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MSc's Dissertation

## **The Power of WHY – the Key to Excellence**

*Why Understanding WHY Leads to Enhanced Customer Satisfaction and Cross-Functional Integration in the Initial Phases of Product Development*

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*Quality & Operations Management, MSc, within the field of Industrial Engineering and Management, offered by the department of Technology Management and Economics at Chalmers University of Technology*

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Sincerely,

A handwritten signature in black ink, appearing to read 'Ludwig Almedal', written in a cursive style. The signature is enclosed within a faint, light-colored circular watermark or background.

*Ludwig Almedal*

2025-05-15

Göteborg



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## Abstract

*To do the right things from start and do it all the time* might sound like an apparent statement, however, it is easier said than done. The prerequisite, as this dissertation will show, to do the right things from the start and do it all the time is to thoroughly understand what to do, how to do it and most essentially, *why* do what you do. This MSc dissertation investigates how a deeper understanding of the underlying *why* behind customer expectations can enhance value creation and customer satisfaction within product development processes. Using Aurobay as a case study and utilising the highly data-driven and fact-based improvement methodology, *Six Sigma*, the research explores the current state of the quote process and its impact on business operations, the influence of expectation alignment on perceived quality, and potential methods for bridging the gap between current and future states. The findings indicate that while existing processes are standardised, they lack sufficient focus on identifying the root drivers of customer value. This limitation leads to misaligned value propositions, increased rework, and reduced customer satisfaction. To address this, a method was developed, grounded in Sinek's Golden Circle and the Value Definition Model, to support early-stage identification and prioritisation of customer expectations. The proposed approach promotes cross-functional collaboration and encourages a shift from task-driven to needs-driven thinking.

The author proposes a novel quality definition. The definition is based on the premise that quality should be assessed not solely by measurable attributes, but by the extent to which a product or service meets or exceeds customer expectations. As such, a product may be perceived as superior in quality even if it is objectively outperformed by alternatives, provided it delivers greater alignment with user expectations. This perspective underscores the importance of perception and expectation management. The study concludes that embedding a deeper understanding of the 'why' behind customer expectations into early development stages enables more accurate value alignment, enhances perceived quality, and supports strategic decision-making. By shifting from a task-focused to a purpose-driven approach, organisations like Aurobay can foster stronger customer alignment, reduce inefficiencies, and create sustainable competitive advantage through improved product development practices.

Ultimately, the thesis highlights the importance of understanding not just what and how to deliver, but *why*—providing strategic insights for improving customer alignment and value delivery in complex development environments.

**Keywords:** *Customer Value, Customer Satisfaction, Expectations, Product Development, Quality, Quality Judgement, Quality Perception, Six Sigma*

## Abbreviations and Keywords

In order to facilitate the understanding of the key terminology used in this MSc thesis an *Abbreviation and Keywords list* is provided.

*Aurobay*: the company where the case study has been performed.

*Author's note*: in some instances, the author has added a clarification in direct citation. This is marked by “author’s note” and is placed after the clarification.

*Author's translation*: in some instances, the author has made translations from another language than English. Citations that have been translated are marked with “author’s translation”.

*AM*: the abbreviation for *Aston Martin*. A British car manufacture founded in 1912.

*E.g.*: the Latin expression *exempli gratia* means “for example”.

*Et al.*: the Latin expression *et alia* means “and others”.

*Etc.*: the Latin expression *et cetera* means “and other similar things” or “and so on”.

*DMAIC*: stands for *Define, Measure, Analyse, Improve and Control*.

*I.e.*: the Latin expression *Id est* means “that is”.

*MSc*: Master of Science.

*ME*: Manufacturing Engineering.

*Tier-one supplier*: a tier-one supplier supplies directly to the final product.

*PQ*: Perceived Quality.

*RQ*: Research Question.

*R&D*: Research and Development.

*Six Sigma*: a highly data driven method and is the method of choice.

*SUV*: Sport Utility Vehicle.

## Musical References

The author has occasionally utilised musical references in the chapters’ titles to give the report a more vibrant sensation. The references are listed in the order they occur in the report.

“*Tell me why*” –

I Want it That Way – Backstreet Boys, *Millennium*, 1999

“*Knowing me, Knowing you*” –

Knowing Me, Knowing You – ABBA, *Arrival*, 1977

“*I was an impossible case*” & “*The Name of the Game*”

The Name of the Game – ABBA, *ABBA – the Album*, 1977

“*It's easier to walk away*”

Easier to Walk Away – Elton John, *To Be Continued*, 1990

“*It's a human sign when things go wrong*”

Sacrifice – Elton John, *Sleeping with the Past*, 1989



# 1. Introduction

The introduction chapter provides the reader with a clear understanding regarding the thesis background, purpose, research questions and limitations. Additionally, the author will present arguments to why the research performed in this MSc thesis was required.

## 1.1 Background

Aurobay is a Sweden based tier-one automotive manufacture employing around 10 000. Aurobay Sweden, as part of Aurobay, has headquarters in Gothenburg and production facilities in Skövde and in Zhangjiakou, China, respectively (Aurobay Sweden AB, 2024). Despite Aurobay being founded as late as 2021, the heritage stretches over a century with production of car engines starting in 1925 in Skövde, but manufacturing of engines had commenced over a decade earlier and production of diverse foundry product had started in 1868 (Almedal & Ivarsson, 2023). Until 2021 and the creation of Aurobay, both the Skövde and Zhangjiakou engine plants were part of Volvo Car Corporation, however, a strategic decision made by Volvo in 2020 to only focus on electric driveability made Volvo to create a new company, exclusively focusing on developing internal combustion engines. The engines manufactured today are four-cylinder petrol engines, although 4-, 5-, and 6-cylinder engines have been manufactured at the Skövde plant (Almedal & Ivarsson, 2023).

Even though the business objective originally was to exclusively develop internal combustion engines, the business has now embraced an offering of a complete engineering solution for internal combustion engines, hybrid powertrains, range extenders and transmissions (Aurobay Sweden AB, 2024). Moreover, Aurobay has recently joined the joint venture, Horse Powertrain Limited, together with Renault Group and Geely and together composes a workforce of 19 000 on three continents.

## 1.2 Framing the Thesis – Introducing the Basic Concepts

The automotive manufactures of today faces fiercer competition than ever before and with potential contenders sailing up, potentially capable of overthrowing world leading manufactures, the need of doing the right thing from the start and doing it all the time has become more vital at an accelerating pace (Yang & Basem, 2009; Lindstedt & Burenius, 2016; Stylidis, 2020). The traditional market is more shattered than before and relying on the actions creating value yesterday may leave business outpaced by other who has learned why they do, what they do and why value is created (Stylidis, 2020). As this MSc thesis will show, getting the quality and its perception right is absolute integral for creating value and customer satisfaction and perhaps most pivotal; failing to understand what, how and foremost, why customers expect certain qualities.

Hitherto, previous research concerning the subject have generated multiple methods, approaches and theories to identify and formulate attributes, qualities and expectations and subsequently prioritise the inherent importance, like the Kano Model (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017), for instance. Organisations do generally know how they do things and especially what they do, however, few organisations managed to understand *why* they do the things they do and even fewer succeeds to communicate *why* they do the things they do to customers. Why is this of importance then, one may ask? Customers buy why organisations do the things they do not what they do (Sinek, 2009). Organisations must prove why they can provide value to the customer and to be successful in the instance of creating customer satisfaction.

The first generation of Volvo XC90 illustrates when customer value and satisfaction were thoroughly intercepted, analysed and translated into a product surpassing customer expectation. How did Volvo achieve that? Most probably by successfully articulating and understanding the customers *why* they understood *why* Volvo should develop a SUV. When the XC90 (see figure 1) was introduced in the beginning of 2002, contenders like Audi, BMW, Mercedes, Toyota; yes, close to virtually every automotive manufacture on the globe, had with success already introduced multiple SUVs models, thus making Volvo's rather late entry to be challenging to say at least (Hedberg & Wedberg, 2018). Yet, the XC90 appeared to align poorly with the Volvo brand image and identity as SUVs were too large, consume too much fuel and were regarded to be unsafe. The latter was evidently in conflict with Volvo's reputation of manufacturing safe cars. As Hedberg and Wedberg (2018) put it:

*“To drive a large and thirsty SUV was not only unnecessary and bad for the environment, but also cruel to other road users [author's translation]” (p.109)*



Figure 1: the first generation of Volvo XC90. It was announced years after competitors like BMW had introduced their SUVs. Photo courtesy to Volvo Car Corporation (Volvo Car Corporation , 2025)

However, this was directly *why* Volvo desired to launch a SUV, although the decision could be regarded as foolish (Hedberg & Wedberg, 2018). The XC90 should challenge the norm of SUVs, recalling SUVs to be thirsty, dangerous and the cruel choice of car, by surpassing the contenders through being the safest, delivering superb fuel performance and most versatile SUV on the market. It was also known by the automotive manufactures that SUVs commonly were utilised to make school runs or take the kids to the football practice. Hence, Volvo arranged focus groups, of which one only consisted of women, to learn the underlying why and understand the segment better and (Vi Bilägare, 2002) and most essentially, the car was required to be perceived as the better alternative. Volvo soon realised that most SUVs were not utilised off-road and were instead used as everyday utility which meant the handling on normal roads should be prioritised over off-road capabilities. The question *how* to be the safest, deliver superb fuel performance and be the most versatile SUV on the market were by introducing avantgarde concepts like the *Roll Over Protection System* (ROPS) preventing the car for to roll over in cases of accident or a new cross frame beam capable of mitigate the forces on the other in a frontal collision (Hedberg & Wedberg, 2018). The XC90 was also offered with a wide range of engines options, configurability in the number of passenger seats and enhanced road- and off-road capabilities, for instance, permitting excellent versatility. Consequently, what the XC90 offered was a blend of capabilities and concepts exceeding the identified shortcomings of SUVs and that appealed to the customers to extent that the sales figures surpassed 60 000 units per

year. Perhaps the ultimate evidence of the attractiveness of the XC90 [author's interference] was when the pope Benedictus XVI acquired one in marine blue and with V8 configuration (see figure 2) (Hedberg & Wedberg, 2018).

Thus, Volvo understood *why* their contribution to the SUV segment was needed and understood *how* it could be done and *what* the XC90 did, creating both customer value and satisfaction.



*Figure 2: Benedictus XVI became fond of the Volvo XC90 and acquired one for personal use. Photo courtesy to Volvo Car Corporation (Volvo Car Corporation , 2006).*

### **1.3 Purpose & Research Questions**

The purpose of this MSc thesis work is to inquire the how the understanding of the underlying *why* can foster greater customer value and satisfaction by deriving the expectations, qualities and attributes propelling value and satisfaction. Additionally, the thesis will inquire how the fulfilment of expectations, qualities and attributes influence the quality perception and the overall quality judgement. Therefore, four research questions are outlined:

#### **RQ1:**

- What is the current state in the quotation process and how does the current state influence business operations today?

#### **RQ2:**

- What importance does the alignment with customer expectations induce on the quality perception?

#### **RQ3:**

- How could the gap between the current state and future state be bridged?

#### **RQ4:**

- What methods and tools can be developed to assist Aurobay's quality assurance department in identifying and defining customer requirements and expectations in the early stages of product development?

### 1.4 Benefit Assessment

As the method imply, an initial benefit assessment should be generated in the outskirts of the project as part of the define phase (see table 1). See the method chapter, *Six Sigma*, for more details.

Table 1: the project benefit assessment

Benefit Assessment	
Hard	Soft
Tools and method capable of assisting the scoping of customer req. and exp	Increased pull-thinking for deriving customer needs and expectations
Reduction in costly late minute changes	How defining customer requirments and expectations in early phases of prod.dev. influnces perceived quality
Reduce the amount of rework in the product development process	Increased awarness why requirments varies between customers
	Understanding the underlying why
	Enhanced understading of the value preposition and customer satisfaction

### 1.5 Limitations

The thesis will focus on the quote process where the initial inquiries of customer requests are performed. More specially, the thesis is made at the Global Quality Assurance department at Aurobay. The department work to ensure customer satisfaction and conformance to the identified quality aspects and the author aim to advance the knowledge concerning customer value, customer satisfaction and quality perception and address the address its inherent implications.

## 2. Theoretical Framework

The Theoretical Framework chapter aims to present an exhaustive background to the concepts, theories and previous research that exist concerning the topic. The chapter is divided in two parts: the first part contains a literature review while the second part addresses the theories and the previous research which have been utilised as a foundation for the thesis. Some of the concepts are, however, presented in the appendix in order to facilitate the flow of the report. Furthermore, it aims to highlight where and most importantly why additional research and inquiries are required. To obtain relevant articles, books and dissertations have the Chalmers Library been utilised.

