ).

Local technical support ( $M = 3.28$  and  $SD = 1.05$ ) was valued by nearly half of the respondents, with 98 respondents giving it a rating of 4 or 5. The deviation for the property was symmetrical (Skewness:  $-.20$ ) and peaking (Kurtosis:  $-.52$ ).

From the figure, it can easily be seen that fast delivery ( $M = 3.79$  and  $SD = .8$ ) was the most valued property in this group. More than half of the respondents rated this as 4 or 5, and no one rated it as 1. The data for the property was symmetrical (Skewness:  $-.19$ ) and normally distributed (Kurtosis:  $-.44$ ).

Second most valued property in this group was possibility to buy many products from the same vendor ( $M = 3.6$  and  $SD = .88$ ). This property also was valued high by over half of the respondents (valuation 4 or 5). Deviation for the property was symmetrical (Skewness:  $-.30$ ) and normally distributed (Kurtosis:  $-.38$ ).

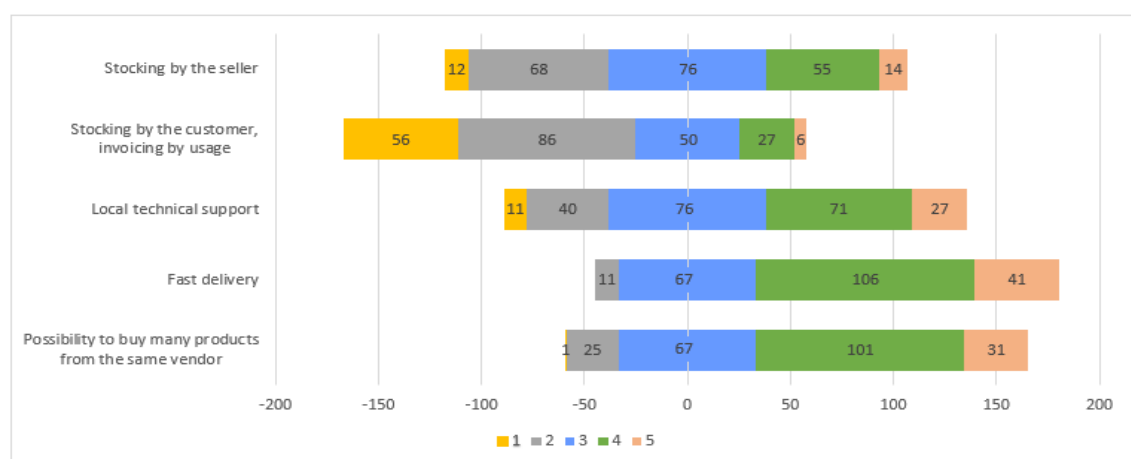


Figure 1 Results for service-related category before scarcity (N = 225)

Results for relationship-related properties are shown in Figure 2. All of the category's properties are seen more as having value than not. Reliable delivery confirmation ( $M = 4.23$  and  $SD = .76$ ) was the most valued property in this category. The data was skewed (Skewness:  $-.60$ ) which can also be seen from the answers where a total of 186 respondents gave this a score of 4 or 5. The data was normally deviated (Kurtosis:  $-.45$ ).

The known and reliable brand ( $M = 3.72$  and  $SD = .94$ ) was the second most valued property in this group. Total of 147, more than half of the respondents gave this value score of 4 or 5. As a result, the data was skewed (Skewness =  $-.60$ ) but normally distributed (Kurtosis:  $.09$ ).

For reliable and personal salesperson ( $M = 3.39$  and  $SD = .98$ ) was fairly high valued with total of 107 respondents giving the valuation of 4 or 5. The data for the property was symmetrical (Skewness:  $-.21$ ) and peaking (Kurtosis:  $-.52$ ).

Long relationship ( $M = 3.27$  and  $SD = .96$ ) was at least wanted property by 176 respondents (valuations 3, 4, and 5). The data for this property was symmetrical (Skewness:  $-.07$ ) and peaking (Kurtosis:  $-.53$ )

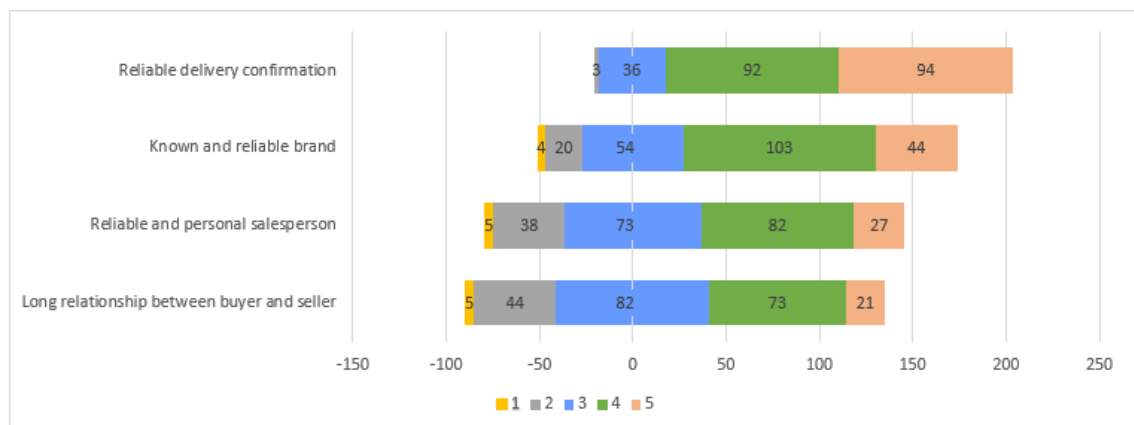


Figure 2 Results for relationship-related category before scarcity (N = 225)

Other service-related properties value claims are shown in Figure 3. In this category, webshop (electronics ordering system) ( $M = 2.55$  and  $SD = 1.08$ ) was the least valued property. The data for this property was symmetrical (Skewness:  $-.22$ ) and peaking (Kurtosis:  $-.75$ ).

Clear webpages and easy access to information were quite highly valued ( $M = 3.54$  and  $SD = .98$ ). 127 respondents gave this a valuation of 4 or 5. The data was symmetrical (Skewness:  $-.40$ ) and normally distributed (Kurtosis:  $-.09$ ).

Personal customer care and telephone assistance ( $M = 3.19$  and  $SD = 1.02$ ) property was seen as wanted value (valuation of 3, 4, or 5) by 170 respondents before scarcity. Data for this property was symmetrical (Skewness:  $-.10$ ) and normally distributed (Kurtosis:  $-.59$ ).

The most valued property in the first sample set of other service properties related category was easy deployment ( $M = 3.62$  and  $SD = .86$ ). Over half put this property as highly valued (4 or 5) and almost a third (67) of the answerers saw this as a possible value. Data for this property was symmetrical (Skewness:  $-.23$ ) and normally distributed (Kurtosis:  $-.16$ ).

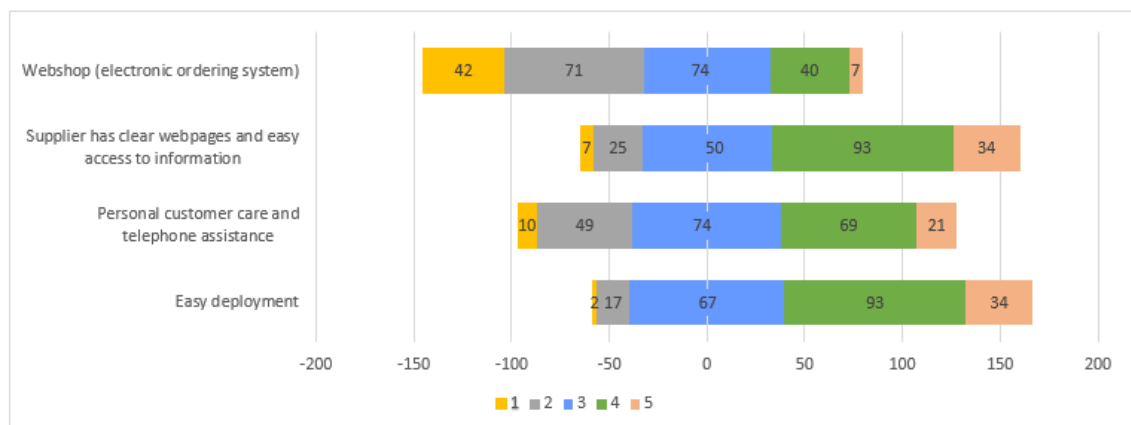


Figure 3 Results for other service-related properties category before scarcity (1st set,  $N = 225$ )

Figure 4 presents the second set of other service-related properties value category. Technical specification / performance ( $M = 4.18$  and  $SD = .8$ ) was seen as the most valuable property in the category. Only 5 answerers saw no value for this property. Data was skewed (Skewness:  $-.90$ ) and peaking (Kurtosis:  $1.10$ ).

Product selection done by the client ( $M = 3.03$  and  $SD = 1.16$ ) divided the respondent's group almost in half. According to 67 respondents this property creates no value (valuation of 1 or 2) and for 81 persons (valuation of 4 or 5) this can be seen as value. Data for this property was symmetrical (Skewness:  $-.22$ ) and peaking (Kurtosis:  $-.73$ ).

Global availability ( $M = 3.39$  and  $SD = .1$ ) was valued high by 114 (valuation of 4 or 5). Data for the property was symmetrical (Skewness:  $-.38$ ) and normally distributed (Kurtosis:  $-.35$ ).

The least valued property in this category was customization by customer ( $M = 2.93$  and  $SD = 1.15$ ). 61 (valuation 4) and 17 (valuation 5) saw this as a valued property. Data for this normally distributed (Skewness:  $.08$ ) but peaking (Kurtosis:  $.85$ ).

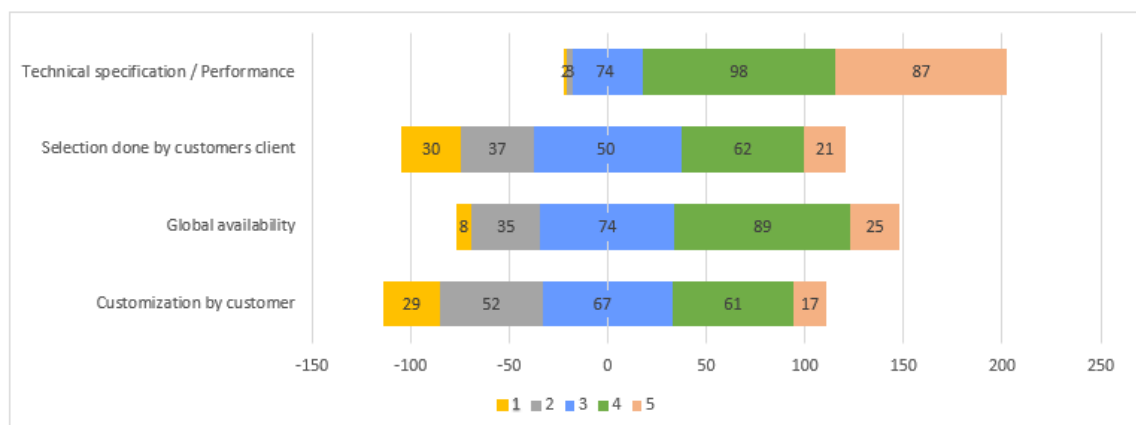


Figure 4 Results for other service-related properties category before scarcity (2nd set,  $N = 225$ )

From products and service-related category in Figure 5, price ( $M = 3.85$  and  $SD = .75$ ) had a great value for customers in general. Data for the property was symmetrical (Skewness:  $-.44$ ) and normally distributed (Kurtosis:  $-.12$ )

A third of the respondents (valuation of 3, 4, or 5) desired free delivery ( $M = 2.74$  and  $SD = 1.09$ ) but nearly half (95) gave this property no value (value of 1 or 2). Data for the property was symmetrical (Skewness:  $-.26$ ) and normally distributed (Kurtosis:  $-.43$ ).

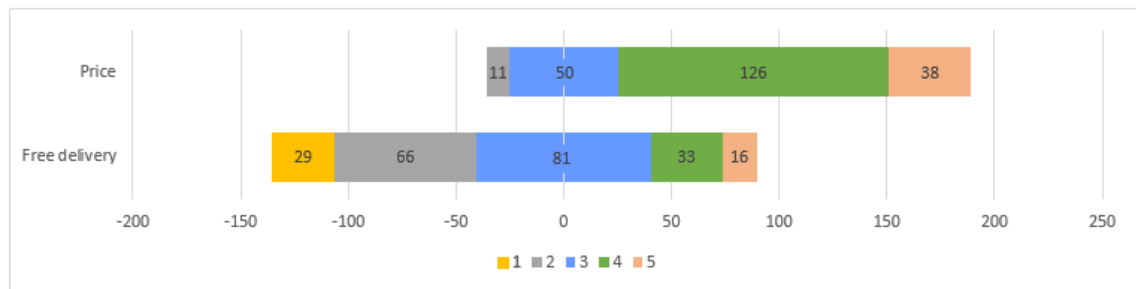


Figure 5 Results for product and service-related category before scarcity (N = 225)

#### 4.2 During scarcity

All of the asked properties gave  $p < .001$  in the normality test. Therefore, we could reject the null hypothesis of the data for the properties' being normally distributed. This result was the same for every property in the questionnaire. This result was the same for every property in the questionnaire.

Skewness and kurtosis standard error are the same in both chapters, before and during scarcity results.

During scarcity, the two first of the most valued properties were fast delivery and reliable delivery confirmation. Other highly valued properties were technical specification / performance, stocking by the seller or consignment stock in customers premises, easy access to information. Results are presented later in this chapter with their key figures.



Most of the service-related properties had value during scarcity. This is shown in Figure 6. Stocking by the seller ( $M = 3.82$  and  $SD = 1.01$ ) was valued very high (148 with valuation of 4 or 5) or as wanted (55 with valuation of 3). Deviation was skewed (Skewness: .66) and normally distributed (Kurtosis:  $-.01$ ).

Stocking by the customer, invoicing by usage was the least valued property ( $M = 2.98$  and  $SD = 1.35$ ). A total of 34 (valuation 5) respondents saw this as a high value and 56 (valuation 4) as a value. For 49 (valuation 3) this was somewhat wanted property and possibly value. Deviation was symmetrical (Skewness: .06) and data distribution was flattened (Kurtosis:  $-1.2$ ).

Local technical support ( $M = 3.37$  and  $SD = 1.04$ ) was a somewhat valued property as a total of 112 respondents saw this as value (valuation 4 or 5). Deviation for the property was symmetrical (Skewness:  $-.33$ ) but data distribution was flattened (Kurtosis:  $-.52$ ).

From Figure 6, it can be seen that fast delivery ( $M = 4.18$  and  $SD = .9$ ) was the most valued property in this group. 175 respondents saw this as a definite value (a valuation of 4 or 5) and 40 (valuation 3) saw this as possible value. None of the respondents valued this with grade 1. Deviation for the property was skewed (Skewness:  $-.76$ ) and normally distributed (Kurtosis:  $-.37$ ).

The possibility to buy many products from the same vendor ( $M = 3.44$  and  $SD = 1$ ) was highly valued by 110 respondents (valuation of 4 or 5). 72 respondents gave this valuation of 3, and for them this can bring value but is not blocking the deal. The distribution of the data was symmetrical (Skewness:  $-.14$ ) and flat (Kurtosis:  $-.7$ ).

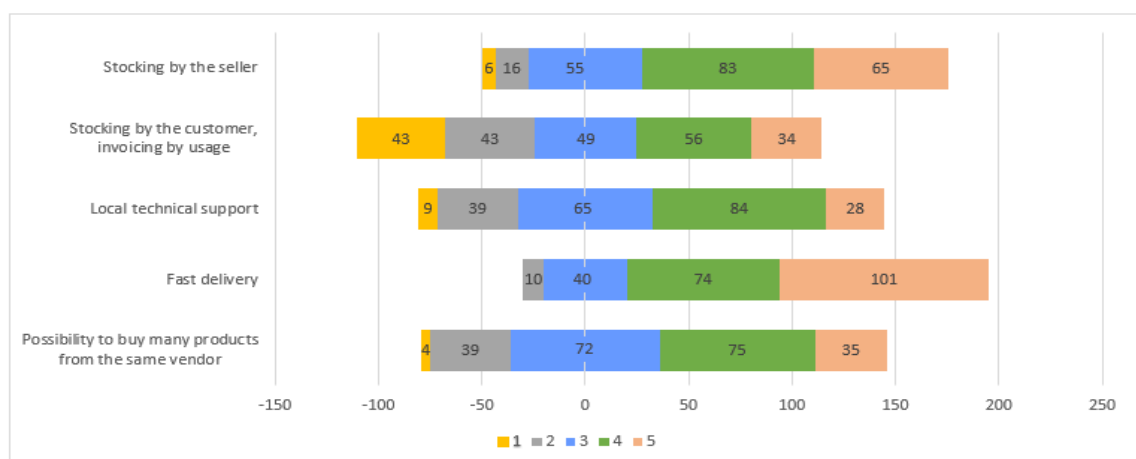


Figure 6 Results for service-related category during scarcity (N = 225)

The results for the relationship are shown in Figure 7. Reliable delivery confirmation ( $M = 4.52$  and  $SD = .73$ ) was the most valued property in this category. The data was skewed (Skewness:  $-1.46$ ) which can also be seen from the answers, where a total of 202 respondents gave this a score of 4 or 5. The data was peaking (Kurtosis: 1.52).

The known and reliable brand ( $M = 3.42$  and  $SD = 1.02$ ) was the second most valued property in the group. Of the total of 114, about half of the respondents, gave this value score of 4 or 5. As a result, the data was skewed (Skewness =  $-.60$ ) and normally distributed (Kurtosis: .45).

Reliable and personal salesperson ( $M = 3.4$  and  $SD = 1.07$ ) was fairly highly valued, with 103 respondents rating it as 4 or 5. The data for the property was symmetrical (Skewness:  $-.14$ ) but peaking (Kurtosis:  $-.65$ ).

Long relationships ( $M = 2.88$  and  $SD = 1$ ) property was valued highly by only 58 (valuations 4 and 5) respondents. Notable here is that a total of 81 (valuation of 1 and 2) respondents saw no value for this property during scarcity. The data for this property was symmetrical (Skewness:  $-.12$ ) and normally distributed (Kurtosis:  $-.41$ ).

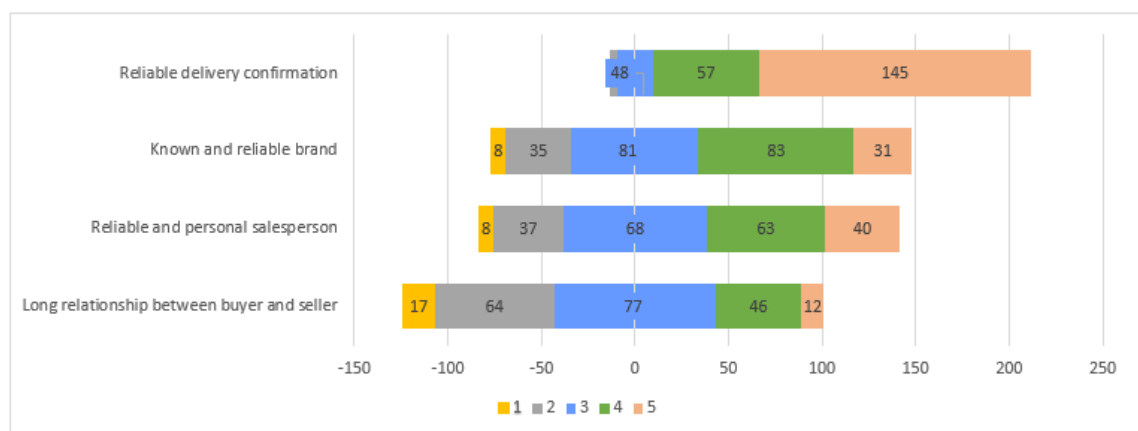


Figure 7 Results for relationship related category during scarcity (N = 225)

Other service-related property value claims are shown in Figure 8. In this category, webshop (electronics ordering system) ( $M = 2.61$  and  $SD = 1.15$ ) was the least valued property. This property was seen as a value only by 52 (valuation 4 or 5) respondents. The data for this property was symmetrical (Skewness:  $-.31$ ) and peaking (Kurtosis:  $-.72$ ).

The most valued property in this group was clear webpages and easy access to information ( $M = 3.54$  and  $SD = .98$ ). 131 respondents gave this a valuation of 4 or 5. The data was symmetrical (Skewness:  $-.47$ ) and normally distributed (Kurtosis:  $-.33$ ).

Personal customer care and telephone assistance ( $M = 3.32$  and  $SD = 1.13$ ) was at least a wanted value (valuation of 3, 4, or 5) by 165 respondents during scarcity. The data for this property was symmetrical (Skewness:  $-.11$ ) and peaking (Kurtosis:  $-.9$ ).

Easy deployment ( $M = 3.46$  and  $SD = .94$ ) was at least a wanted value (valuation of 3, 4, or 5) for 192 respondents. The data for this property was symmetrical (Skewness:  $-.10$ ) and normally distributed (Kurtosis:  $-.46$ ).

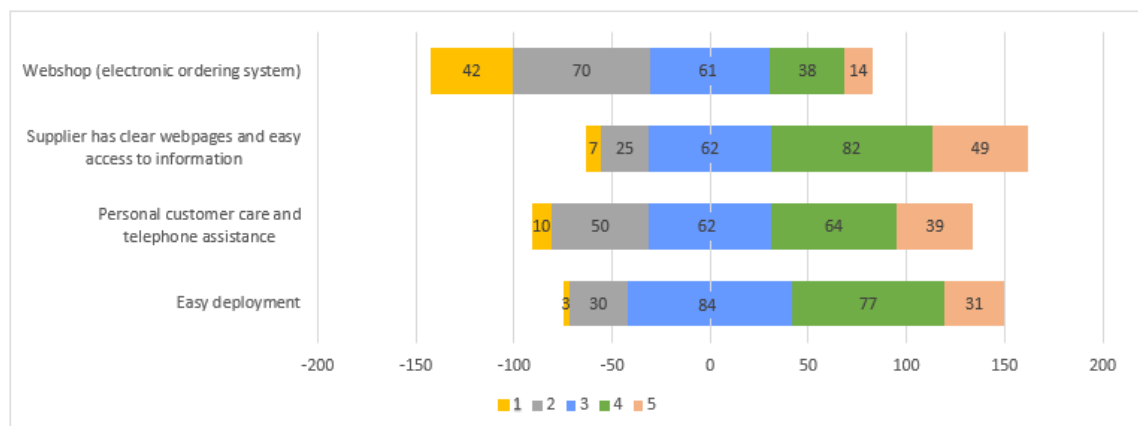


Figure 8 Results for other service-related property category (1st set,  $N = 225$ ) during scarcity

Figure 9 presents the second set of other service-related properties value category. Technical specification / performance ( $M = 3.97$  and  $SD = .86$ ) was seen as the most valuable property in the category. Only 2 answerers saw no value in this property. Data was skewed (Skewness:  $-.66$ ) and normally distributed (Kurtosis:  $.32$ ).