Key words utilised in the literature research and review:

- Product design
- Product development
- Product development and design
- Six Sigma
- Design for Six Sigma
- Perceived quality
- Perceived quality and product development
- Craftmanship
- Lean
- Toyota Production System
- Customer value

The reader is referred to the appendices for information regarding *Aesthetics and Craftmanship influence on Perceived Quality* and *Global Perceived Quality*.

### 2.1. Quality – Just an Illusion?

Different field of research attain different conclusions on how to define and articulate perceived quality. The marketing perspective adopts an antagonistic, i.e., not quantifiable, view of perceived quality, thus regard it as imaginary and subjective. Frequently referred to in this instance, the customer judgement of product superiority or how the company has managed to perceive the customer are examples of the antagonistic view. Despite the antagonistic definition made by marketing researchers, additional research discloses the fact that perceived quality in the manufacturing processes depends on metrics that can be objectively measured and appraised. For instance, split lines and gaps between different car body panels have an influence on how customer perceives the overall product quality. Methods like *Robust Design* is widely recognised as a key enabler to achieve the desirable output. Robust Design aids to control undesirable geometrical variation and fluctuation which impinge the tactile and visual impression. *Affective Engineering*, sometime referred to as *Emotional Engineering*, articulates perceived quality as how the product affectively impacts the customer. Consequently, the composition of product attributes is accordingly analysed in order to distinguish the affective response the product has on the customer. One method applied to analyse the composition is *Kansei Engineering*; yet the complexity of the method makes it difficult to utilise properly (Stylidis 2020).

### 2.1.1 Information Asymmetry and Perceived Quality Dimensions

Although the industry already today recognises the new challenges, the gap between how designers and engineers interpret the customer and what they intended with the product design and attributes is far from always aligned with the expectations. Hence, the envisioned high quality by designers may not be equal with the customer's perception of high quality, a state called *information asymmetry*. *Information asymmetry* is a relatively new phenomenon facing automotive manufacturers and their R&D departments today (Stylidis 2020). Historically, brand image, structure- and strategies have been rather straightforward matters, however, in recent years the complexity concerning brands has become increasingly more intricate pushing manufacturers to create, maintain and develop a strong identity with relevant touch points with the customer. The touch points are in many cases created through the perception the customer has with the company, therefore do the perceived quality attributes have an important role to play. The perceived quality attributes involve many of the aspects that affect the customer's cognition and product properties, such as aesthetics, emotions and design interpretation. Research highlights two important cases where asymmetry is of certain interest, i.e., *information regarding quality* and *information about intent*. The phenomenon can occur if the conveyed information is blurry interpreted by the customer, or when the development process is rushed, thus limiting the time when engineers can gather information about the customer and base the decisions on facts. Additionally, information asymmetry is prone to occur if the product is deemed to be too complex or if the brand is affected negatively by prior events (Stylidis, 2020). When the product is too complex, the actual quality tends to not be apparent for the customer. Based on an analysis of the different interpretations of perceived quality made by Stylidis et al (2015) distinguish a marketing-oriented- and an engineering approach. Stylidis (2020) defines the engineering viewpoint of perceived quality as “*the perceived quality domain is a place where the product meaning, form, sensorial properties and their execution intersect with human experience*”. Stylidis (2020) argues the interpretation relies on the interplay between product quality and its context, yielding the equation where customer expectations need to be aligned and met by engineering design intent which requires to be in equilibrium.

Car manufacturing has become increasingly more important in recent years and the market, especially the premium segment, has become highly competitive. Manufacturing quality with “zero-defects” is still important, yet not sufficient. Stylidis et al (2015) recognise the advantages emerging from understanding the customer's perception of quality, thus how they interpret perceived quality. Additionally, the lack of common terminology regarding perceived quality able to explain and define all necessary aspects is acknowledged. The authors (Stylidis et al., 2015) imply perceived quality consists of two dimensions, i.e., *Value Based Perceived Quality* (VPQ) and *Technical Perceived Quality* (TPQ). The two dimensions address different aspects of the issue of customer perceived quality. VPQ concerns all possible customer experience of the product attributes and the associated external factors through senses and cognition, whereas TPQ regards the engineering approach, i.e., the technical aspects of the product, with the intent to convey the formulated customer requirements and competitiveness. Moreover, the two-dimensional approach, i.e., VPQ and TPQ, is intended to bridge the gap between the marketing and manufacturing view on perceived quality since it offers a common terminology.

Despite the many methods developed to translate subjectively formulated customer requirements and expectations into technical requirements, for instance the *Kano method* or *Kansei Engineering*, they are limited in the ability to sufficiently appraise the subjective perceived quality attributes. According to Stylidis et al (2015), articulating a comprehensive terminology regarding the matter is a first important step towards a more objective justification. The proposed definition is the VPQ and TPQ, forming a framework. The VPQ is the total customer experience and the TPQ, as mentioned, the engineering approach. As discussed, Stylidis (2020) divides perceived quality in a two-dimensional typology, i.e., *value based perceived quality* (VPQ) and *technical perceived quality* (TPQ), where TPQ is mediated by VPQ. The interpretation of perceived quality is a physical and cognitive event and consequently the information obtained can be communicated through the related technical aspects derived through the sensorial apparatus. The human primary senses connected to TPQ are *visual-, tactile-, auditory-, olfactory- and gustatory* qualities. Based on the line of reasoning, the authors (Stylidis et al., 2015) propose a framework, *perceived quality framework* (PQF), projected to breakdown which sensory modalities and ground attributes belonging to which sense. The primary senses constitute the first level in the framework and the sensory modalities, e.g., paint quality, joining quality etc., found the second level. The third level, the ground attributes, are lowest point where the engineers and customers still can efficiently interact and communicate around technical aspects and derive meaningful feedback. In order to do so, the customer must fully understand the meaning of each attribute. However, the framework does not regard any influence of VPQ, thus potentially limiting the use of the framework, but can be utilised in all phases of product development to test and study designs with regard to perceived quality.

In order for the framework to be of any leverage to the engineers the customers must rank and prioritise the attributes accordingly. The *Perceived Quality Attributes Importance Ranking* (PQAIR) method is developed and designed to aid engineers to adequately evaluate the relative importance of each perceived quality attribute, and the method is a synergy between the objective and measurable information and the subjective perception made by customers (Stylidis, 2020). The method take aim to facilitate the decision-making process when evaluating the relative importance of the attribute for final product design but can be deployed in other phases in synergy with PQF. The product attributes are unique to each manufacture; thus, they must articulate, map and connect each attribute to PQF. Utilising the PQAIR method will yield an importance ranking for each ground attribute, denoted  $n$ , there the most significant factor is assigned the letter  $R$ , but the relationship between the different the importance factors is linear. The number of occurrences, denoted  $o$ , a ground attribute impacts one of the primary level attributes, e.g., tactile quality, must be noted as the impact of one ground attribute is determined from the relationship between  $R/o$ . Moreover, the number of sensory modalities attributes is as well identified. The line of reasoning yields the following equation:

$$S_p = 1, \dots m = \sum_{i=1}^n \frac{R_i}{o_i}$$

Söderberg et al (2020) conducted an empirical structural validity test of the PQAIR method, with participants from a number of automative manufactures in Europe, concluding the method

proves to be a capable tool to display the ground attributes for the customers and for the designers and engineers to evaluate and weigh the importance to perceived quality. Even though Söderberg et al (2020) allude that the method can be further enhanced, the method was determined to be able to determine the required TPS to achieve a successful design.

The importance of having a framework and an objective method like PQAIR to describe, determine and articulate which perceived quality attribute influencing the overall quality perception of the product is instrumental, despite PQF and PQAIRs inability to address VPQ. Stylidis (2020) conclude customers generally are unaware of the number of attributes compromising perceived quality in such a complex product as a car, thus making it difficult to ask customers questions regarding perceived quality to evaluate them at a later stage, showcasing the need to articulate them accordingly in the early phases. Additionally, Stylidis (2020) alludes that it is not overweeningly challenging to develop a car with high perceived quality at the expense of time and money; the challenge is to strike the optimal balance between perceived quality and the boundaries and limitations defined by financial aspects, product development lead time and technical feasibility. Consequently, projects failing to define and articulate perceived quality in all phases of the development project might be unsuccessful to find the adequate balance.

### 2.1.2 Defining Quality

However, in order to adequately define perceived quality, one must thoroughly understand the term quality. Three definitions from three different researchers are presented and discussed in the article. The Garvin, the Zeithaml, and the Aaker definition (see figure 3). They are briefly summarised as follows:

- Garvin propose a five-step approach of quality definition, i.e., *transcendent, product based, manufacturing approach* and *value based*. However, the transcendent approach, for example, is of a more philosophical nature since it suggests that the term quality is rather abstract and thus cannot be defined precisely. In contrast, the manufacturing approach is more tangible and essentially identifies quality as to which extent the requirements are fulfilled. Moreover, Garvin formulated a framework of product quality elements consisting of eight dimensions, namely *performance, features, reliability, conformance, durability, serviceability, aesthetics* and *perceived quality*, where *the aesthetics* and *the perceived quality* dimension is appraised to be most subjective. A more exhaustive analysis of Garvin's definition follows in a succeeding paragraph.
- Zeithaml defines perceived quality as the subjective judgment regarding the overall superiority of a product separated from objective quality. Zeithaml definition does however impose the opinion that the perceived quality is not measurable and hence cannot be objectively determined.
- The Aaker definition is rather similar to the Zeithaml's but adds the aspect that the subjective overall quality or superiority is judged and compared towards the intended purpose and its relativeness to alternatives. Consequently, perceived quality is simply a perception.

Thus, the definition of quality is multidimensional, and a single interpretation might be insufficient.

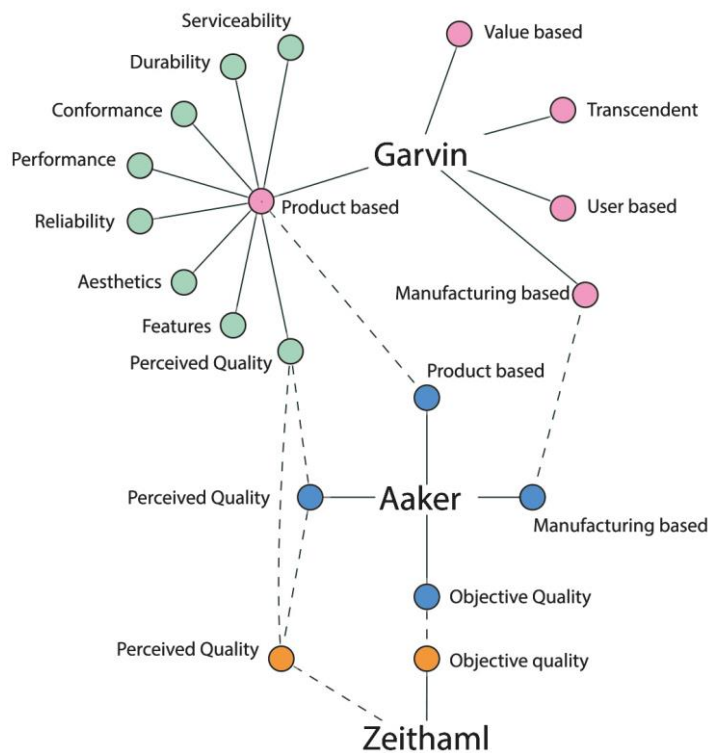


Figure 3: the three quality definitions by Aaker, Garvin and Zeithaml. Picture adopted from Styliadis (2020)

The identified five-way approach to define quality by Garvin (1984) alludes defining quality is a rather delicate matter and that the definition should not be regarded as static since the term quality has different implications for, e.g., marketing- and manufacturing departments. Thus, Garvin (1984) identifies a five-way approach to define quality, namely, *the transcendent approach of philosophy (I)*, *the product-based approach of economics (II)*, *the user-based approach of economics, marketing- and operations management (III)*, *the manufacturing-based (IV)* and *the value-based approaches (V)*. The five approaches vary in terms of it views a quality objectively, measurable and concrete matter, or if quality rather is something subjective, philosophical and abstract. For instance, the transcendent approach relies heavily of Plato's line of reasoning about beauty, which cannot be defined, and can only be appraised based on experience and personal taste. In contrast, the product-based which implies that quality is differences in quantity, meaning a car engine with six-cylinders has greater quality than one with four, put simply. Yet, even if the different approaches open up for further in-depth analysis of each approach and its implication, the key insight is to understand the consequence of having multiple coexisting definitions. By allowing multiple definition to coexist, the competing views concerning quality that generally exist can be articulated and aid to resolve the potential conflicts surrounding the definition. Additionally, only conforming to one definition might lead to inferior performance compared to competitors as the product, for instance, agrees to all stipulated standards which suggest that the manufacturing-based approach is fulfilled, but fall short of being accepted by customers. However, the opposite might also be true, but what is equal to both cases is the increase in cost or lost in revenue. Consequently, if applying different

approaches to identify key characteristics in the product development phase and manufacturing phase respectively, and besides, the adequate product- and process attributes can be recognised without causing internal turmoil or falling short of satisfying customers (Garvin, 1984).