Product selection done by the client ( $M = 2.92$  and  $SD = 1.13$ ) divided the respondent's group almost in half. According to 70 respondents, this property creates value (valuation of 4 or 5) and for 74 persons (valuation of 1 or 2) this property has no value. The data for this property was symmetrical (Skewness:  $-.1$ ) and peaking (Kurtosis:  $-.67$ ).

Global availability ( $M = 3.43$  and  $SD = 1.08$ ) was valued high by 111 (valuation of 4 or 5). The data for the property was symmetrical (Skewness:  $-.23$ ) and peaking (Kurtosis:  $-.67$ ).

The least valued property in this category was customization by customer ( $M = 2.83$  and  $SD = 1.13$ ). Only total of 63 (valuation 4 or 5) saw this as a valued property. The data for this property symmetrical (Skewness:  $.03$ ) but peaking (Kurtosis:  $.72$ ).

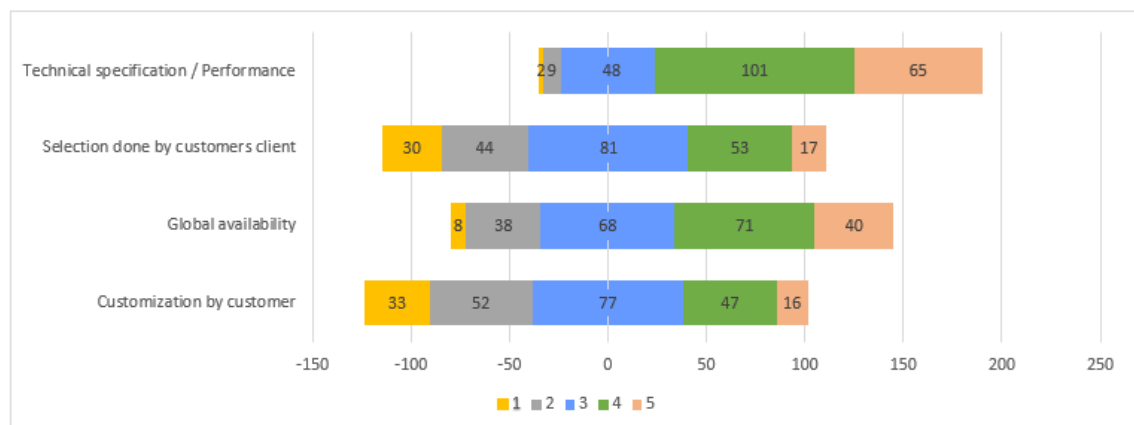


Figure 9 Results for other service-related properties category (2nd set,  $N = 225$ ) during scarcity

Results for products and service-related category results are shown in Figure 10. Price ( $M = 3.32$  and  $SD = .95$ ) had value for customers in general. For 100 respondents, this property was great value (valuation 4 or 5) and for 79 (valuation of 3) this property could be a value. Data for the property was symmetrical (Skewness:  $-.1$ ) and peaking (Kurtosis:  $-.57$ ).

Free delivery ( $M = 2.48$  and  $SD = 1.06$ ) was a wanted property by 105 respondents (valuation of 3, 4, or 5), yet nearly over a half (120) of the respondents gave this property no value (valuation of 1 or 2). Data for the property was symmetrical (Skewness:  $-.43$ ) and normally distributed (Kurtosis:  $-.32$ ).

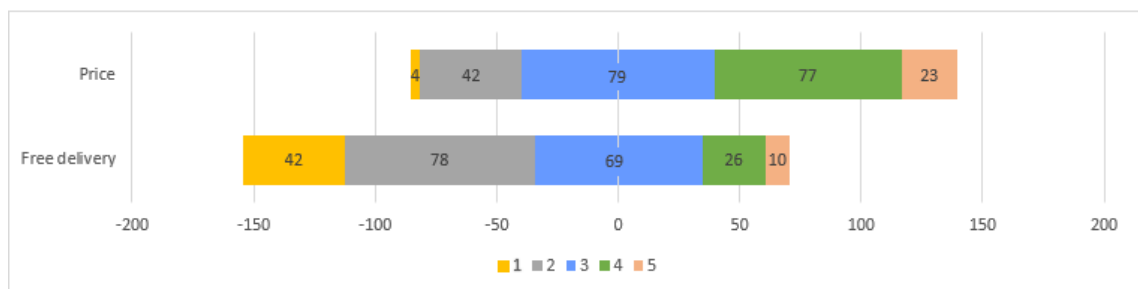


Figure 10 Results for product and service-related category during scarcity (N = 225)

#### 4.3 Value perception change

For statistical comparison, the Wilcoxon Signed rank test was selected. Nonparametric testing was used since the Kolmogorov-Smirnov Test to check normal distribution showed that the initial data was not normally distributed. Also, the Wilcoxon signed rank test was the most suitable to use as the questionnaire results are based on opinions (Taanila, 2020).

With the Wilcoxon signed-rank test, this thesis makes a test hypothesis that if  $p < .001$  the change has been statistically significant. This means that, with 99.9% accuracy, the observed statistical difference is not due to chance but a real one (Corder and Foreman, 2014). Results are shown separately by each property and not as in groups as in paragraphs 4.1 and 4.2 in order to have easily readable results.

The Wilcoxon signed rank test indicates that the valuation of the property, stocking by the seller, has increased during scarcity. For this property, the differences were 139 (62%) answers with increased value for the property and 14 (6%) with less value for the property. 72 (32%) kept their answer as it was before scarcity. The results are shown in Figure 11.

We can see from the results before ( $M = 2,96$  and  $SD = 1.00$ ) and after ( $M = 3.82$  and  $SD = 1.02$ ) scarcity, that there has been an increase to the value of approximately 1 unit on the scale of 1 to 5 in mean value.

Based on the findings ( $Z = 9.3$  and  $p < .001$ ), we can assume that the increase in value is statistically significant, with a large effect size ( $r = .59$ ).

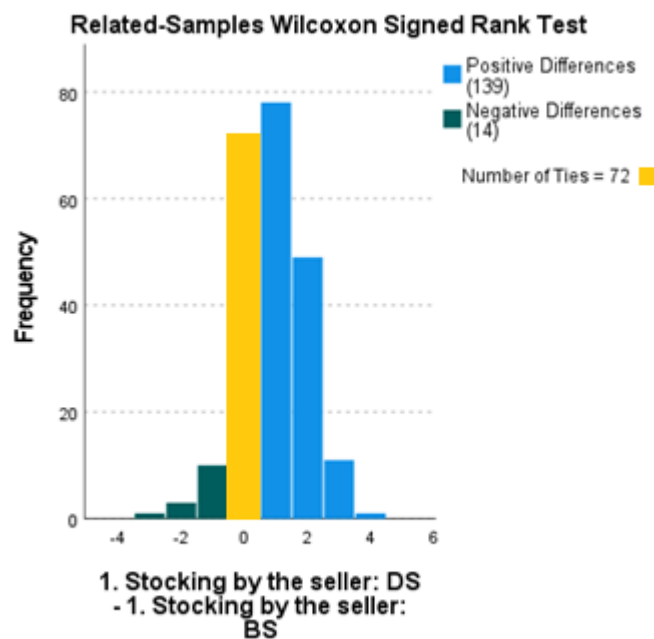


Figure 11 Test results for property: Stocking by the seller (N = 225)

Figure 12 shows the difference in stocking by the customer before and during scarcity-property. This property has more value to customers during scarcity than before it. The Wilcoxon signed rank test indicates that the valuation of the property has increased during scarcity. For this property, the differences were 105 (47%) answers with increased value for the property and 7 (3%) with less value for the property. 113 (50%) kept their answer the same.

We can see from the results before ( $M = 2.29$  and  $SD = 1.05$ ) and after ( $M = 2.98$  and  $SD = 1.35$ ) scarcity, that there has been an increase in the value by .69 units on the scale of 1 to 5 in the mean value.

Based on the findings ( $Z = 8.47$   $p < .001$ ), we can assume that the increase in value is statistically significant with a large effect size ( $r = .54$ ).

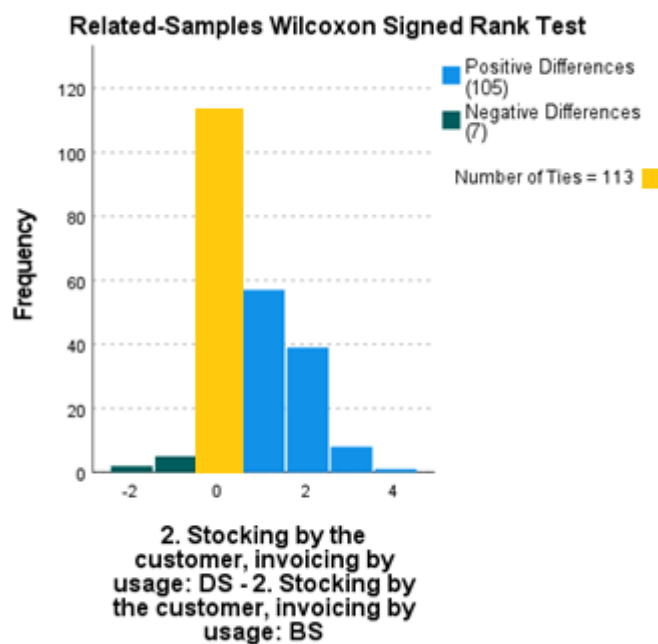


Figure 12 Test results for property: Stocking by the customer, invoicing by usage (N = 225)

For some, local technical support was seen as more valuable during scarcity than before it, but just a little less saw it as less of a value at the same time. This can be seen in Figure 13. For this property, the differences were 23 (10%) answers with increased value for the property and 11 (5%) with less value for the property. 191 (85%) kept their answer as it was before scarcity.

We can see from the results before ( $M = 3.28$  and  $SD = 1.05$ ) and after ( $M = 3.37$  and  $SD = 1.03$ ) scarcity, that there has been a small increase of .09 units in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test indicate that the valuation of the property, Local technical support, was statistically the same before and during scarcity.

Based on the findings ( $Z = 2.48$  and  $p < .013$ ), we can assume that the increase in value is not statistically significant supported by the small effect size ( $r = .16$ ).

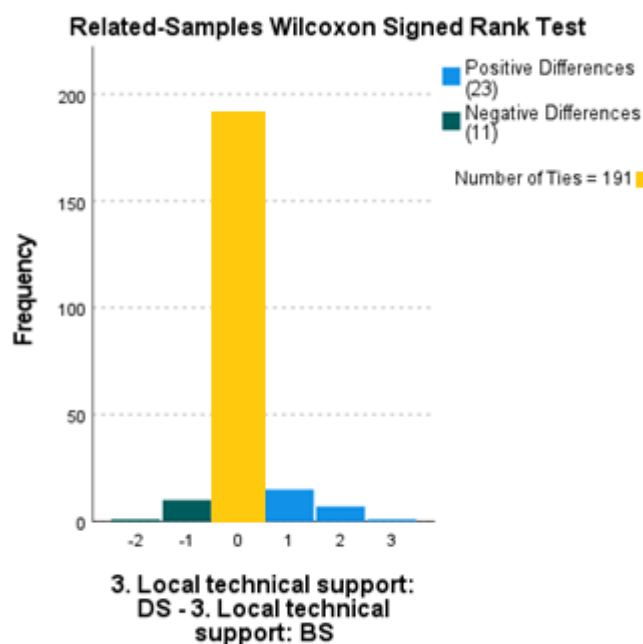


Figure 13 Test results for property: Local technical support (N = 225)



As seen in Figure 14, fast delivery was valued at about the same amount before and during scarcity by 125 (55%) of the answerers. 83 (37%) of the answerers valued this property more during scarcity, and only 17 (8%) valued it less during scarcity.

We can see from the results before ( $M = 3.79$  and  $SD = .8$ ) and after ( $M = 4.18$  and  $SD = .88$ ) scarcity, that there has been an increase to the value by .39 units in mean value, in the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, fast delivery, has increased during scarcity.

Based on the findings ( $Z = 5,67$  and  $p < .001$ ), we can assume that the increase in value is statistically significant with a moderate effect size ( $r = .36$ ).

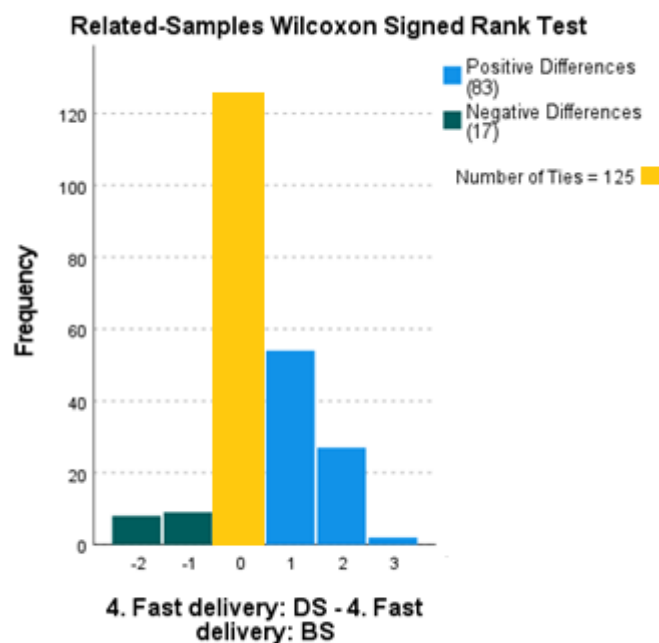


Figure 14 Test results for property: Fast delivery (N = 225)

Figure 15 shows that 153 answerers (68%) valued the possibility to buy many products from the same vendor by the same amount before and during scarcity. Only 23 (10%) valued this property more and 49 (22%) saw this property as less value for them during scarcity.

We can see from the results before ( $M = 3.60$  and  $SD = .88$ ) and after ( $M = 3.44$  and  $SD = 1$ ) scarcity, that there has been a small decrease in the value by  $-.17$  units in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test suggests that the valuation of the property, the possibility to buy many products from the same vendor (large portfolio), has decreased during scarcity.

From the results ( $Z = 3.22$  and  $p > .0012$ ) we can assume that this change of having less value can possibly be statistically significant but not confirmed, with a small effect size ( $r = .20$ ).

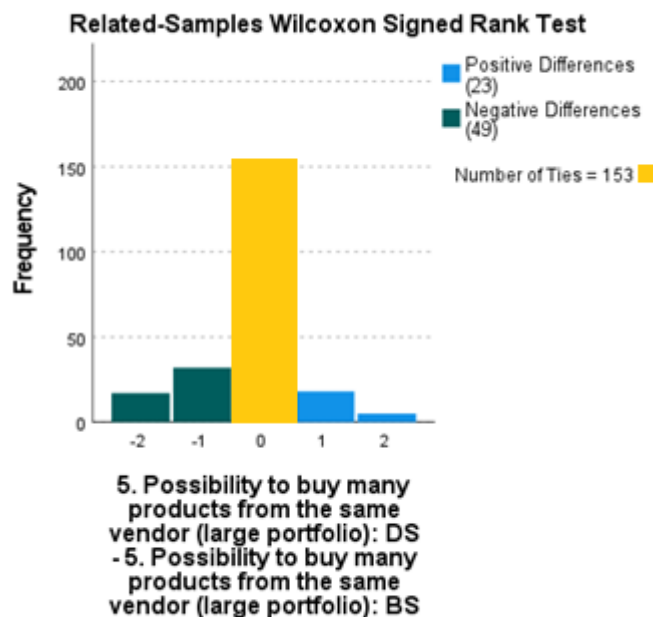


Figure 15 Test results for the property: Possibility to buy many products from the same vendor (N = 225)

For reliable delivery confirmation in Figure 16, the results were 139 (62%) of the answerers giving the same value, 69 (31%) giving more value, and only 17 (7%) giving less value for this property during scarcity versus before scarcity.

We can see from the results before ( $M = 4.23$  and  $SD = .76$ ) and after ( $M = 4.52$  and  $SD = .73$ ) scarcity, that there has been an increase in the valuation by .29 units in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, reliable delivery confirmation, increased during scarcity.

Based on the findings ( $Z = 4.91$  and  $p < .001$ ), we can assume that the increase in value is statistically significant with a moderate effect size ( $r = .31$ ).

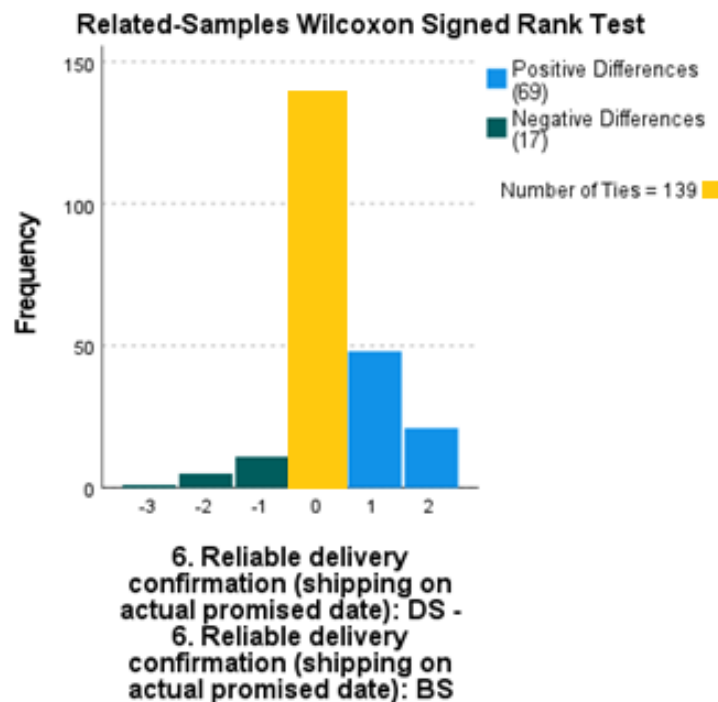


Figure 16 Test results for property: Reliable delivery confirmation (shipping on actual promised date) (N = 225)

Results for known and reliable brand results are shown in Figure 17. 151 (67%) of the answerers gave the same score for this value, but 61 (27%) gave this property a smaller valuation. Only 13 (6%) of the answerers saw this property as more valuable during scarcity than before.

We can see from the results before ( $M = 3.72$  and  $SD = .94$ ) and after ( $M = 3.41$  and  $SD = 1.02$ ) scarcity, that there has been a decrease in the valuation by  $-.31$  unit in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, a known and reliable brand, has decreased during scarcity.

Based on the findings ( $Z = 5.44$  and  $p < .001$ ), we can assume that the increase in value is statistically significant with a moderate effect size ( $r = .34$ ).

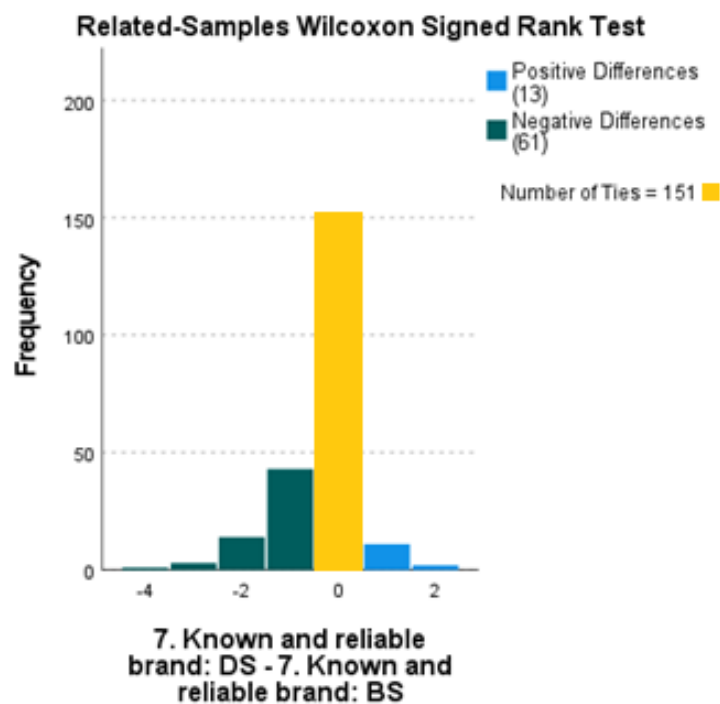


Figure 17 Test results for property: Known and reliable brand (N = 225)

Reliable and personal salesperson results in Figure 18 show how the valuation of this property has changed as a value for customers during scarcity. 158 (70%) of the answerers gave this property the same value before and during scarcity. 40 (18%) saw this as having greater value for them during scarcity and 27 (12%) saw it as having less value for them.

We can see from the results before ( $M = 3.39$  and  $SD = .98$ ) and after ( $M = 3.40$  and  $SD = 1.07$ ) scarcity, that there has only been a small increase of .01 units in valuation on the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, reliable and personal (nominated) salesperson, has stayed the same during scarcity.

From the results ( $Z = .03$  and  $p = .979$ ) we can assume that this change of having more value is not statistically significant with a small effect size ( $r = .002$ ).

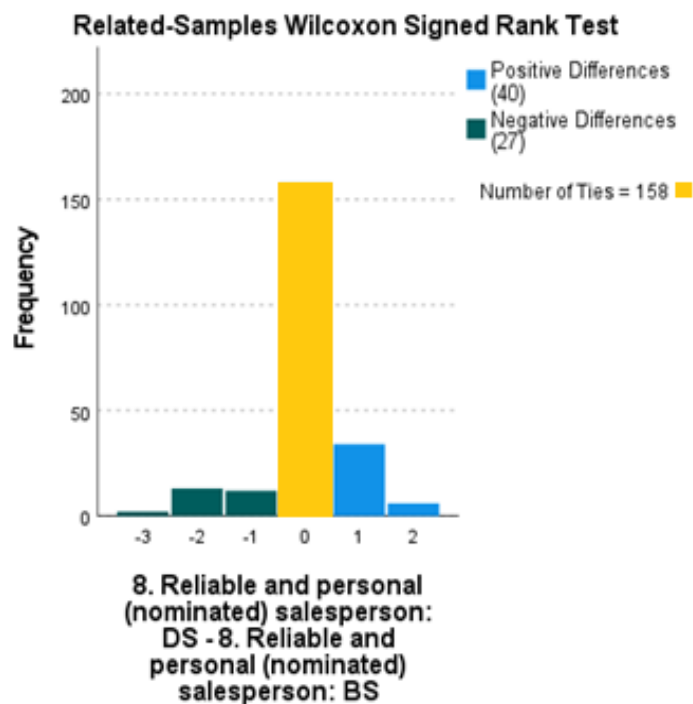


Figure 18 Test results for property: Reliable and personal (nominated) salesperson (N = 225)

For the property of a long relationship between buyer and seller, there was a notable difference before and during scarcity. The results are shown in Figure 19. 139 (62%) of the answerers kept their answers the same before and during scarcity. 70 (31%) of respondents thought this property had less value during scarcity, while only 16 (7%) thought it had more value during scarcity.