The eight dimensions of quality intendeds to facilitate the interpretation of the five approaches as they focus on unique quality aspects, in addition to attempting to resolve the inherent conflicts between them. The dimensions are *performance, features, reliability, conformance, durability, serviceability, aesthetics* and *perceived quality* (Garvin, 1984) .The strategic implication for companies intending to compete on quality is instrumental since pursuing and attempting to excel on too many dimensions can cause more harm than good. Garvin (1984) take the piano industry as an example. The renowned German piano manufacture, Steinway & Sons, had for many years been industry leading with their handcrafted piano with unique sound and superior quality when Yamaha sailed up as a competitor, emphasising reliability and conformance rather than aesthetics and perceived quality. Nevertheless, both Steinway & Sons and Yamaha were successful to attract customers and are still to this day up and running. Both companies have a versatile product range; yet the prioritised quality dimensions are noticeable (Steinway & Sons, 2024; Yamaha Corporation, 2024). Thus, the companies have managed to identify which dimension of quality that is important to them.

Nevertheless, the authors (Stylidis et al., 2015) acknowledge that certain convergences and disengagements in the proposed definitions, yet the outlined framework offers a definition of perceived quality components in relation to the automotive industry.

### **2.1.3 Cognitive Quality**

However, it seems that the customers interpretation of perceived quality, at least, partially is mediated by aesthetic quality which itself only can be defined vaguely. Researchers mean that the aesthetic quality, or cosmetic quality for that matter, is perceived and interpreted by visual inspection and comparison or even as “the look” of the product. The car interior can likewise be described to be judged on individual assessments of sensory interaction and emotional impact on the customer. Habitually, craftsmanship, material choice- and quality are factor associated with the perceived quality of a car interior. *Noise, vibration and harshness* (NVH) are commonly referred to important attributes of the perception of vehicle quality (Stylidis et al., 2015). Despite Garvin (1984) references to Plato’s reasoning about beauty and Stylidis et al (2015) line of reasoning, have several research projects inquiring aesthetics and cognitive quality been conducted (Tovillo et al., 2024; Braun et al., 2020).

Braun et al (2020) introduces *cognitive quality* as a third dimension to the perceived quality framework (PQF) in order to address the gap in the PQF and PQAIR. The dimensions concerns, as discussed, the extrinsic attributes of perceived quality, such as e.g., brand image- and heritage, design, affective customer judgement etc., i.e., VPQ, and the attributes controlled by design and engineering specifications are covered by TPQ. Yet, the dimensions do not focus on the mental processing of the product design. The initial encounter between the customer and a new product triggers a reaction instantaneously in form of *like or dislike* and *approach or avoid*, in addition to judging the quality. Worth to be noted, the customer does not necessarily need to

interact physically with the product. Only a quick glance can be sufficient for the customer to appraise the overall product quality (Braun et al., 2020).

Cognitive quality encompasses two dimensions: *perceived aesthetics* and *perceived functionality* (Braun et al., 2020). Perceived aesthetics embodies aesthetic emotion and aesthetic judgement and are the response triggered by the cognitive process. Aesthetic emotion is the pleasure or happiness whereas the aesthetic judgement is interpreted as the cognitive aspect of aesthetic processing. Furthermore, research disclose the more fluently the customer can interpret, analyse and cognitive process a product's attributes, the likelihood of a positive response increases. On the contrary, if the opposite is true, the likelihood for a negative response increase and can lead to an evasive behaviour, dislike, or deeming the quality to be inferior of the expectations. The perceived functionality, on the other hand, regards the product's perceived feasibility including practicability, reliability, comfort, safety, functionality, usability and more (Braun et al., 2020). Even if only a small part or system of a product is badly designed, could yield an overall poor-quality judgement. For instance, complex to operate and non-user-friendly design of buttons can be prone to infuriate drivers and their interpretation of the overall quality. Thus, adding an additional dimension to the perceived quality framework proves to be relevant since perceived quality cannot alone be explained by TPQ and VPQ. In extension, the third dimension, cognitive quality, opens to extend the understanding of quality impression.

#### **2.1.4 Brand Image and Heritage Influence on Perceived Quality**

However, single handedly analysing the intangibles of perceived quality with regard to the aesthetics- and cognitive aspects is insufficient as there are more intangible aspects requiring attention (Stylidis, 2020, pp. 27-32). Additional intangible aspects are *brand image*, *brand heritage*, *perceptions of aesthetics* and *craftmanship*. The reason why it is essential to understand the intangible aspect is because of customers do not only demand zero-defects quality, but as well products to be *error-free*. Thus, products must excel at even more dimensions than before. Additionally, the automotive market has in recent decades become more competitive, complex and fragmented, and the development is not likely to stagnate; especially not reverse. Consequently, automotive manufacturers must therefore foster their brand image-and heritage carefully as research (Stylidis et al., 2015; Stylidis 2020) disclose a correlation between brand image, quality and performance. Low or weak perceived brand image has the prospect to influence performance more negatively than actual poor product quality. High perceived brand image can essentially compensate for quality related performance losses. The phenomenon can be observed in Carlsson & Mathiasson (2020) MSc thesis as participants in advance were made aware that a particular brand would participate in the study, leading to participants to be more prone to select the brand since it had high brand perception than the other brand involved in the study. The brand with higher brand perception earned less technical point, but was despite that, more preferred. Even if the effect has its limitations can efforts trying to increase the perceived image improve the monetary result more compared to efforts intended to remedy inadequate actual quality. In conclusion, Stylidis (2020) concludes that brand heritage is an important positive factor when deciding to purchase or not purchase a vehicle.

### **2.1.5 Premium and Luxury Car Segments**

Efforts aimed to distinguish are required where on the luxury/premium spectrum the company intends to be since the term is extensively used in the automotive industry (Stylidis, 2020). Despite the extensive use, the term causes confusion for both companies and customers as the term and its implications is not fully outlined nor understood. Historically, luxury has been more concerned with aesthetics and an emotional and personalised approach to product design and quality, however, the focus is changing towards the aspects the premium segment generally has recognised as key. Premium car manufactures have emphasised measurable quality attributes, such as e.g., vehicle body split lines, flush metrics etc. Metrics, as discussed earlier, influence the perception of the product quality, thus perceived quality. Additionally, the manufactures convey a more functionality-based approach. Although the automotive manufactures have tried to navigate their way through the hurdles and sometimes diffuse definitions, the luxury customers have started to expect the equal amount of refinement concerning perceived quality as customers in the premium segment consequently imposing a new trend. Yet, the R&D department of a luxury car manufacture is not equally constrained by production time and cost as their premium segment counterparts (Stylidis 2020).

## 2.2. Product Development & Creating Customer Value

To successfully develop and launch products to the market is an intricate process involving a large amount of problem solving and cross-functional integration (Johannesson et al., 2013). In order to prevail and even excel in product development, profound knowledge of the complexity, its context, actors and the methods, tools and execution is a requirement. The term “*product development*” could be interpreted as a common term for development of products which have unique prerequisites depending on business area, intended problem to solve, inherent complexity and the level of innovation (Johannesson et al., 2013). Product development could describe as a “*process*” and is frequently divided in phases to help structure the work. The structure of the process, number of phases etc., is distinct for each organisation. Each product has an inherent list of demands and expectations which is based on how the products intended, or expected, application area. The latter will have a significant impact on the components and the ingoing development work. Johannesson et al (2013) alludes there are two primary sources for initiating product development, i.e., *technology push* and *market pull*. Technology push refers to the organisation believes the technology it possesses has a vantage who could be exploited in terms of creating a need at the market, whereas market pull is concerned to identify market needs and subsequently develop an adequate product according to the need. Both have indeed its own advantages since technology push could potentially foresee the market demand and thus create a significant leverage towards competitors if first to market, i.e., *first mover advantage*. However, the potential hazard is the developed products is met with low enthusiasm leading to poor sales and revenue. Market need, on the other hand, is more of a safe card as it relies more on already existing technology and leans on market research and analysis to make decisions on what and what not to develop. Yet, the approach could compromise development of novel technologies and put greater emphasis on refinement and enhancement (Johannesson et al., 2013).

One of the major challenges of product development is to create customer value which according to Lindstedt and Burenius (2016) can defined as the perceived benefits of the product the customer gains in relation to the total expenditure in effort in terms of time, money etc., yielding:

$$\text{Customer value} = \frac{\text{Perceived benefits}}{\text{Total expenditure}}$$

The value the customer perceives can be further enhanced by satisfy more needs and expectations or by reducing the cost for an offered benefit. However, identifying the needs and expectations is far from always a straightforward manner due to the distinct uniqueness of each customer and their specific needs and expectations, leading to customers interpreting the same attributes differently. The customers will as well react different to price. Lindstedt and Burenius (2016) alludes the spectrum of value perception frequently bring additional challenges as the demand for customer tailored products essentially is an absolute most in order to achieve maximum customer value for a product. Consequently, adequately defining the intended market segment is an absolute necessity if the business will be successful in attaining the greatest customer value. Moreover, the customer value is not fixed or stagnated phenomena and will on the contrary constantly evolve by either reducing the expenditure or increasing the number of

benefits respectively for the customer. Another challenge of creating customer value is to convey the business *value proposition*, which is a statement capturing the essence, purpose and the potential value delivered to the customer (Nusem & Starker, 2019). Thus, the value proposition is what the organisation does to create value for the customer and in extension, itself.

Even though a value proposition is defined and formulated the need to measure customer satisfaction will remain. Frankly, the relationship between satisfaction is not complicated and consequently would a greater customer satisfaction yield greater customer value. Thus, objectively measuring the customer satisfaction could be an advantage for ensuring customer value. Fortunately, the *Kano Model* offers the possibility to effectively elaborate on the relationship between satisfaction and product criterion performance and appraise the importance to customer satisfaction. The Kano Model was first proposed by Noriaki Kano in 1984 and intendeds to distinguish the expectations and what attributes to prioritise in order to achieve maximum customer satisfaction (see figure 4) (Južnik Rotar & Kozar, 2017). The attributes are occasionally referred to as *qualities*. The model comprises two-dimensions and three distinct quality categories, namely *must-be quality (or basic quality)*, *one-dimensional quality (or performance quality)* and *attractive quality or delighters*. The vertical dimension measures satisfaction versus dissatisfaction whereas the horizontal dimension answer how sufficient the attribute is (Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017). The outlined categories are depicted accordingly:

- *Must-be quality* are attributes that must be fulfilled for the customer to be content with the product and could only yield dissatisfaction if the performance of the attribute is perceived to be subordinate. Even though the performance is superior for a must-be quality attribute can the satisfaction never rise above the neutral level. Thus, the customer is *indifferent* towards the attribute and regards the attribute as a prerequisite. Nevertheless, the integral importance of must-be attributes should not be evaded since if they are not fulfilled the customer interest of the product might be non-existing (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017).
- The *performance attributes* are linear, meaning high attribute performance yields high satisfaction and the customer satisfaction is proportional to the level of fulfilment. Luckily, the performance attributes are normally articulated by the customer (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017).
- *Attractive attributes* are non-articulated expectations that the customer has difficulties to define. Hence, products having attractive attributes will lead to an increase in customer satisfaction, however, in cases they are not defined and featured will the satisfaction not be affected negatively as they are not expected. They will be a delight for the customer, though (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017).
- However, it may be qualities that have the opposite effect, i.e., qualities impairing customer satisfaction, so called *reverse attributes*. Thus, the more of the reverse attributes, the more dissatisfied the customer becomes.

Each identified product attribute should be ranked based on a set of questions, accordingly. The question inquires whether the customer would be *satisfied, judge the attribute should that way,*

*indifferent, can live with it or dissatisfied* with the suggested attributes. The studies performed by Chen and Chuang (2008) and Južnik Rotar and Kozar (2017) inquire the aesthetics of products and intangible aspects of sales, respectively, and highlights the model's potential to create a vantage. The model offers enhanced understanding of the customer requirements and key factors that could propel the customer satisfaction as well as offering prediction or indication of what creates value for the customer.