We can see from the results before ( $M = 3.27$  and  $SD = .96$ ) and after ( $M = 2.88$  and  $SD = 1$ ) scarcity, that there has been a decrease in the value by  $-.39$  units in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, long relationship between buyer and seller, has decreased in value during scarcity.

Based on the findings ( $Z = 6.15$  and  $p < .001$ ), we can assume that the change in value is statistically significant with a moderate effect size ( $r = .39$ ).

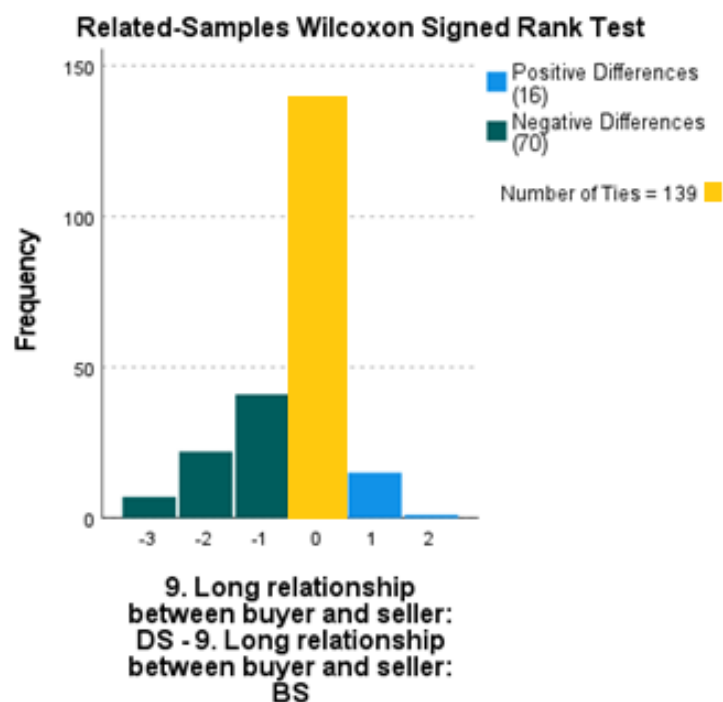


Figure 19 Test results for property: Long relationship between buyer and seller (N = 225)

As seen in the results in Figure 20, 185 (82%) of the respondents gave this property the same score for before and during scarcity. 24 (11%) saw that webshop gave more value and 16 (7%) saw it as having less value during scarcity.

We can see from the results before ( $M = 2.55$  and  $SD = 1.09$ ) and after ( $M = 2.61$  and  $SD = 1.15$ ) scarcity, that there has been an increase in the value by .06 unit in mean value, on the scale of 1 to 5.

The Wilcoxon signed rank test indicates that the valuation of the property, webshop (electronic ordering system), has stayed the same during scarcity.

From the results ( $Z = 1.39$  and  $p = .166$ ) we can assume that this change of having more value is not statistically significant with a small effect size ( $r = .09$ ).

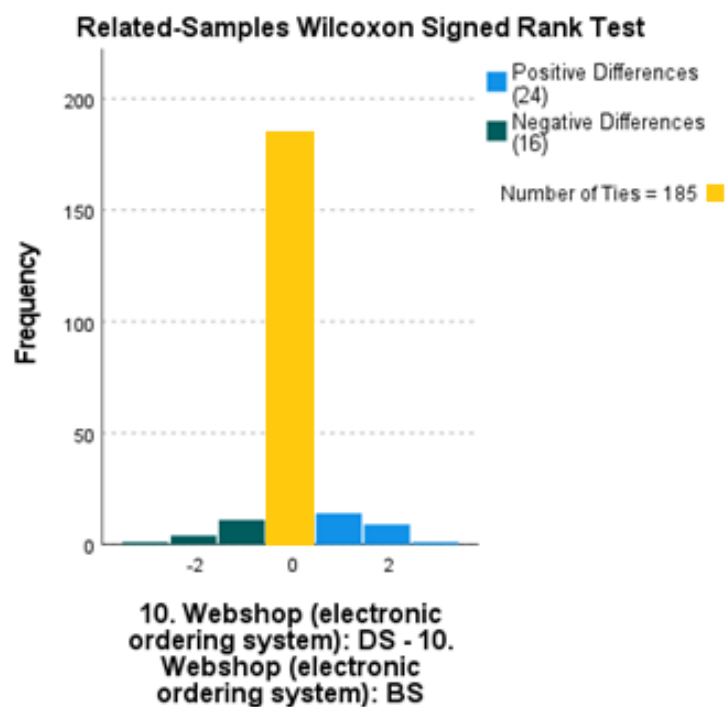


Figure 20 Test results for property: Webshop (electronic ordering system) (N = 225)

For the property of the supplier having clear webpages and easy access to information shown in Figure 21, there was a slight increase in the property's value. For this property, the differences were 33 (15%) answers with increased value for the property and 13 (6%) with less value for the property. 179 (79%) kept their answer as it was before scarcity.

The results of the Wilcoxon signed rank test indicate that the valuation of the property has stayed the same during scarcity.

We can see from the results before ( $M = 3.54$  and  $SD = .98$ ) and after ( $M = 3.63$  and  $SD = 1.04$ ) scarcity, that there has been an increase in the value by .08 units in mean value, on the scale of 1 to 5.

From the results ( $Z = 2.09$  and  $p = .037$ ), we can assume that this change of having more value is not statistically significant with a small effect size ( $r = .13$ ).

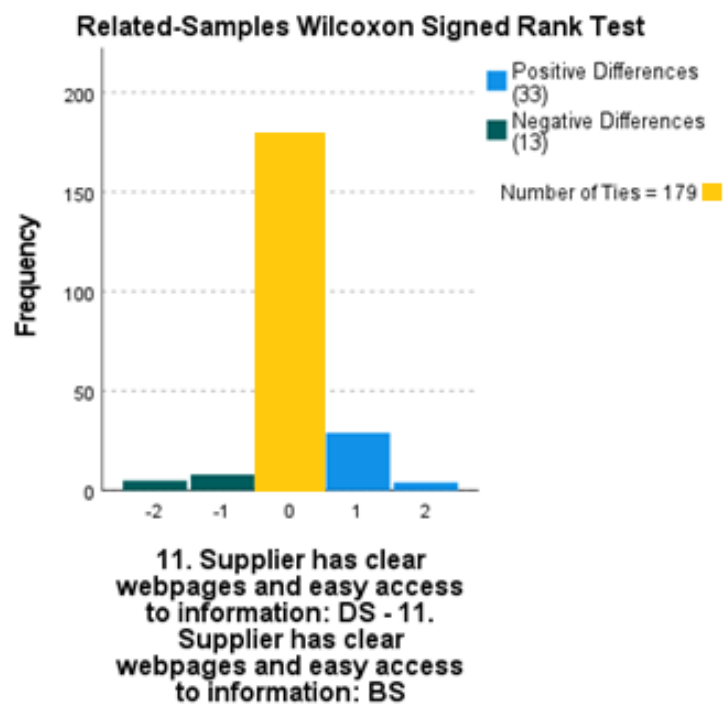


Figure 21 Test results for property: Supplier has clear webpages and easy access to information (N = 225)



Figure 22 shows some increase in value for personal customer care and telephone assistance. For this property, the differences were 46 (20%) answers with increased value for the property and 17 (8%) with less value for the property. 162 (72%) kept their answer as it was before scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, personal customer care and telephone assistance, has stayed the same during scarcity.

We can see from the results before ( $M = 3.19$  and  $SD = 1.02$ ) and after ( $M = 3.32$  and  $SD = 1.13$ ) scarcity, that there has been a small increase in the value by .13 units in the mean value, on the scale of 1 to 5.

From the results ( $Z = 2.82$  and  $p = .005$ ), we can assume that this change of having more value is not statistically significant with a small effect size ( $r = .17$ ).

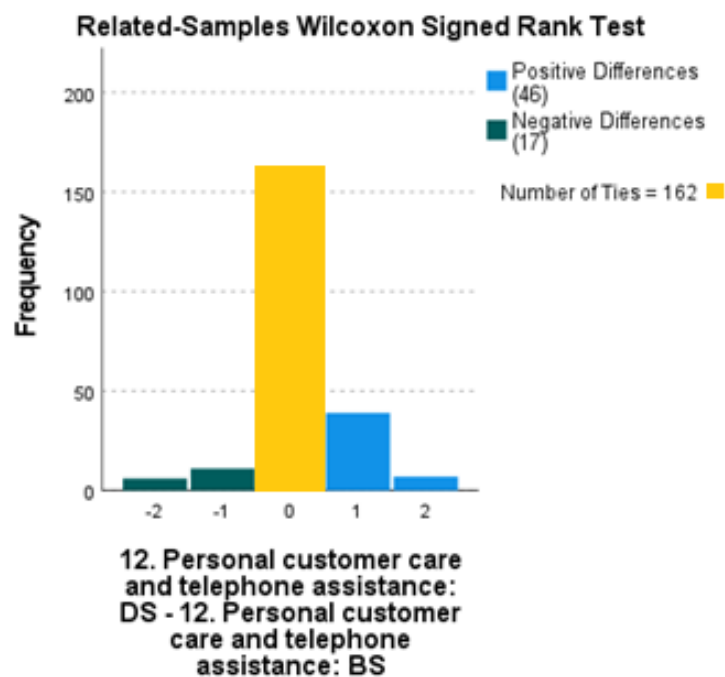


Figure 22 Test results for property: Personal customer care and telephone assistance (N = 225)

As seen in Figure 23, easy deployment was not valued as highly during scarcity as it was before scarcity. For this property, the differences were 7 (3%) answers with increased value for the property and 31 (14%) with less value for the property. 187 (83%) kept their answer as it was before scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, easy deployment, has decreased its value during scarcity.

We can see from the results before ( $M = 3.62$  and  $SD = .86$ ) and after ( $M = 3.46$  and  $SD = .94$ ) scarcity, that there has been a small decrease in the value by  $-.16$  units in mean value, on the scale of 1 to 5.

Based on the findings ( $Z = 4.18$  and  $p < .001$ ), we can assume that the change in value is statistically significant with a small effect size ( $r = .26$ ).

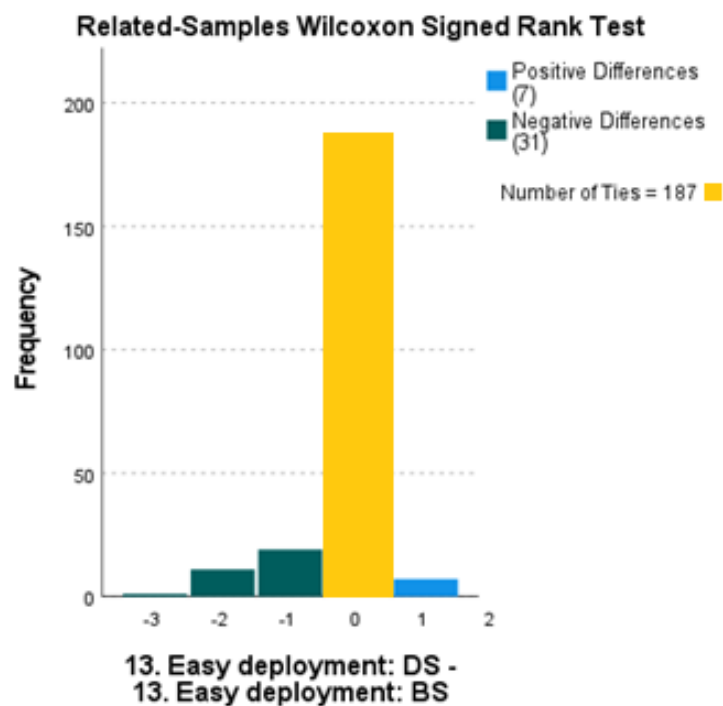


Figure 23 Test results for property: Easy deployment (N = 225)

Negative change for the property technical specification / performance can be seen in Figure 24. For this property, the differences were 2 (1%) answers with increased value for the property and 41 (18%) with less value for the property. 182 (81%) kept their answer as it was before scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, technical specification / performance, has decreased during scarcity.