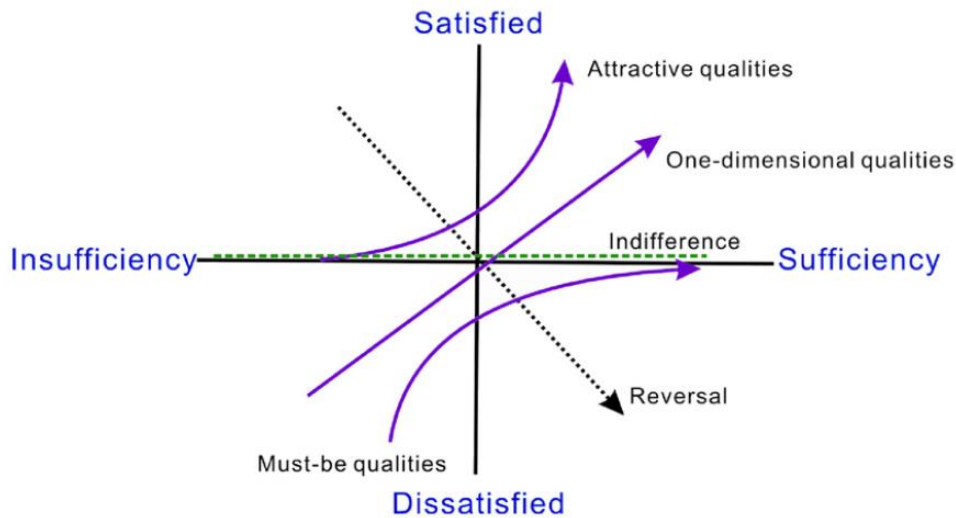


Figure 4: the Kano Model, introduced by Noriaki Kano in 1984 (Chen & Chuang, 2008).

According to Matzler et al (1996) the advantages of deploying the Kano Model to classify customer requirements and expectations are numerous. The authors allude the requirements that are being stipulated on the product is more thoroughly understood regarding customer satisfaction, in addition to facilitating what to prioritise in product development. For instance, development of attractive- or performance attributes should be prioritised over must-be attributes, especially if determined to perform at the desired level. Moreover, the model has the ability to resolve trade-offs situations when two or more competing attributes cannot be fulfilled simultaneously due to technical or financial reasons, for instance, as the attributes have been appraised and categorised accordingly. Consequently, the attribute with greatest value for the customer should be selected. The deployment of the method could also be advantageous for creating tailored solutions for specific market segments as high-end segments will regard and perceive attributes such as must-be different compared to low-end.

In order to the master thinking behind customer value and get the maximum possible out of it, the customer interaction points with the product and the organisation must be thoroughly understood. Consequently, Lindstedt and Burenius (2016) suggest a five-phase approach to analyse the customer interaction, dividing the interaction the phases of *prospect, buyer, recipient, user* and *decommissioner*. The first phase emphasises improving the *image* of organisation which conveys a message of how the customer perceives potential benefits and value. The value is the cornerstone in the second phase since customer evidently requires the maximum *value* for money which goes hand-in-hand with the third phase where *precision* is emphasised. In this instance, precision refers to delivering at the right time, the right things and in the right way as well as conveying the correct information. In the user phase is *quality* the

key word as the customer value will be greater the longer the product maintains its quality, thus ability to delivery over time. In the last phase *recycling* is the key word.

However, the importance of product development has never been so pivotal as now as the competition has become increasingly fiercer, product lifecycles shorter and market segment progressively more shattered, for instance Stylidis (2020). Even though a car manufacturer, for instance, today is regarded to be world leading within its segment, the challenge is far from over as underdogs could lure in the dark with avantgarde technologies or concepts turning the show upside down in an instance. Hence, the main challenge of the past of becoming a market leader is now contested by the challenge of staying lucrative and compatible in today's market and still maintain consistent profitability and continuous growth (Lindstedt & Burenius, 2016). Therefore, recognising the pivotality of product development is consequently an absolute necessity. Utilising tools and methods like, for instance, *Design for Six Sigma* to *Design it right the first time* and *Do the right thing all the time* offers the plausibility to identify factor critical to satisfaction and construct a system resilient and robust to variation (Yang & Basem, 2009).

What are the causes for initiating a new product develop project or triggering new inquiries from customers? Products will, evidently, at some point in time reach their end-of-life and Karana et al (2014) alludes the end-of-life of a product is governed by mainly six reasons:

- a) *Physical life* implying the product is beyond what is plausible to repair due to monetary reasons.
- b) In case the need for the products cease to exist, the product has reached its *functional life*.
- c) When new advances in technology, leading to old products are outpaced in terms of performance, the *technical life* of the older products comes to an end.
- d) New and perhaps avantgarde design and technology paves the way for new products with the same functionality but with lower operating cost, thus making existing products antiquated regarding *economic life*.
- e) The *legal life* is governed by directives, legalisation, standards etc., and revision of those can make the product illegal.
- f) As time goes by fashion, taste and aesthetics develops and could yield the existing products become unattractive. Thus, the product has reached the end of its *desirability life*.

Subsequently, products coming to an end-of-life, regardless of reason, will create a void needed to be filled with a new product, capable of surpassing shortcomings of the out-dated product. However, the "cause of death" might not single handely rely on one reason, as the causes may be several. Thus, the subsequent need for product development might be complex and intricate, alluding the motives must be understood thoroughly in order to develop a product capable of bridging the gap and capturing the market needs and expectations.

### 2.3. “Tell me why” – Why Everything Starts with Why

Asking question fosters curiosity, relationships and is process of discovery and is indeed a natural behaviour. However, asking the right questions is more difficult (Finlayson, 2001). According to Finlayson (2001), too much effort is put on finding the right answer rather than articulating a correct and exhaustive question that can derive the right answer. Equally important is formulating the question clearly and presenting it in a way that signals its significance, so the respondent perceives it as meaningful rather than redundant or trivial. This is essential to avoid misunderstandings or stalled discussions (Finlayson, 2001). Unfortunately, asking questions are in some instances completely avoided due to the fear of getting in trouble, confrontation, being intellectually inferior or simply a fear of information overload. Yet the upsides of asking questions are several such as increased creativity and effective action. Questions with the power to motivate and encourage creativity, for instance, are *why*, *why not* and *so what* and according to Finlayson (2001) it is about creating a positive question culture. Finlayson (2001) alludes the process of enquiring the right questions starts with developing an awareness of *what do I really need to know* as it proposes three advantages, namely *getting the right attention*, *verify what is already known* and *establishing goals*.

Simon Sinek (see figure 5) outlines a concept called *the Golden Circle* composed of three layers, i.e., *why*, *how* and *what* (see figure 6), to better understand the value of the business through an enhanced understanding of *why*. The concept suggests that first an organisation must understand *why* the activities are performed before answering *how* the key activities are realised, prior to answer *what* the organisation do, in other words inside-out thinking (Nusem & Starker, 2019). The Golden Circle was inspired by the *Golden Ratio*, or *sectio aurea* in latin, which is a mathematical formula describing proportions (Sinek, 2009).



Figure 5: Simon Sinek presenting his “Golden Circle” at his TED Talk. Sinek’s TED talk is one of the most popular to date (Sinek, How great leaders inspire everyone to take action - TED Talk, 2009).

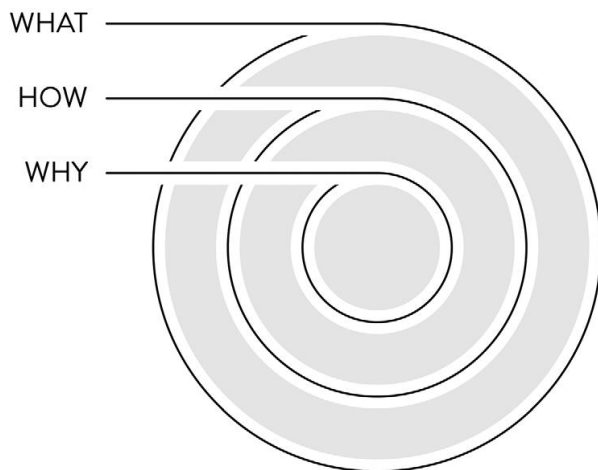


Figure 6: the Golden Circle as depicted by Simon Sinek (Nusem & Starker, 2019).

Sinek (2009) alludes most businesses do not know why their customers are customers in the first place or why they choose their product over competitors and consequently does not actually understand what creates value. What is more, when the message of *why* is transmitted and intercepted accordingly, the process starts with understanding *how* the product could be utilised in a specific context and *what* specifications the product should have. Starting with showcasing *what* a business can provide and *how* the activities are performed yields poor arguments to *why* the product has the potential to solve a specific issue (Sinek, 2009). For instance, why does people purchase an Aston Martin DBX over an equivalent sized SUV from, let say KIA? Both have the ability to take a person from A to B, i.e., *what*, and both is a technical composition capable of propelling the car forwards with help of a four- or eight-cylinder engine, i.e., *how*, however, *why* they do it completely different. In KIA's case, *why* is presumably a mean of everyday transportation whereas Aston Martin wants to create an experience and perhaps an articulation of individual expression. Thus, the level of aspiration is widely different and *why* they do it is in stark contrast to each other. Then it does not become too challenging to decipher *why* certain individuals never would select a KIA over an Aston Martin.

Furthermore, the part of the brain that control decision-making does also control the part controlling feeling, trust etc., however, does not have the capacity of analytical considerations or language (Sinek, 2009). Consequently, humans have difficulties when expressing *why* option A was selected over B, or why two people love each other. In those cases, people tend to rationalise and talk around the decision. For instance, "I love him since he makes me complete" is an attempt to express a feeling but does not suggest *what* it mean or *how* that could be achieved (Sinek, 2009). Hence, the trick is to capture the feeling.

According to a study performed by Nusem and Starker (2019), an overwhelming part of the 100 asked organisations (61 %) had their value proposition in *what* they do. Comprehending *why* creates a vantage in terms of learning to know *how* and *what* creates value for the customer and, subsequently, the organisation. Nusem and Starker (2019) underline its integral importance, and Simon Sinek alludes in his interview with Lily Halpern (Halpern, 2015) that comprehending *why* has the plausibility to bring people together, tear down antagonism and reveal the problem in plain sight. However, the *why* should be recognised from both an

organisational and a customer point of view respectively and should combine both inside-out and outside-in perspectives in order to disclose the misalignment between customer and organisation. Likewise, the dual perspective is integral to understand how the organisation and its product, services etc., is perceived. Thus, when applied, a dual perspective must be undertaken to inquire the value definition through identifying the touch points between organisation and customer. Although deriving a value proposition by comprehending *why* before *how* and *what*, could be an intricate issue will the upsides, however, be worth it since it yields clarity, direction and alignment of value (Nusem & Starker, 2019).

Nusem and Starker (2019) drafts an approach, *the Value Definition Model*, consisting of four parts in two horizontal and vertical dimensions respectively (see figure 7). The horizontal dimension is correspondingly divided in a customer and organisation segment, where customer is the left segment, and the organisation represents the right segment, conversely. Proceeding to the vertical dimension which comprises segments of inside-out-and outside-in thinking, accordingly. Questions are subsequently assigned the dimensions and segments and are depicted as follows:

Organisation perspective:

- Outside-in:
  - I. *What does the organisation do?*
  - II. *How does the organisation perform its key activities?*
  - III. *Why does the organisation perform these activities?*
- Inside-out:
  - I. *Why does the organisation provide value?*
  - II. *How does the organisation provide value?*
  - III. *What value does the organisation provide?*

Customer perspective:

- Outside-in:
  - I. *What does the customer think the organisation does?*
  - II. *How does the customer think the organisation performs its key activities?*
  - III. *Why does the customer think these activities are performed?*
- Inside-out:
  - I. *Why does the customer value the organisation over its competitors?*
  - II. *How does the organisation communicate its value to customers?*
  - III. *What can be done to reinforce the value provided to customers?*

# Value Definition

ORGANISATION NAME: \_\_\_\_\_

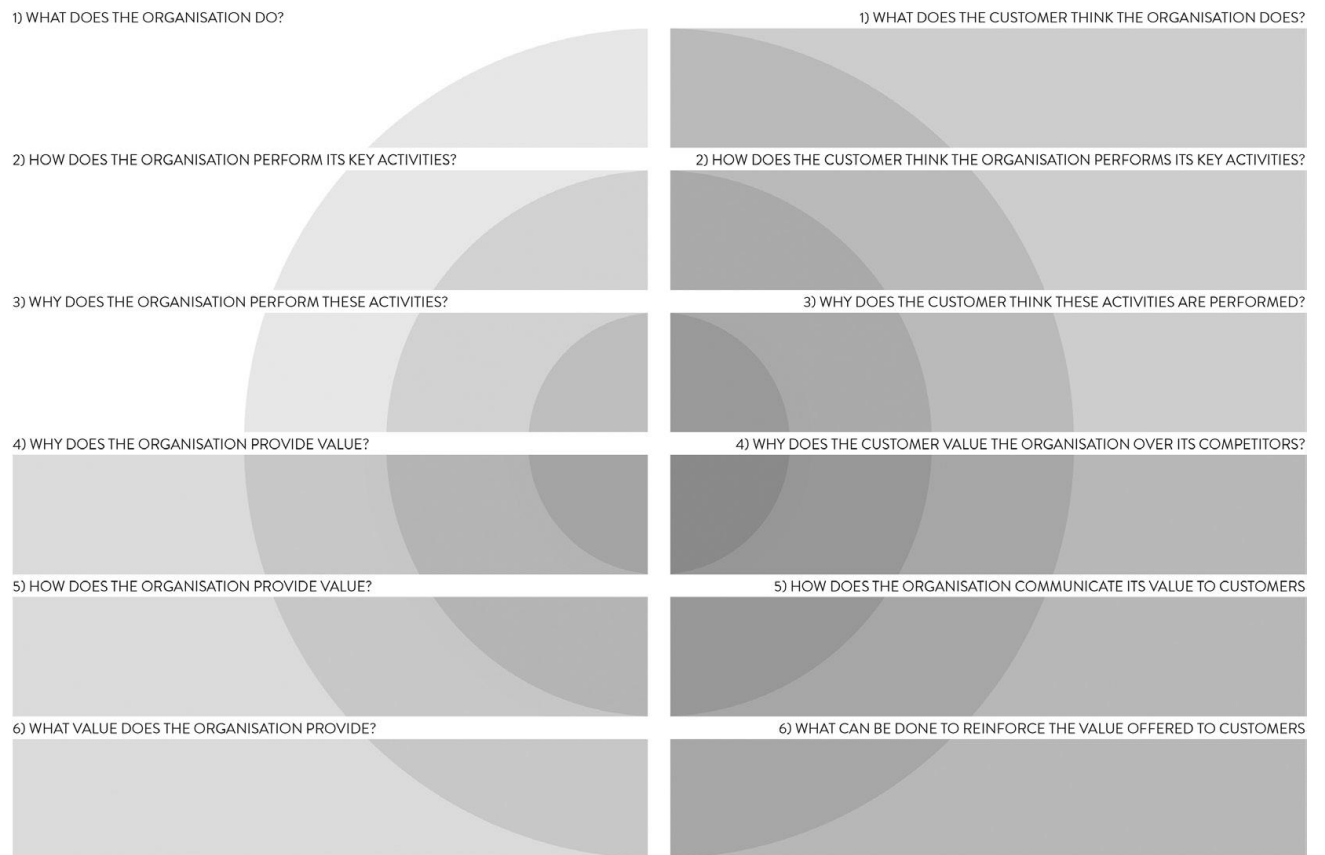


Figure 7: the Value Definition model as outlined by Nusem and Starker (2019).

## 2.4. Design for Six Sigma and Lean Production Principles

The main intent with Design for Six Sigma is to enhance the products developed and manufactured with respect to quality, reliability, customer value and cost (Yang & Basem, 2009). Yang and Basem (2009) alludes manufacturing and design organisations mainly are occupied in elementary modes, namely *fire prevention* and *firefighting*. The first mode means the organisation is successful in developing products and deliver to the potentials although organisations, unfortunately, spend most of the time in the latter mode devouring resources. Fortunately, DFSS has the potential of improving the fire prevention and limit the time spent firefighting. Correctly utilised, DFSS has the power to virtually mitigate all downstream corrections since it emphasises *design it right the first time* through targeting design vulnerabilities. The design vulnerabilities are to be divided into *conceptual-* and *operational vulnerabilities* and concern violation of the basic defined design rules and insufficient robustness respectively and ultimately yielding excellence in designing of product, manufacturing operations, business- or service processes. Complying to the statement will return increased customer satisfaction and more lean in-house operations. The organisation can subsequently focus on *do the right thing all the time*, meaning that the process always delivers what it was designed to do. The latter of the two imperative statements regards achieving high consistency and minimal variability, i.e., *six sigma*, leading to superior performance (Yang & Basem, 2009). Consequently, the overall aim is building in robustness in the design of product development- and manufacturing operations for instance, in order to ensure the process, whatever it might be, can handle variation and always perform what it was designed to do.

The deployment of the DFSS introduces several vantage points which if utilised properly could impose a significant leverage for development projects and the organisations embracing DFSS. One key vantage point is the mitigation of waste associated with product development. The wastes can be characterised in multiple categories, however, the *wasted sale opportunities due to poor value* can successfully be mitigated by DFSS whereas the others require the deployment of Lean management tools (Yang & Basem, 2009). The following items are included in the category:

- Limitations or lack of ability to adequately capture the voice of the customer (VOC).
- Limitations or lack of ability to adequately decode VOC and translate it into appropriate design.
- Inferior choice of technologies.
- Inferior or impaired innovation capabilities.
- Failing to align the innovation with VOC.
- Inferior reliability, quality and robustness in designed product.

In addition to mitigate the wastes mentioned above, the chances of preventing costly late minute changes to design increases extensively by utilising DFSS. The late minute changes could potentially be a direct effect from one of wates since, for instance, the designers first discover that VOC has been wrongly decoded leading to changes are required trying to remedy the issue. Thus, the deployment of DFSS yield enhanced ability of preventive action and decrease the need for corrective actions.

Design for Six Sigma follows like downstream Six Sigma a stratified approach consisting of four phases. The four phases *Identify requirements, characterise the design, Optimise the design* and finally *Verify the design*. However, other roadmaps exist such as *DMADV, DCOV* or *IDOV*. In order to comprehend the subtle differences in nature, *DMADV* and *DCOV* approaches is briefly outlined below:

- The acronym *DMADV* stands for *Define, Measure, Analyse, Design* and *Verify*. The different steps are decoded as follows (McShane-Vaughn, 2023):
  - a) **Define.** Here *define* emphasis interpreting the customer and market needs, requirements and expectations on the new process or products, unlike the define phase in DMAIC which regards defining the problem. The project goals must be set and documented in a project charter.
  - b) **Measure.** The *measure* phase concerns capturing the *Voice of the Customer* (VOC) and *Quality Function Deployment* (QFD) is often deployed in this phase.
  - c) **Analyse.** Here should the best concept and design be analysed and selected according to the customer and market requirements, needs and expectations.
  - d) **Design.** In the *design* phase should the process or product consequently be designed. Tools and methods as pilot trials, simulations, prototyping and models are highly encouraged.
  - e) **Verify.** Like the control phase in DMAIC there the proposed action or actions must be ensured that they perform as intended, must the suggested design be verified in order to see if it conforms with customer requirements. However, the author imply the terms “*verify*” is more concerned of ensuring compliance more than ensuring effectiveness of the design process and how capable it is of meeting the requirements of the final product or process. Hence, the authors propose that the team also should *validate* the design in order to check the design effectiveness.
- *Design, Characterise, Optimise* and *Verify/Validate* approach emphasis creating robustness of a product or process and thus excelling customer satisfaction (McShane-Vaughn, 2023).
  - a) **Design.** The design phase aim at decoding the customer and identifying *Critical to Satisfaction drivers* (CTS) and their related functional targets.
  - b) **Characterise.** The phase involves two main activities. First to breakdown in the identified CTS’s into specific outcomes, i.e., big Y:s, and characterise the robustness opportunities of each Y. The second activity is to functionally map the CTS to *Critical to Quality* (CTQ) design parameters, i.e., the x:s, and find a suitable strategy to deliver the robustness.
  - c) **Optimise.** There should the product be design in a robust manner in order to minimise the sensitivity of the product to potential disturbing conditions from manufacturing and usage. Even though the product is subject to robust design should the process in which the product will be manufactured be designed to handle incoming variation.
  - d) **Verify/validate.** Performance is verified and validated by performing tests and performing pilot trials. In addition, the results from the tests and pilots can be utilised to assess future robustness and performance.

Despite the roadmaps utilises essentially the same tools the *IDOV* approach, according to Yang & Basem (2009), undertake a slightly different angle of attack and applies some nontraditional tools. Additionally, the *ICOV* methodology emphasis to a greater extent the voice of the

customer and robustness as well as developing process from scratch whereas DMADV and DCOV have greater focus and somewhat narrower focus on the product development itself (Yang & Basem, 2009). Judged on the nature of the project, i.e., the outskirts of product development, the ICOV methodology was deemed to be most suitable. The phases will now be further depicted in order to understand the purpose, goals and deliverables of each phase.

The *Identify requirement phase*, henceforth denoted as *I-phase*, entails two steps. The first step focus on drafting a project charter and has stark resemblance with D-phase in a DMAIC improvement project. However, DFSS project tends to stretch over a longer period of time and normally is the initial project spendings higher. The underlying reasons are there is more customer requirements to be recognised and defined in addition to identifying all *critical-to-satisfaction* (CTS) metrics which generally are more limited in a DMAIC project. In order to obtain necessary information regarding the customer may market- and customer segment research be needed. In the proceeding step shall the customer- and business requirements be identified and tools like *Quality Function Deployment* (QFD) and Kano-analysis are powerful tools to collect, analysis and articulate the customer needs and expectations. With help of Kano and QFD can the CTS be quantified in terms of numerical limits and targets and the CTS should subsequently be characterised accordingly, i.e., critical to quality, delivery etc. Consequently, the first phase should return the *Voice of the Customer* (VOC) by deriving the needs, wants and expectations. The VOC is then translated into measurable metrics (Yang & Basem, 2009).

The subsequent phase, *Characterise design* or *C-phase* for short, contains three major deliverables: *decoding the CTSs to product and process requirements*, *formulate design solutions* and *assessing the design alternatives*. Directly using the CTSs as product and process requirements will not be plausible and decoding them with, for instance, QFD is necessary. While formulating design solutions must the functional requirements previously identified be kept in mind and the step will certainly comprise product development methods, especially if novel- or improvements of existing technologies are required. After generating a set of design solutions must they be evaluated accordingly. Product development evaluation methods like, the Pugh decision matrix, Kesselring matrix etc., could present a feasible way for assessing and evaluating the alternatives at hand. To be underlined, however, is the weaknesses and flaws detected during the evaluation could be corrected as long as proof-of-solving the problem is valid (Yang & Basem, 2009). The solutions passing through the evaluation have the potential to be optimised and enhanced which is the main objective in the third phase; *Optimise the design phase* or *O-phase* henceforth. The O-phase should inquire whether the design can be optimised or not and if so, how. Proceeding to the final phase, i.e., *Validate the design phase* or *V-phase*, there the chief objective is to ensure proof-of-concept. Ensuring proof-of-concept normally encompass pilot tests and additional refinement before making the final validation and control plan. In resemblance with a DMAIC project one need to establish control plans to assure the critical characteristics are delivered on. In the last step is the project deliveries commercialised, and a handover is made to the process owner (Yang & Basem, 2009).

The advantages from the practices and philosophy of Lean production are indisputably recognised by an array of literature and research projects. Perhaps one of the most notable writings on the subject is the book “*the Toyota Way - 14 management principles from the world greatest manufacture*” by the eminent Prof.Dr Jeffery Liker (Liker, 2020) in which Liker dissects and explain the elements of *Toyota Production System* (TPS), spearheading the way for Lean principles and production philosophies. Despite Lean principles and TPS habitually are associated with production of cars, airplanes, medicines etc., are they far from limited to hardware production and could be adopted in product development, service processes and more, yielding the same advantages (Yang & Basem, 2009; Liker, 2020). Yang and Basem (2009) suggest then the Lean principles are applied in contexts like product development, should the principles instead be referred to as *Lean operation principles*. Although referred to differently, the objective is mutual: to detect waste and other non-value adding activities and erase them and thus enhancing the process efficiency (Yang & Basem, 2009; Liker, 2020).

One key element of Lean operations is the *pull-based flow* (Yang & Basem, 2009). In a pull-flow is the direction of information inversed to the actual direction of the process. The customer or one making the order trigger the last step of the process to start which in turn tiggers the preceding step and that continues to information string has reached the outskirts of the project. Thus, the process is *demand-driven* rather than the *push-flow* which in contrast has the information flow in the same direction as the actual direction of the process. The push-flow delivers not matter if the demand downstream exists or not and does, consequently, “push” or force the products or services on to the market. The risk is that the push-flow produces goods that is redundant. One of the great vantage points with a pull-based flow is the demand is derived and created based on an existing demand, conversely to the push-flow.