We can see from the results before ( $M = 4.18$  and  $SD = .80$ ) and after ( $M = 3.97$  and  $SD = .86$ ) scarcity, that there has been a decrease in the value by  $-.21$  units in mean value, on the scale of 1 to 5.

Based on the findings ( $Z = 5.68$  and  $p < .001$ ), we can assume that the change in value is statistically significant with a moderate effect size ( $r = .36$ ).

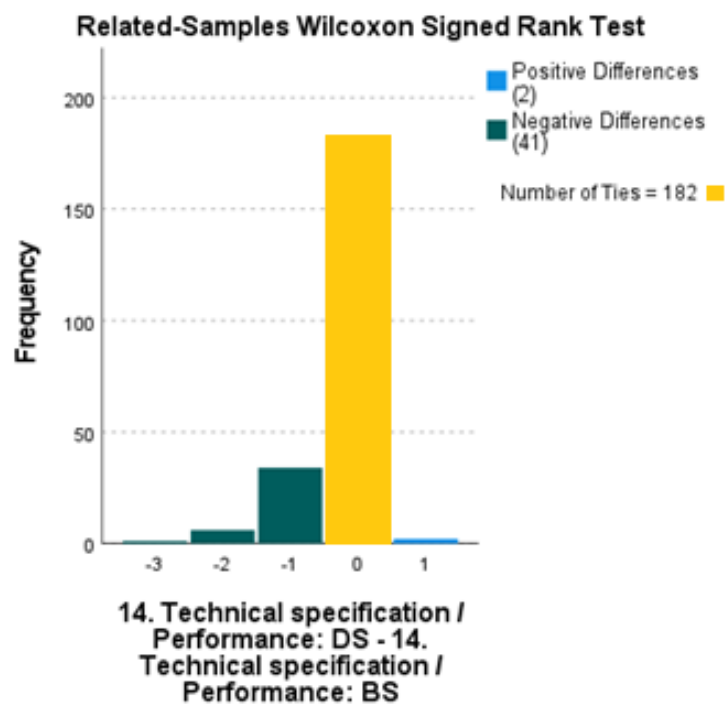


Figure 24 Test results for property: Technical specification / performance (N = 225)

A slight overall negative change for the property for the selection done by the customer can be seen in Figure 25. For this property the differences were 6 (2%) answers with increased value for the property and 24 (11%) with less value for the property. 195 (87%) kept their answer as it was before scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, selection done by the customer's client, has stayed the same during scarcity.

We can see from the results before ( $M = 3.03$  and  $SD = 1.16$ ) and after ( $M = 2.92$  and  $SD = 1.13$ ) scarcity, that there has been the same to the value by  $-0.1$  unit in mean value, on the scale of 1 to 5.

From the results ( $Z = 3.18$  and  $p > .001$ ) we can assume that this change of having less value is not statistically significant with a small effect size ( $r = .2$ ).

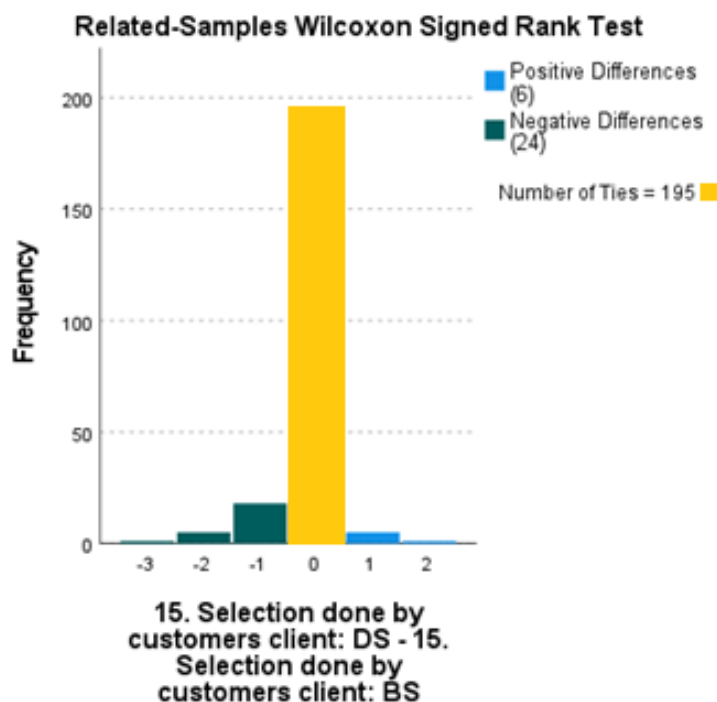


Figure 25 Test results for property: Selection done by customers client (N = 225)

Results for global availability seen in Figure 26 show that over half of the answerers change their perception of value for this property.

146 (65%) did not change their answers about the property before and during scarcity valuation. On the one hand, 45 (20%) valued this property more, but on the other hand, 34 (15%) valued this property less during scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, global availability, has stayed the same during scarcity.

We can see from the results before ( $M = 3.39$  and  $SD = .99$ ) and after ( $M = 3.43$  and  $SD = 1.08$ ) scarcity, that there has been a very small increase in the value by .04 units in mean value, on the scale of 1 to 5.

Based on the results ( $Z = 0.6$  and  $p = .550$ ), we can conclude that the increase in value is not statistically significant with a small effect size ( $r = .04$ ).

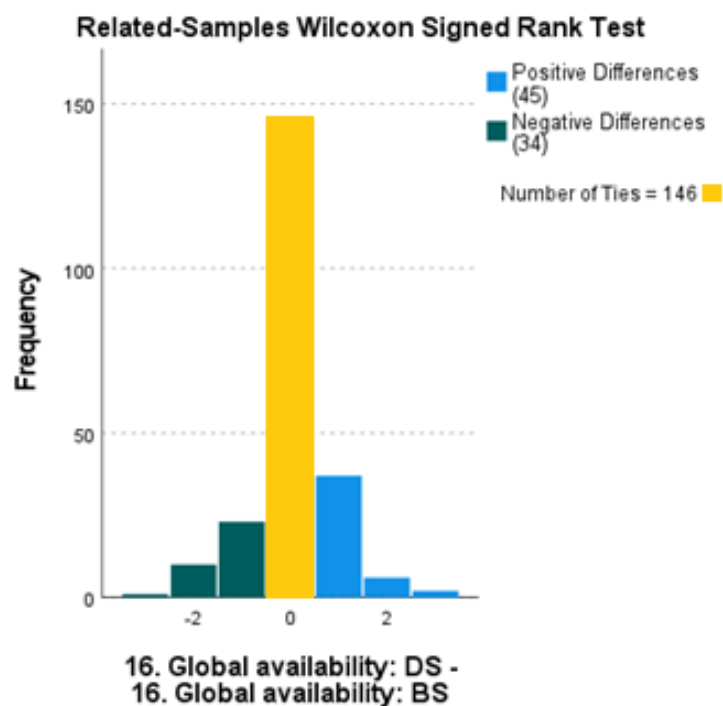


Figure 26 Test results for property: Global availability (N = 225)

Customization by customer was a property that was valued less during scarcity. This can be seen in Figure 17. 29 (13%) gave this property less value and only 9 (4%) gave it more value during scarcity. 187 (83%) of the answerers stated the same value before and during scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, customization by customer, has decreased during scarcity.

We can see from the results before ( $M = 2.93$  and  $SD = 1.15$ ) and after ( $M = 2.83$  and  $SD = 1.13$ ) scarcity, that there has been a decrease in the value by  $-.10$  units in mean value, on the scale of 1 to 5.

Based on the findings ( $Z = 3.4$  and  $p < .001$ ), we can assume that the change in property value is statistically significant with a small effect size ( $r = .21$ ).

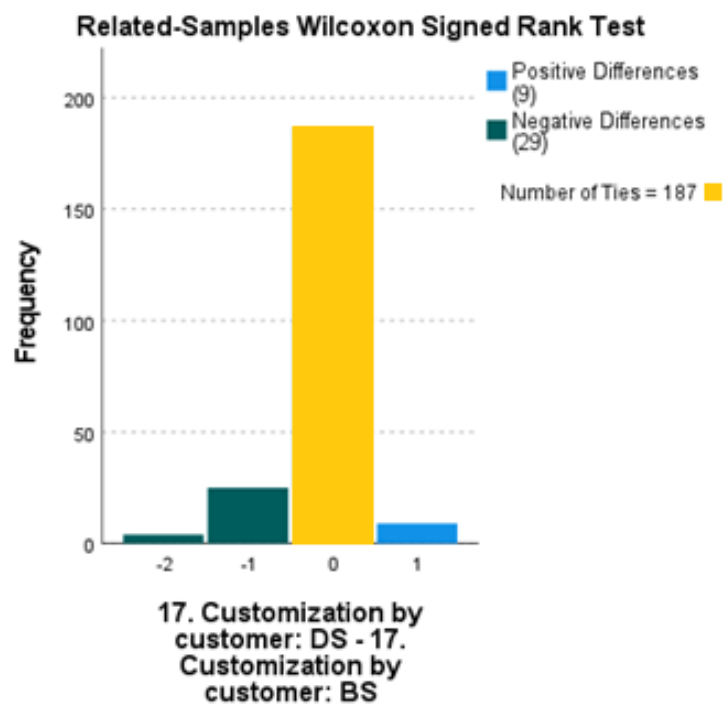


Figure 27 Test results for property: Customization by customer (N = 225)

Price property had the biggest change overall, as 107 (47%) kept their valuation the same. As seen in Figure 28, the negative difference is significant. 106 (46%) of the answerers gave a lower score for price and did not see it as a value property. Only 7% saw that this property had more value during scarcity than before.

The Wilcoxon signed rank test indicates that the valuation of the property price has decreased during scarcity.

We can see from the results before ( $M = 3.85$  and  $SD = .75$ ) and after ( $M = 3.32$  and  $SD = .95$ ) scarcity, that there has been a decrease in the value by  $-.52$  units in mean value, on the scale of 1 to 5.

From the results ( $Z = 7.37$  and  $p < .001$ ) we can assume that this change in the property having less value is statistically significant with a moderate effect size ( $r = .47$ ).