Likewise, a production process, does a product development process contain wastes. According to Yang and Basem (2009), the product development process complies to the Lean operations principles by identifying the Voice of the Customer (VOC) and successfully translate the VOC to excellent quality at high pace and low cost, thus achieving high product value and quality at low production cost and persistently striving for an even more efficient and effective development process. As discussed, the main objective with the Lean principles is to eliminate waste and other non-value adding activities in order to improve process efficiency, however, the seven plus one wates normally seen in manufacturing operations appears in various shapes in a product development process. Yang & Basem (2009) imply the wastes associated to product development best is described and understood when characterised in waste categories. The categories are:

- a) *Wasted sale opportunities due to poor product value*
- b) *Waste in manpower, resources, and time*
- c) *Waste in knowledge and information*
- d) *Waste due to poor design*

*Design for Six Sigma* (DFSS) can adequately address the first category of waste (DFSS is dissected in the methods chapter), however, the remaining three requires Lean deployment. Yang and Basem (2009) outlines six Lean development approaches, though three of them will be elaborated in the literature review, namely *Lean task management*, *improved stage-gate*

*process* and *set-based design*. Set-based design, also referred to *set-based concurrent engineering* (Ward et al.,1995), is utilised by Toyota to enhance their product development process. The idea behind set-based concurrent engineering is to delay decision making to the latest point possible in order to collect all the necessary information (Ward et al., 1995). Starting off with a wide range of alternatives to gradually eliminate inferior alternatives until the latest feasible decision point and thus elaborate on sets of solutions instead of pursuing one. However, the development work at Toyota is surrounded of guidelines in style of so-called *white books* or *lesson learned books* in order to constrain e.g., the styling process, although project may be largely unconstrained when exploring new territories. Toyota explore a large number of concepts concurrently and the concepts are realised in large clay models, and delay to establishing key dimension parameters as well as delaying the release of final specification to suppliers in order to get as much information as possible. The model of Toyota's set-based concurrent engineering can be framed in a five-step parallel approach. In the first step does the team define a set of solution on a system level rather than looking on to a single solution, followed by the second step where development of solutions for various subsystem to the concepts. The third step entails parallel exploration of the subsystem using analysis, design rules and experiments to define an outcast of solution to the sets. The fourth step is characterised by the narrowing the funnel of potential solution towards one potential solution through utilising the analysis conducted in the preceding step. In the final step is the most promising solution selected and will not be changed if not deemed to be absolutely necessary.

The advantages with Toyotas approach are summarised in five key phrases:

- I. In contrast to the conventional point-to-point model will the set-based concurrent engineering ensure *reliable and efficient communication patterns* as communication describes the whole set of possible solution and remains valid even when the set narrows due to supplementary information. Changes made in the conventional model may lead to invalidation of previous decisions.
- II. *Parallel work and exploration are enabled in the set-based concurrent engineering in addition to more effective use of subsystems.*
- III. *Critical and early decisions are made on empirical data.*
- IV. *Promotion of institutional learning.*
- V. *Allow exploration of the most potent design.*

The improved stage-gate process is an improvement of the ordinary stage-gate process (Yang & Basem, 2009). The stage-gate process regards product development projects as a process and as a process can the product development process be refined and enhanced continuously. The process is divided into stages or phases, where each stage is preceded by a decision point, or a go/kill point called *gate*. Depending on the outcome of each review at the gate is the road either closed or opened for further work and acts as well as quality check point. The common format of a gate is the *input*, consisting of a predefined list of deliverables that the project leader should be able to present, followed by the *criteria*. The criteria articulate the conditions on which the project should be judged and depending on the judgement will the *output* be a kill, go, hold or redo with an approved action plan. To be noted, the appraiser of the project progress, i.e., the judge, is the project sponsor. The improved stage-gate process suggest that the time consuming and tedious elements of the original process could be surpassed having stage overlapping,

meaning different stages work concurrently instead of waiting until the first stage is complete. However, relying on overlapping to enhance the efficiency would presumably require an increase of cross-functional integration and improved communication patterns and will impose vantages like strong performance when markets are dynamic and time is at the essence (Wheelwright & Clark, 1992). Wheelwright and Clark (1992) outline *serial mode*, *early start in the dark*, *early involvement mode* and *integrated problems solving* as four possible communication patterns and the authors argues the level of richness, mutually and intensity are key factors for enabling effective cross-functional integration. Thus, in case of product development and eliminating, or even preventing waste, is presumably the latter two modes the way to pursue. In the *early involvement mode* are the groups engaged in more interactive communication patterns and the upstream group shares insight regarding design, analysis and tentative proposal with their downstream colleagues long before the design is handed over. Communication is also transmitted from the downstream group on e.g., process capabilities. Two major benefits are entailed in the approach. First, the upstream engineers develop a better understanding of the challenges facing their counterparts and second, the sense of the issues and constrains become embodied in the design. the *integrated problem solving*, there downstream engineers participate in dialogue and shares information with the upstream counterpart. The information and insights are then utilised to get a flying start. Key issues in order to be successful with the approach is the communication must be rich, bilateral and intense.

## 2.5. Theoretical Framework – Analysis

The literature review has explored the nature of quality perception and the definition of quality. The review discloses that defining quality is an intricate matter since many definitions coexist and perhaps a single definition might not be sufficient. Yet, the five-way approach to quality and the eight dimensions of quality by Garvin (1984) offers the prospect of solving the inherent conflicts that many times exist between the R&D-and manufacturing department as Garvin (1984) alludes the one definition is inadequate to articulate and define the customer expectations. The expectations will certainly not be static as the product progress through the organisation and the requirements identified by R&D must be translated to terms manufacturing engineers comprehends in order to yield the desired quality. The importance of understanding perceived quality and its implications is instrumental in the automotive industry today, due to the increased competition and market fragmentation. In addition, the premium and luxury segments have become more intertwined, making it more difficult for automotive manufactures to comprehend the market. Perceived quality is constituted by tangible- and intangible aspects respectively, where the tangible aspects generally concern the engineering specifications and the intangible aspects concern brand image- and heritage, aesthetics and general emotional appeal. Likewise, research does also reveal perceived quality is mediated manufacturing methods, like utilisation of traditional methods which is perceived by customer to benefit cultural preservation and positively affects factors like purchase intent and *willingness to pay* (WTP) (Wilcox et al., 2023). The aspects influencing the post-purchase behaviour have as well been explored and recognised as important to the perceived quality of a car (Souki et al., 2018).

The proposed *Perceived Quality Framework* (PQF) and *Perceived Quality Attributes Important Ranking Method* (PQAIR) by Styliadis et al (2015) and Styliadis (2020), empirically validated by Söderberg et al (2020), divides perceived quality in two dimensions, i.e., *Value Based Perceived Quality* (VPQ) and *Technical Perceived Quality* (TPQ). The framework manages to articulate and breakdown the response triggered by the sensorial apparatus into attributes, which importance can be ranked with PQAIR method. Hence, PQF and PQAIR constitutes a method of defining perceived quality and in extension indicate where to put development- and final efforts. However, PQF and PQAIR respectively is more concerned with product design evolution, which should be noted. Braun et al (2024) introduces *cognitive quality* as an additional dimension to the framework seems appropriate due to the perception of aesthetics- and functionality is not necessarily encompassed by VPQ and TPQ. The ground attributes are already identified, perhaps limiting development projects to not inquiring additional aspects. Carlsson and Mathiasson (2020) succeed to bring greater understanding of which attributes of a car interior that influences the customer to perceive whether the car is premium or not. Subsequently, they proposed eight design guidelines; however, the study was performed in Sweden and could consequently emphasise attributes important to the Swedish clientele, thenceforth the guideline might not be generalisable for other markets. Yet, the first impression and interaction with the product and its interface proves to be instrumental for the overall quality perception, correlating with findings like Braun et al (2020) or (Styliadis 2020). Moreover, the formulated guideline is a guideline, meaning it is a tool to appraise attributes rather than a method to define which attributes are perceived higher. Yet, the literature study

showcase perceived quality is a rather explored and understood concept, that is its implication and meaning for the automotive industry.

The review highlights the highly complex nature of perceived quality and that much research has indeed inquired the many aspects of it. Thus far, the research has mainly focused on trying to understand the constituting elements of perceived quality and have been successful in addressing the tangible-and intangible aspects, however, the research on how to define and articulate perceived quality in order to create pull-thinking concerning perceived quality in early and initial phases of product development is yet to be discovered. Despite the PQF and PQAIR method (Stylidis et al., 2015; Stylidis 2020; Söderberg et al., 2020, Braun et al., 2020), offering some possibility to create a pull-thinking, i.e., the attributes are derived from the customer rather enforcing the attributes on them, regarding perceived quality, a more extensive method or theory is required. The review also points at the progressively more competitive automotive market with many pitfalls to step into, implying that it is increasingly more important to get it right from the first time. Consequently, the void in knowledge is how to create a pull-thinking and define the most important perceived quality attributes each unique customer context in the initial phases of product development inquiries. Additionally, the literature review reveals the integral importance of customers quality perception on the total quality experience and how well the delivery aligns with the expectations.

Existing research does also highlight the importance of creating customer value and excel on customer satisfaction in order to remain competitive and not lose ground to potential underdogs who might sail up with new avantgarde technologies and vantage points (Johannesson et al., 2013; Lindstedt & Burenus, 2016). Consequently, exceling on product development by designing a product development process capable of attaining all customer expectations, requirements and comprehend why a need for development is thus pivotal. Fortunately, successful deployment of methods like *Design for Six Sigma* could streamline the process by designing an insensitive process to variation which reduces wastes like rework due to erroneously interpreted customer needs and expectations (Yang & Basem, 2009). Additionally, the use of Lean Production Principles as outlined by Yang and Basem (2009) and Liker (2020) could forcefully reduce the amount of non-valuable activities. Depicted are also methods, tools and techniques proficient to reduce variation and improve collaboration, e.g., communication patterns or concurrent engineering (Wheelwright & Clark, 1992; Ward et al., 1995). Moreover, the Golden Circle might be advantageous to utilise in contexts like product development to develop an enhanced understanding of why the customer expect certain characteristics of the product but also articulate the most favourable way to execute the characteristics and attributes (Sinek, 2009; Južnik Rotar & Kozar, 2017). According to research performed concerning the Kano Model, the model offers several advantages in terms resolving trade-offs or what to emphasis in the project, for instance, and the model is described to yield an improved understanding of the customer (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017). Hence, the additional research is required to investigate the potential vantages points and synergies of deploying the thinking behind the Golden Circle and Kano Model in a product development process and inquire whether it aligns with the ambitions of Design for Six Sigma.

To conclude, failure to understand and articulate the customer needs and expectations will negatively affect the customer satisfaction and in turn the perceived customer value. Failing to do so will yield inferior quality perception and subsequently impair the total quality experience. As of today, extensive research has been performed, enabling frameworks and methods, e.g., PQF, PQAIR and the Kano Model, capable of inquiring customer expectations and attributes and how they influence the value proposition and satisfaction, and subsequently perceived by the customer. Yet, the use of the methods has a prerequisite, namely that the attributes and expectations already have been identified which can, however, in many instances be the most difficult issue to solve (see figure 8). Consequently, additional research is required to present a feasible and reliable way to identify and articulate them before they can be further scrutinised. Thus, the need of this MSc thesis has been revealed.

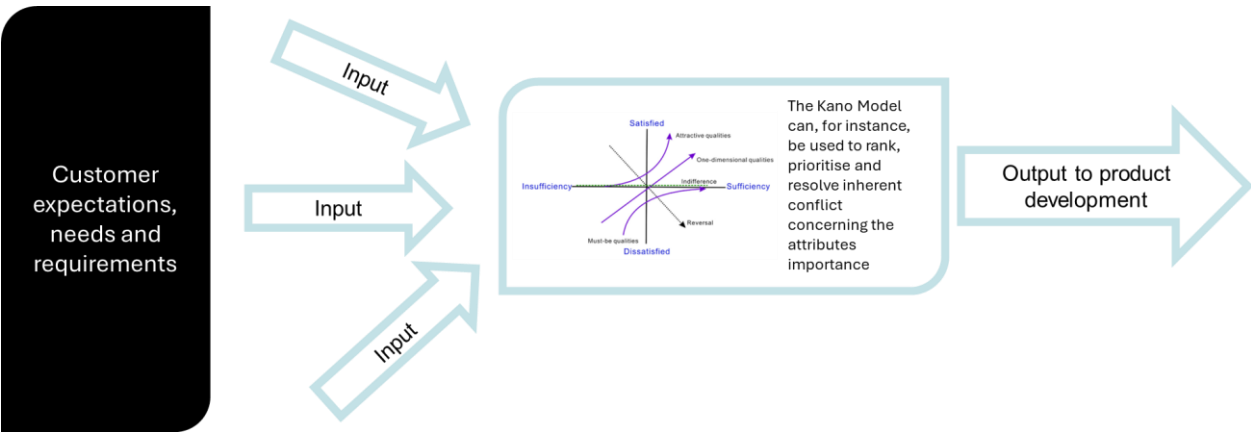


Figure 8: the customer expectations, needs and requirements can be rather intangible and are consequently difficult to identify and articulate accordingly. Here, portrayed as a black box. Yet, many of the methods that exist to help to resolve inherent conflict between the attributes, like the Kano Model, requires that all necessary information concerning the customer is known prior to the deployment of the method.