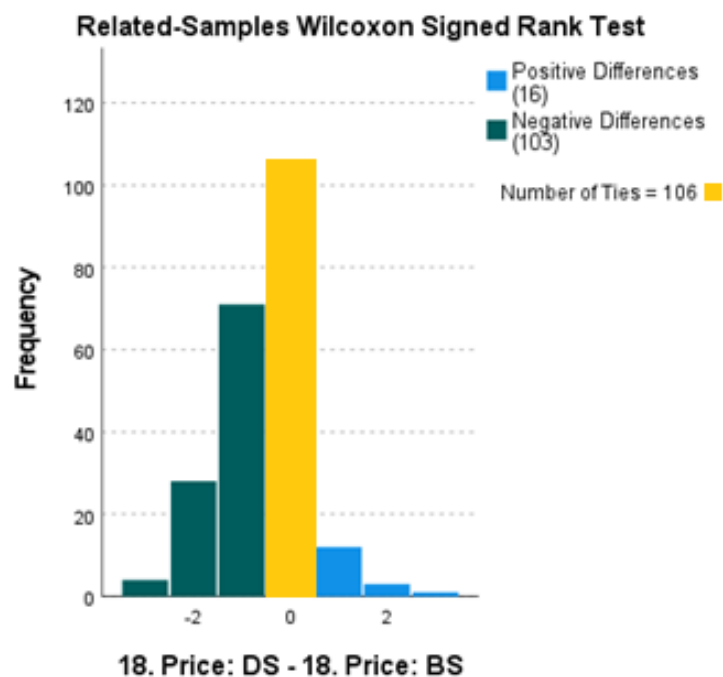


Figure 28 Test results for property: Price (N = 225)

As seen in Figure 29, free delivery was seen as less valuable during scarcity. 165 (73%) of the answerers gave this property the same score before and during scarcity. 53 (24%) saw it as less value, and only 7 (3%) thought it had more value during scarcity.

The Wilcoxon signed rank test indicates that the valuation of the property, free delivery, has decreased during scarcity.

We can see from the results before ( $M = 2.74$  and  $SD = 1.08$ ) and after ( $M = 2.48$  and  $SD = 1.06$ ) scarcity, that there has been a decrease in the value by  $-.25$  units in mean value, on the scale of 1 to 5.

Based on the findings ( $Z = 5.85$  and  $p < .001$ ), we can assume that the increase in value is statistically significant with a moderate effect size ( $r = .37$ ).

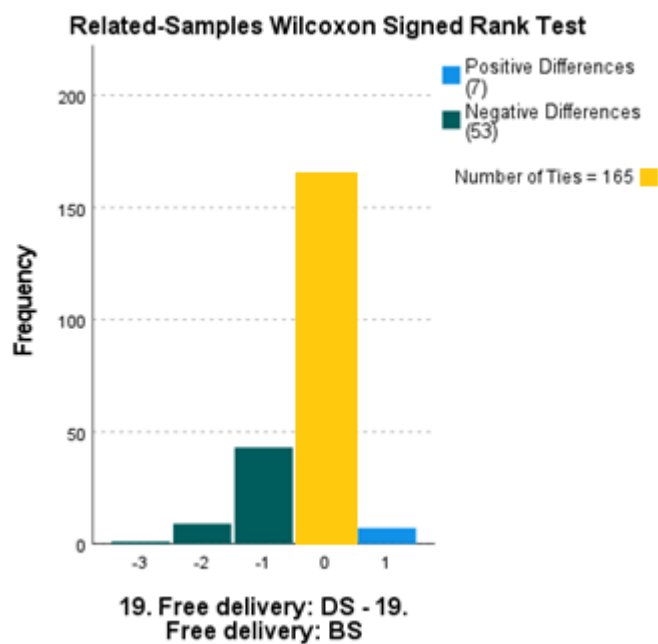


Figure 29 Test results for property: Free delivery (N = 225)



## 5 CONCLUSIONS

### 5.1 Value perception before scarcity

For the sub-question "what was seen as a value before scarcity?" The findings indicate that certain highly valued properties should be prioritized.

The most important value properties are discussed below. These are the ones that had a valuation of 4 or 5 from over 140 subjects (top five value list, 62.2% of the answerers).

Reliable delivery confirmation (186 answers with a valuation of 4 or 5) was at the top of the list. This implies that many customers are relying on lean production and they need to have products delivered just in time, and the valuation of the seller's supply chain is high. The technical specification (185) was ranked second on the list. This most probably means that the specification should be right, not the best, as the third most valued property was price (164). Combining the last two will create the most value with the biggest return on investment. Finally, when there is no scarcity in the markets, customers appear to prefer to work with a well-known and trustworthy brand (147).

Of the nineteen properties with claimed value, ten were valued by more than 80% of the answerers. The results are shown in Figure 30. Over 80% of the answerers gave a score of three or more for the property. This means that these are at least wanted properties that can have value. With a score of three, however, the property is still not a barrier for trade. The full results are shown in Figure 30 in the order of their valuation.

The ten valued properties (with a score of three or more) were: reliable delivery confirmation (99%), technical specification / performance (98%), fast delivery (95%), price (95%), easy deployment (92%), known and reliable brand (89%), possibility to buy many products from the same vendor (88%), clear webpages and easy access to information (86%), reliable and personal salesperson (81%), and global availability (81%). Only one property was valued under 50%, and it was stocking by the customer, invoicing by usage (37%).

Notable high valuations with scores of four or five were given to reliable delivery confirmation (83%) and technical specification / performance (82%). Price (72%) was also quite highly valued. Fast delivery (65%) and known and reliable brand (65%) were also of high value for over half of the answerers.

Most valued, with a score of five, was technical specification (39%). Known and reliable brand (20%) was also highly valued by some customers.

The scores presented above indicate which value properties should be prioritized by industrial automation companies. Omron is constantly working to increase the value of the ten most valuable properties found in this study. One big advantage for Omron is its broad portfolio of products. Before scarcity, deliveries and delivery confirmation were on a very good and reliable level.

The least valued properties, with a score of one or two, were stocking by the customer (63%), webshop (50%) and free delivery (42%). For stocking by the customer, 25% gave the score of 1. Even though electronic ordering systems and webshops are used, they are not necessities for the majority.

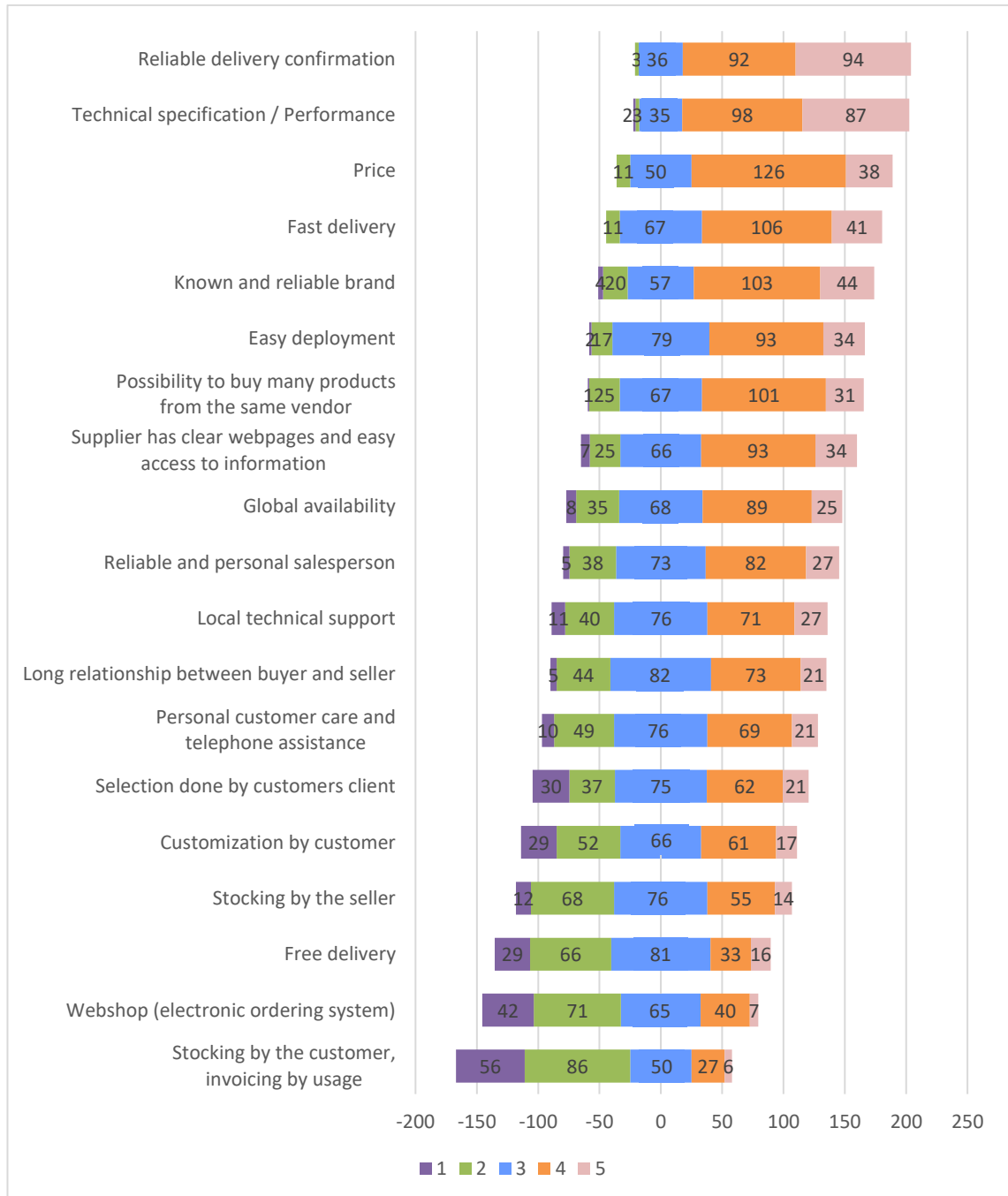


Figure 30 Value before scarcity

## 5.2 Value perception during scarcity

To the second sub-question, "What was seen as a value during scarcity?". The most important answer to the question is data accuracy for delivery times and immediate notice to customers when the date changes. As availability cannot be improved due to scarcity, the availability and accuracy of the delivery data is crucial for the customer.

During scarcity, there were eleven properties that got valued with a score of three, four, or five by the respondents. This means that these are at least wanted as a value. With a score of three, however, the property is not a barrier for trade. Valuations are shown in Figure 31 in the order of their valuation. The eleven most valued properties were: reliable delivery confirmation (98%), fast delivery (95%), technical specification / performance (95%), stocking by the seller (90%), clear webpages and easy access to information (86%), easy deployment (86%), possibility to buy many products from the same vendor (81%), known and reliable brand (81%), reliable and personal salesperson (80%), global availability (80%), price (80%).

Notably, high valuation, with a score of four or five, was given to reliable delivery confirmation (90%), fast delivery (78%), and technical specification (74%). Most highly valued, with a score of five, were reliable delivery confirmation (64%) and fast delivery (45%).

The least valued properties during scarcity with a score of one or two were free delivery (53%), webshop (50%), customization by the customer (38%), stocking by the customer, invoicing by usage (38%), and a long relationship between buyer and seller (36%).

For Omron, selling industrial automation products, the eleven mentioned most valued properties are the ones that need the most attention. In this era of scarcity, there are three complicated properties.

Reliable delivery confirmations may be an issue for the vendor due to component scarcity. Yet this seems to be the most important property for the customer, so supply chain issues need to be addressed and Omron's supplier data needs to be available as soon as possible. Stocking is a problem as demand exceeds supply due to scarcity. Due to the two earlier mentioned properties, fast delivery will also be an issue.

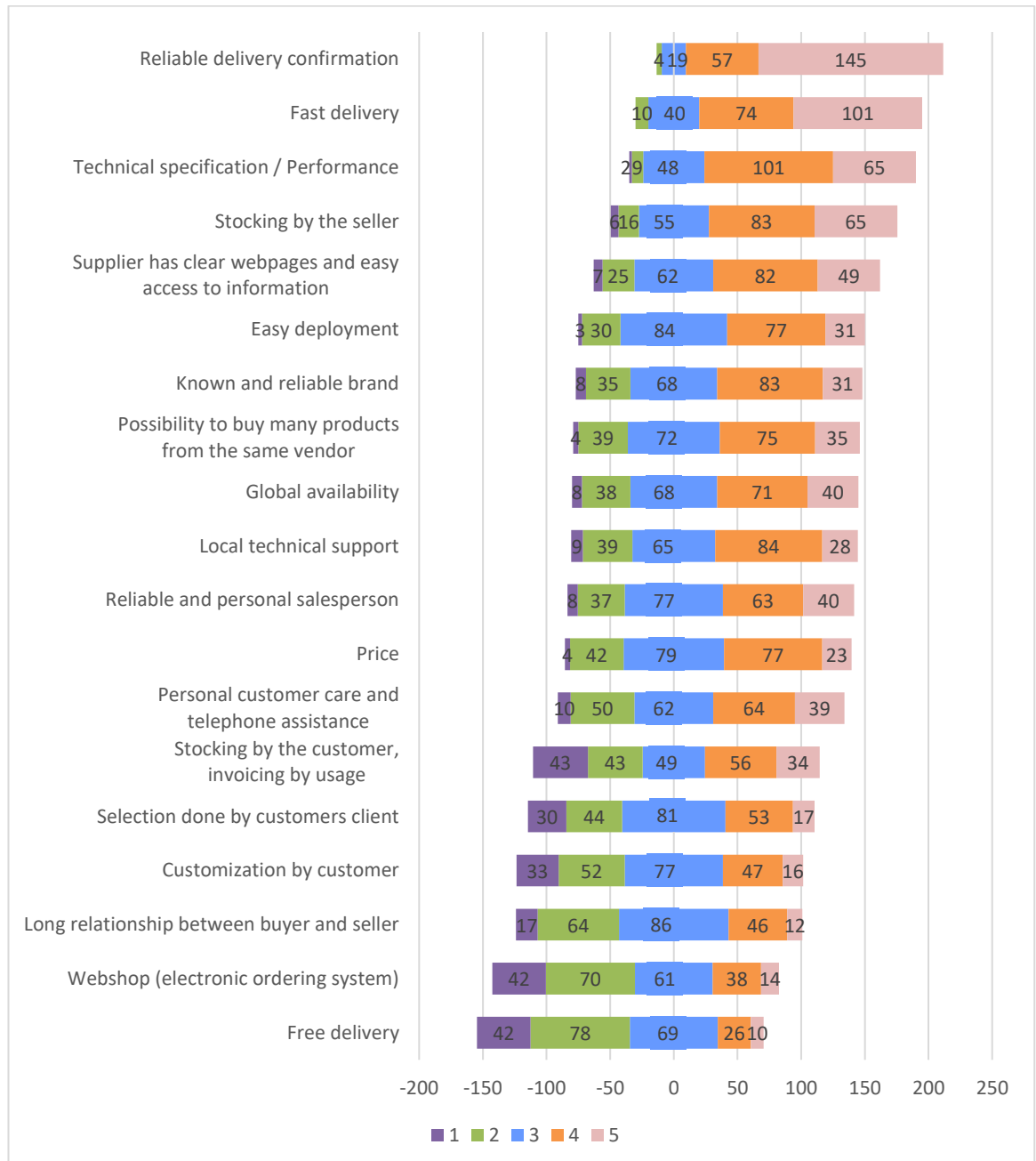


Figure 31 Value during scarcity

### 5.3 Perception of value changes during scarcity

The results indicate that there has been a shift in the perception of value during scarcity. This study supports the view of Pucci (Pucci, as cited in Jorgensen, 2021) on the level that availability has greater value than before. Stocking by the seller together with fast delivery, meaning availability, is perceived as more valuable than before scarcity.

Clear webpages and easy access to information are more valuable during scarcity than before. The reason behind this may be the component scarcity and the need to keep up to date with delivery data. The same applies to the rising value of personal customer care and telephone assistance.

As a whole, local technical support is seen mainly as valuable as before, and scarcity has not affected the valuation of this service too much. The same is true for a trustworthy and personal (nominated) salesperson, a webshop, and global availability. Since component scarcities have no meaning in how these services are produced, the results seem natural. There has, however, been a small increase in the valuation of local technical support. This may be linked to using local technical support to find alternative solutions to components and products in short supply.

According to the study, the possibility of buying many products from the same vendor has also declined a little. This may be due to scarcity, as it seems to be more important to get the product or service on time than to centralize buying. The same ideology may be the case with the known and reliable brand. Most likely, customers will seek another brand if the known brand's products are unavailable.

Product properties like easy deployment and technical specification / performance have had somewhat of a negative impact during scarcity. Easy deployment may not help if the availability is bad. Performance can be lower if availability is better. Customization by the customer can be put into the same category. There is likely a need to change specifications rather than wait for customized products.

The results indicate that during scarcity, loyalty has lowered as the valuation of a long-term relationship between buyer and seller has lowered. It may be so that loyalty is not the number one priority when products are not being delivered by the seller.

Selections made by the customer's customer seem to have lower value during scarcity. This may be because of the availability. One reason could be that a machine builder cannot store unfinished machines on their premises for too long and therefore tries to have more influence on the specification and to change products.

Price and free delivery have much less value to the customer than before scarcity. This is also most probably related to the rise in the value of availability (stocking, fast delivery). For a company, time is usually more valuable than price during scarcity, and therefore, the product can be more expensive if it is available sooner than the cheaper one.

#### 5.4 Reliability and validity of the study

The reliability of the study can be questioned as there was no reference research found on the same topic from the same area of industry. There can be a doubt with an anonymous quantitative questionnaire as nothing binds the answerer to be truthful. The answers may have been affected by the answers collected about history at the same time as the current time (scarcity).

The questionnaire was arranged to be answered to both claims at the same time, before and during the scarcity. As the situation in industrial automation markets is scarce and times are generally bad, this leaves open the question of what the answerers' mood towards the questionnaire was. Due to scarcity and maybe a level of frustration, the time for the questionnaire was not perfect. On the other hand, it should have been easier to compare the time before scarcity to this day with scarcity.

There may be differences in how the questions were understood. This may introduce some errors to the data and lower the quality of the study. This study was conducted on all types of industrial automation customers and this leaves out some questions like what type of product did the customers have in mind when answering, as the product in question was not pre-selected to ensure a bigger answer ratio.

However, the results correlate with experiences from the field that were mentioned in the introduction (J. Saastamoinen, Area Sales Manager at Omron, personal communication, Jan. 5, 2022) and with estimations (Voas & Kshetri, 2021 and Pucci, as cited in Jorgensen, 2021). Also, the results seem to relate to the scarcity principle (Chen, 2020) and commodity theory (Lynn, 1991).

More reliable results would have been obtained by using more points on the scale. This would have made the mean value vary more widely (Matell and Jacoby, 1971).

### 5.5 Managerial implications

As noted in the results, the level of valuation for loyalty seems to have declined during scarcity. This can be concluded from the data as the valuation of the long relationship, big portfolio, and known brand was lowered during scarcity. Therefore, it is crucial for the seller to maintain close contact with the customer. This may not prevent the customer from moving to a competitor, assuming better delivery performance, but it can help to keep the customer's loyalty and possibly ease the situation for winning back the customer after scarcity.

As earlier mentioned, the accuracy of the delivery data needs to be checked regularly, and a company must do everything in its power to deliver accurate data for the sales so that close contact with the customer can be achieved.

The valuation of easy deployment and technical specification / performance was lowered during scarcity. At the same time, local technical support and customer care were valued higher. On top of these properties, price had less meaning for the customer. This research suggests that sellers should find alternative solutions to solve customer issues, even with a much higher price tag.

### 5.6 Further studies

There may be differences in how the questions were understood. This may introduce some errors to the data and lower the quality of further studies if using the same data. For future research, there should be a longer explanation for the claimed value. Also, some qualification questions could be made by using the Kraljic matrix (Caniels and Gelderman, 2005) to understand better how the perception of value is seen in different customer segments.

As customer satisfaction is measured by companies regularly, it might be a good idea to implement a regular study around value. Regular questionnaire data with tuned questions should help companies to see where value can be built. Especially if data



collection is not anonymous but at least tied to the company and the answerer's position in the company.

### 5.7 Learnings

The results imply that value is multidimensional, as Sánchez-Fernández and Iniesta-Bonillo (2007) suggested. When data from two respondents is compared, there can be significant differences in how value is perceived in the claimed properties when the situation shifts from normal supply to scarcity. At the same time, the results also concur that value is time-dependent like Langley (1999) suggested.

It seems that the scarcity principle (Chen, 2020) concurs with the change in perception of value during scarcity. What is notable is that some, mainly intangible services, were not affected statistically significantly by scarcity. Also, as the value changed mainly and notably in tangible item price and availability, the results support commodity theory (Lynn, 1991), where the commodity has to be useful, transferable from owner to owner, and it must have the potential to be possessed (Lynn, 1991).

As stated in the managerial implications, it is crucial to put all effort into delivering accurate data and maintaining close contact with customers, as it very much seems that the valuation of loyalty lowers during scarcity.

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## **Appendix 1, Research questionnaire**

# **Value perceptions change during component scarcity in industrial automation sector.**

Value is considered as benefit that a product or service may offer to a customer. Often this is tightly bind to purchase decision.

Questionnaire is anonymous.

This questionnaire has two sections. In the first section some background information is collected from the respondent. In the second section there are claims of properties that can possibly add value to customer. Respondent needs to answer how the value has been seen perceived before and during scarcity.

1. Customer type and industrial automation product/service usage?

Machine builder (OEM)

End user in a factory (maintenance)

System integrator (part of solution)

Engineering office (part of design)

Other, what industry?

2. What is your current working position?

R&D and projecting (automation, electrification, mechanics)

Assembly

Maintenance

C-Level position

Procurement or Purchasing

Other, what position?

3. Do you have ownership in the company?

Yes

No

4. Are you part of decision making (for industrial automation products or services)?

Yes

No

5. How many decision makers there are (for industrial automation products or services)?

0 Decision is made by the client

1 to 8 or more

In the next phase there are claims for value and you should answer to two different period of value perception. First is the time before scarcity that followed Covid-19 pandemic. Second is the time during scarcity.

Scale for answering:

1. Property adds no value and doesn't affect purchasing decision
2. Property has secondary meaning in purchasing but doesn't create notable value
3. Property has meaning in value creation and is wanted property but not determinant
4. Property creates some value and is mandatory property.
5. Property is a determinant in decision making and value creation.

6.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Stocking by the seller	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Stocking by the seller	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Stocking by the customer, invoicing by usage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Stocking by the customer, invoicing by usage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Local technical support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Local technical support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Fast delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Fast delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Possibility to buy many products from the same vendor (large portfolio)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Possibility to buy many products from the same vendor (large portfolio)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Reliable delivery confirmation (shipping on actual promised date)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Reliable delivery confirmation (shipping on actual promised date)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



12.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity:	Known and reliable brand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity:	Known and reliable brand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity:	Reliable and personal (nominated) salesperson	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity:	Reliable and personal (nominated) salesperson	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity:	Long relationship between buyer and seller	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity:	Long relationship between buyer and seller	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity:	Webshop (electronic ordering system)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity:	Webshop (electronic ordering system)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity:	Supplier has clear to webpages and easy access to information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity:	Supplier has clear to webpages and easy access to information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Personal customer care and telephone assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Personal customer care and telephone assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Easy deployment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Easy deployment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Technical specification / Performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Technical specification / Performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Selection done by our client	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Selection done by our client	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21.	Does below property have value and impact to purchasing decision.	1	2	3	4	5
Before scarcity: Global availability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Global availability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Customization by customer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Customization by customer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Free delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Free delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

25.	Does below property have value and impact to purchasing decision.				
	1	2	3	4	5
Before scarcity: Own value, What?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During scarcity: Own value, What?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>