### 3. Method

The utilised research method and approach is outlined in the method chapter. First, the method of choice is presented, i.e., Six Sigma, and its vantages points are conveyed, discussed and elaborated accordingly. In the proceeding and second section is the general research strategy- and design presented and discussed.

#### 3.1. Six Sigma

Six Sigma is an improvement methodology that provides organisations with an adequate toolbox to improve capability and performance metric. Likewise, it could be referred to as a business philosophy enabling superior quality through controlling and reducing variation as well as empowering continuous improvement (Yang & Basem, 2009; Carleton, 2018). By utilising the DMAIC approach can the methodology be deployed in various business contexts and help to govern and steer the work. Yang and Basem (2009) describes Six Sigma as "*an extremely successful business management system*" (p.21) and emphasis the vantage point the deployment of Six Sigma creates for an organisation with an increase in performance on behalf of a decrease in variation, thus propelling enhanced quality, profits, morale and eventually; spearheading business excellence. The name *Six Sigma* is directly derived from statistics and its terminology, where sigma ( $\sigma$ ) denotes variability of a process and is defined according to the specification limits, thus the degree of variation. The essence is the greater sigma value a process achieves, the fewer defects the process generates and in the case of a process complying to six sigma limits will only 3,4 defects occur per million opportunities (DPMO) (Carleton, 2018). Despite Six Sigma habitually is associated with improvement of product quality when applied to processes, the application area is certainly not restricted to just product quality since the key processes of the business operation can benefit from its deployment. The main task of the Six Sigma improvement methodology is to identify root causes and find adequate solutions, derived from a highly data and fact-based approach, but does not concern redesigning the structure of the underlying process. If the process is judged to require a fundamental redesign, then *Design for Six Sigma* (DFSS) should be utilised instead. DFSS is referred to by Yang and Basem (2009, p.57) as "*Six Sigma going upstream*" by building in system reliance to incoming variation. For DFSS, see *Design for Six Sigma and Lean Production Principles*.

Six Sigma has its roots in the American electronic equipment and components manufacturer giant *Motorola* who during late 1970s had become increasingly aware of the superior quality performance by their Japanese counterparts. Efforts leaning on statistical tools trying to enhance the performance were launched in 1981 and increased quality and customer satisfaction could be noticed, respectively. Even though ambitions and mind set indeed were high, the performance was still deemed to be inferior and thus yielding more measures aimed to tackle the issue. The new improvement initiative intended to bolster the process performance by stating that the processes should achieve 3.4 defects per million opportunities, thus not varying more than *six sigma*. The CEO at the time, Robert W. Galvin, liked the name *Six Sigma* and the program was subsequently named to Six Sigma. Hence, the Six Sigma methodology was born.

The DMAIC approach, briefly mentioned above, contains the five distinct phases *Define, Measure, Analyse, Improve* and *Control*. In the Define phase shall the full scope of the problem be comprehended and adequately defined from several perspectives, such as the customer, the business, the process and major stakeholders. The D-phase is the most important phase of all phases since not fully comprehending the problem could lead to the wrong problem statement is addressed and thus not solving any root causes, subsequently yielding only modest or even no improvement at all. An essential understanding of the D-phase is that it is highly iterative, meaning it contains both measure- and analyse phases. The main deliverable is *an agreed-upon project charter* which contains the customer needs, scope, goals and success criteria of the project in addition to deadlines and other important information (Carleton, 2018). However, the project charter can be articulated in various forms and in this case, an approved and confirmed *Planning Report*. The planning report is effectively the cumulative outcome from the tools and methods deployed in the define phase. In order to inquire the customer needs, the process at hand, and distinguish what, how and why to improve was *Effective Scoping* and the seven question first put forward by Edward Deming. Effective Scoping is essentially an enhanced version of SIPOC, which is normally applied in D-phase, but in contrast emphasises *what* the improvement really concerns and *why* it should be done or is a problem before asking *how* and narrowing down the scope (Zanti, 2015). The main aim of *Effective Scoping* is to nurture pull-thinking rather than push-thinking and should be executed in a three-way manner. Another method that has been used to understand the situation further and to obtain additional insights is the *Affinity Interrelationship Method*, normally denoted AIM, originating from two of *the seven management*, namely *affinity diagrams* and *interrelationship diagram* and is performed in a workshop format. The method was one of the main methods deployed during the define-phase. The method has been commonly utilised at universities and organisations around the world to approach complex and intricate problems and is of the bottom-up type, meaning the further the workshops continue, the more abstract it becomes. Briefly put, AIM is essentially brainwriting method where the participants are assigned a problem statement which they are supposed to “solve” during the workshop by deriving tacit and explicit knowledge respectively (Alänge, 2009).

Moreover, the AIM workshop yields a bottom-up analysis of a question, i.e., an issue or a problem, however, the outcome shall not be regarded as a definitive solution or answer. Consequently, additional work must be performed to further inquire the problem, yet the method acts as a good starting point for further action and how the problem should be interpreted, and most often, a direction on how to proceed (Alänge, 2009).

In total were four AIM workshops conducted with two unique problem statement themes. The first problem statement was “*Why does perceived quality vary between customers?*” whereas the proceeding third and fourth AIM workshops intended to further inquire the collected result from the first two. The second theme concerned the implications of not understanding why in the customer case description and the statements were “*What is the greatest problem with the absence of the question “why” in the customer case description?*” and “*What is the greatest problem of not understanding “why” in the customer case description?*” respectively. and were performed in both Skövde and Göteborg. The number of participants varied from three to eight

persons and the participants came from various departments, such as quality assurance, plant quality, R&D and production, for instance. The participants were selected, hence sampled, to represent the who normally participated in the quote-process but as well capturing the “voice of the company”, i.e., individuals with great knowledge and insight in everyday operations.

The method has been modified over the years and does now contain a straightforward guide entailing ten steps. Briefly, the steps are as follows:

1. **Formulating the question.** The organiser shall in advance prepare a problem statement, which should strike a balance between becoming too narrow and too wide. To be noted, the statement should undertake a neutral tone, implying the problem statement does not suggest a preselected or preferred outcome for the workshop. The organiser might need to elaborate on several statement before finding the balance and the statement should not be presented to the participants in beforehand.
2. **Warm-up.** An important first step is to let everyone share their thoughts regarding the problems statement by letting each one by one express their initial thoughts openly. Do note that the criticism is not allowed.
3. **Collect data.** In the third step, the participants are encouraged to write answers to the question in single full sentences. No questions or single words are allowed. The answer should be rather concrete than abstract.
4. **Clarifying the meaning.** The workshop leader shall in step four ensure that everyone understands the meaning of each post-it note. The leader read the content out loud, and the author can briefly elaborate on the content and the rest of the group has the opportunity to ask questions. However, criticism is once again prohibited but a clarification can be added if deemed necessary.
5. **First level grouping.** Now the ladder of abstraction increases a degree as the participants should group the post-its depending on their affiliation. The affiliation should be determined intuitively, and the participant must do it in silence. Each group may contain up to two to three post-its but not more, thus potentially leaving some post-its as “lone wolves”. The lone wolves might be grouped in a later stage but can remain as lone wolves for the entire workshop.
6. **Higher-level grouping.**
  - a. *Write headings.* The first step in the *higher-level grouping* is to write heading the to the first level grouping. The content of each group is described in a one full sentence, but the lone wolves are left without.
  - b. *Second level grouping.* The grouping continues with the putting the first level groups and lone wolves in an additional level of abstraction. The same goal and rules apply as in first level-grouping.
  - c. *Third level grouping.* If the groups are more than five after second level grouping a third level grouping should be performed. Lone wolves do not count.
7. **Show connection.** The connections between the groups and lone wolves are highlighted with help of arrows indicating *cause-and-effect*, *contradiction* or *is not allowed*.
8. **Final layout.** Major reorganising of the post-its may be necessary in order to make the layout sensible.
9. **Evaluation.** In step nine is the importance to the question of each group or lone wolf respectively evaluated by the participants. By individually dividing 3, 2 and 1 points on

the group or lone wolf one thinks influence the question most, the importance will reveal itself.

10. **Concluding sentence.** In a one single sentence is the analysis and essence of the workshop summarised, thus answering the problem statement.

As mentioned, it is essential to understand the customer needs and the involved stakeholders and even though Effective Scoping is a potent method for doing so, it could be wise to highlight and organise them in the *Voice of the Customer* (VOC). By applying VOC can the customer needs, wants, expectations etc., be categorised, organised and easier interpreted by the team conducting the Six Sigma project. It also permits the team to focus on the most important measures. A *project benefit assessment* should also be done to help determine the benefits and value to the business of the DMAIC project. The benefit assessment normally contains a *hard-* and *soft* part respectively. The former one concerns the benefits directly measurable in monetary terms whereas the latter one addresses the benefits who cannot directly be seen in monetary terms but rather in the intellectual and organisational terms (Carleton, 2018).

The subsequent phase is the *Measure phase*, normally denoted *M-phase*, which aims to measure and capture the *as-is* or *the current state* (Carleton, 2018). Hence, the main deliverable is mapping the current state but before doing so shall the data needed to be collected be understood and a plan on how to collect it should be made. The data can be of both quantitative and qualitative. Quantitative data can generally be divided into discrete or continuous, where discrete measures is data that can be divided into distinct, nonoverlapping and separate categories, like counts, colours, good/bad etc., for instance. On the contrary, continuous data, or variable data, cannot be divided into distinct categories as it can be measured infinitely and does not have clear boundaries, such as time, temperature or weight (Yang & Basem, 2009; Carleton, 2018). During this thesis work has interviews and additional AIM workshops constituted the major part of the M-phase and *semi-structured interviews* have constituted the chief part of the performed interviews. Sampling has been made to represent the “voice of the company”, i.e., individuals with knowledge and insight in everyday operations. Those individuals were identified with the help of the company supervisor and colleagues that could guide the author to come in contact with the relevant knowledge of the subject that was inquired. The interviews were utilised to understand the current state and learn more about the tacit knowledge that exist within organisation.

According to Adams (2015) the advantages with semi-structured interviews are:

- a) The method allows open-ended questions allowing interviewees to elaborate and expand their line of reasoning.
- b) If the topic is yet to be discovered or no prior research exist, the respondents can share their views and experience for freely, potentially opening new doors.
- c) Aid to solve the puzzle after analysing quantitative data.

The main disadvantage is the methods is quite time consuming in terms of transcribing and analysing the vast amount of obtained data sets. Additionally, the interviewer must be aware of the sample, i.e., the number of persons interviewed, perhaps not is representative if the number of interviewees is limited, meaning the conclusions may not be exhaustive. Thus, the information, statements and insights obtained from the semi-structured interviews should be

verified or validated with additional information gathering and analysis. Especially in cases when the data set, i.e., number of interviewees, is limited.

Adams (2015) suggest the interviewer creates an interview outline, consequently forming a direction for the interview with planned topics and questions. One of the strongholds of semi-structured approach, besides from the vantage grounds mentioned above, is that the question sequence is tentative meaning the interviewer may ask the questions in the sequence deemed suitable. The interview format permits the interviewer to add open-ended questions, thence increasing the knowledge and insights gained during the session. The analysis consists of summarising the records and interpretation of themes found in the answers, which normally can be derived from looking for a pattern in multiple answers.

Bell et al (2019) elaborates further on the advantages disadvantages of asking open question, which is the normal type of question in semi-structured format. The authors recognise that the respondents answers are not restricted by the already formulated sentences, the question does not allude a certain type of answer leading the respondent to expand their answer and disclosing additional knowledge, permits greater exploration of uncharted territory. Additionally, the outliers are explored, i.e., respondents talk more freely and might answer in an unusual way, as the advantages of open questions. However, the drawbacks must be considered as the open questions are generally more time consuming to answer and to decode. The decoding is a potential source of subjectivity as the decoder might interpret the interviewee in an unwanted way or variability in decoding, thus potentially impairing the measurement validity. Furthermore, Bell et al (2019) implies even if open questions impose great advantages can closed questions be good complement as it permits vast amount of data to be gathered during a short time span.

Another research method which has been deployed to evaluate the proposed method is *case study design* and allows the researcher to acquire in-depth knowledge regarding a subject. According to Bell et al (2019) should the case be based on the anticipation of what to learn and the cases should consequently be selected according to the greatest potential to learn. Three different types are outlined: *intrinsic*, *instrumental* and *multiple*. The intrinsic aim to acquire insight of a given situation on behalf of other cases or more generic issues while the instrumental case approach intends to understand a broader issue or to permit existing generalisations to be challenged. The last one, multiple case approach, includes several cases inquired concurrently to explore a wider phenomenon. Case studies can both concern generating theory and subsequently test the generated theories in an iterative manner (Bell et al., 2019).

In order to evaluate the method and determine whether the method is capable of doing what it is designed to do, the author formulated a fictive case. The case follows the outlined methodology by Bell et al (2019). When outlining the case, the author had access to old RFQ and RFI: s in order to fabricate a case as close to reality as possible. Other inputs were derived from the interviews, the current state analysis and general observations and understandings made during the project. The intention was to design a case that pushed the limits of an ordinary

case and thus forcing the team to perhaps assume an “avantgarde” mindset to solve the case; yet, maintaining the nature of a RFQ by reviewing old RFQ:s.

The Measure phase is complete when sufficient and adequate information has been collected in order to initiate the analysis of potential root causes in the *Analyse phase*, or *A-phase*. The A-phase intend to, as the name might imply, analyse the measured data and information obtained the previous phases. Yang and Basem (2009) and Carleton (2018) have different suggestion on which tools to apply in the A-phase, however, they agree on that the phase should return a list of potential root causes, stratified and visualised data and that the root causes are validated and confirmed through data and statistics. Yang and Basem (2009) suggest that *Design of Experiment* (DOE) could be utilised to verify the root causes, in contrast to Carleton (2018) who alludes it mainly should be deployed in the subsequent phase, i.e., the *improve phase*. Nevertheless, the main objectives are seemingly equal and to be noted, each Six Sigma project is unique and consequently will the tools and methods needed to be utilised unique to each project. Thus, in some project it might be appropriate to apply (DOE) whereas in another project it might not be an appropriate action at all.

In the proceeding phase, the *improve phase* and normally abbreviated as *I-phase*, should potential solutions be put forward and subsequently checked whether they solve the root causes or not. The tools and methods to be applied must be selected depending on project and proposed solutions, however, DOE and hypothesis testing are frequently deployed.

The last phase, the *Control phase*, aims to ensure the wins generated by the project are maintained and deliver as desired through issuing a standardised control plan. The benefits first identified in the outskirts of the project must be checked to see whether the project has delivered as intended or not. Likewise, the project outcome must be verified whether it aligns with the customer expectations and needs first identified in the benefit assessment (Carleton, 2018). Hence, a revised benefit assessment should and will be presented.

### 3.2. General Research Strategy- and Design

All research performed within business and management, including Master of Science theses, must comply to quality criteriums in order to assess the quality of the research (Bell et al., 2019). The criteriums are *reliability*, *replicability* and *validity*. Reliability mainly concerns the consistency of the deployed measures and is most prominent in quantitative research and is associated with replicability. Future research might want to replicate the methods and approaches utilised in the original research, thus the methods and how the research was executed must be described to allow replication. However, replication of business research is quite uncommon, but nevertheless, to thoroughly describe the tools, methods and execution contributes to increased transparency. The last criteria are generally divided into four validities, namely *measurement*, *internal*, *external* and *ecological* and are further elaborated below:

- Measurement validity concerns whether the measure captures what it is intended to capture. For instance, if an operator needs to measure a metric on a crankshaft in micrometres, is a normal ruler sufficient? Presumably not since it is only refined enough to measure millimetres and, evidently, not in micrometres.
- Internal validity deals with the question whether the observed causal relationship between two variables is valid and can it be determined with certainty.
- Are the patters and behaviours observed, and conclusions made able to be generalised in a larger context than the research? If so, the research is external valid. In order to be generalisable must the sample valid and representative, otherwise the research might just have captured a snapshot.
- Lastly, ecological validity concerns whether the findings and conclusions in normal, everyday and natural settings, thus settings that are not controlled in a research experiment.

Qualitative research entails an additional four criteria, i.e., *credibility*, *transferability*, *dependability* and *confirmability* (Bell et al., 2019):

- Credibility is associated with internal validity, thus the trustworthiness of findings.
- Transferability concerns whether the findings apply to other contexts, just like external validity.
- The dependability criteria parallels reliability, that is are the findings applicable at other times?
- Confirmability regards the researcher objectivity and whether it has influenced or intruded on the results.

There are two major approaches of inquiry, namely *the deductive-* and *inductive approach*. The deductive approach the researcher formulates a hypothesis or hypotheses which will undergo empirical scrutiny in order to be confirmed or rejected. The hypothesis is based on the researcher previous knowledge and bias regarding the question. The inductive approach does, on the contrary, permit the researcher to go back between the steps and the approach is highly iterative. The steps are:

- a) Data collection.
- b) Interpretation.
- c) Implications for theory.

Although the approach cannot tell whether the data collection is exhaustive, the approach is highly useful for generating theories out of data and is often associated with qualitative research, in contrast to the deductive method which normally, but not exclusively, is used in quantitative research. Additionally, the method aims to combine concepts in new ways (Bell et al., 2019). However, Bell et al (2019) alludes that neither research projects undertaking the deductive approach nor the inductive will be able to have a “pure” execution in one of the approaches since the deductive approach tend to divert from its linearity as findings compel the researcher to revise the hypotheses while the inductive in the end will follow some kind of linear process. Nevertheless, inductive is still the more iterative approach and they both have reliance on each other. As expressed by Bell et al (2019) “*they [author’s note] are therefore better thought of as tendencies than as a hard-and-fast distinction*” (p.24). In recent time has a third line of reasoning emerged and gained popularity as it attempts to bridge the shortcomings of deductive and inductive approaches respectively, that is *abductive* (Bell et al., 2019). The abductive approach starts with at the end, i.e., with an observed effect, and work backwards trying to explain it and leads the researchers to select the most plausible explanation to the causes of the effect. The approach is highly iterative since it often involves repeated tests to see whether the reasoning is valid or not. The approach has greater emphasis on iterations as the conclusions from the data evolves in dialogue with the collected knowledge of the researcher, yielding new hypotheses are needed to be tested. The outcome from the test is analysed and is iterated continuously until an adequate puzzle is laid able to explain the effect (Bell et al., 2019). However, in contrast to the deductive reasoning there the conclusion made can be judged to be valid if the premises is true, the outcome of abductive reasoning shall be regarded as the most plausible explanation and thus the “most likely” or “feasible” explanation (Testani & Patil, 2021). Consequently, the abductive reasoning imposes to some extent an uncertainty in the conclusion but could be used as vantage point for further inquiries with the deductive methodology.

Bell et al (2019) addresses the importance of ethics in research and alludes the ethics aspects must be kept in mind during all parts of the research in order to completely mitigate or reduce any eventual impact. In total, Bell et al (2019) outlines four ethical principles: *harm to participants, lack of informed consent, invasion of privacy and deception*. The first principles directly concern if research will inflict harm to anyone. Harm could undertake a physical- and physiological nature respectively. In qualitative research can interviewees, individuals, organisations, places etc., that the researcher have been in contact with, be effectively anonymised and the use of pseudonyms protects individuals who wishes to remain anonym. Such measures may be undertaken even in quantitative research as well. However, the researcher must at all times have transparency towards the participants in order to mitigate any mistakes regarding anonymity, for instance. Confidentiality might be another aspect of the harm principles as confidential information may be involved in the research. Confidentiality agreements might be an effective tool to resolve the issue. The second principle regards the issue the participants are informed to the degree about the research intent that a decision can be made whether to participate or not. The principle does also concern that the participant is made aware of any used observation methods and recording equipment.

The third principle, the privacy principle, is indeed associated with informed consent but encourage the researcher be aware of participants might have agreed to an interview but refuse to certain questions since the partaker may find the topic or question is intruding on the privacy. The fourth principle occurs when the researcher deceives, hence lure or trick, the participant about the research intent, scope etc. Bell et al (2019) presents to main arguments to why deception is a problem. Firstly, it is evidently not a nice thing to do. Secondly, deception defiles the researcher and open-up for the possibility to question the whole research and its credibility. It may as well defile the research community as the perception will be negatively influenced.

What kind of reasoning does Six Sigma fall under? Six Sigma is a melange and thus fall under all three. The reasons for that are several. The outlined DMAIC methodology is indeed a scientific approach, relying heavily on data to prove correlation- and causality effects, i.e., deductive reasoning, and shall be regarded as one of key advantages of Six Sigma (Testani & Patil, 2021). The work progress under the wings of data. However, DMAIC also contains inductive and abductive elements since iterations of the DMAIC cycle is common practices as new findings and analysis might lead to redefinitions and conclusion yielding new theory to rely on. For instance, the I-phase will generally the inductive and abductive approaches dominate due to the verified root causes distinguished in the A-phase. Testani and Patil (2021) argues the potential stagnation of the project due to not having sufficient data could be overcome with the inductive- and abductive reasoning. The interpretation of the author of this thesis paper, a trained and certified Six Sigma Black Belt, is that the Define phase indeed also involves inductive, deductive- and abductive reasoning respectively since acquiring information and developing an understanding of the problem context, eventually yielding a problem definition, is highly iterative but does rely heavily on data in order to base the conclusions on facts. For instance, the analysis of the result of the AIM workshops is iterative, thus inductive, and has been subsequently used as inputs to additional workshops.

The process will also likely undertake a convergent parallel approach, meaning qualitative and quantitative data is collected concurrently to then be analysed, compared and merged. The qualitative sampling is utilised to get a depth knowledge of the current situation at the company and what the research community already knows about the topic, whereas the quantitative methods have been applied to analyse the acquired data and to draw conclusions.

## 4. Result & Elaboration

The Result and Elaboration chapter intends to present a comprehensive and detailed account regarding the outcome of the work and disclose the most essential findings. Subsequently, the results are reviewed and discussed in order to assess the results validity. However, the chapter will not concern the adequacy of the research methodology, experimental uncertainties nor address the consolidation of research space. The matters will be approached in the subsequent chapter, chapter 5 *Discussion*.

### 4.1. Knowing me, Knowing you – What is the Current State?

Aurobay is a tier-one manufacture and develops internal combustion engines for automotive manufactures like Volvo, for instance. Since becoming a stand-alone company in 2021, after parting from Volvo Car Corporation, Aurobay has embarked on a journey to expand the product- and service portfolio. An array of automotive manufactures submits inquiries to Aurobay through either filing a *Request for Quotation* (RFQ), or *Request for Indication* (RFI) and a quotation team is organised to answer the request.

The main process of identifying the customer needs and demands is described in detail in the *Strategic Value Pathway* (SVP) and the process can be divided into four processes with unique objectives and deliverables (see figure 9). The four processes are:

- 5.0 *Customer Acquisition and Retention (CAR)*
- 2.0 *Propulsion Solution Engineering (PSE)*
- 3.0 *Manufacturing Systems Engineering (MSE)*
- 4.0 *Manufacturing & Logistics Operations (MALO)*

The CAR process aims to understand and articulate the customer needs and demands, which should be utilised as inputs to R&D. The CAR process will be further elaborated. Proceeding to the PSE process, the inputs from the CAR will be converted to product demands and thus generating inputs to product development, manufacturing engineering and supplier. The product demands must be converted and put in context of manufacturing engineering. The main deliverable of the MSE process is to provide prerequisites for the development of manufacturing operations further on by translating product demands into process demands. Progressing to the final process, the MALO process, the products developed are now manufactured according to the defined specification in addition to monitoring the process demands in order to ensure the products conforms with the needs and demands.



Figure 9: a simplified schematic of the Strategic Value Pathway.

However, the CAR process should be regarded as the most important one since it essentially defines what the project concerns and yield the direction for the project. The interviews have highlighted that several aspects regarding expectations of the product is defined and understood in the CAR process and identifying or wrongly interpret the customer could potentially jeopardise the customer satisfaction if the expectations are not meet. Furthermore, the interviews discloses that the general terms applied when discussing and describing the customer mainly are focused on demands and needs articulated in technical requirement, yet the knowledge regarding what the customer expects appears to be limited. Consequently, the current state mapping and analysis has emphasised the CAR process.

In order to comprehend the process and the intention, one must describe the process thoroughly. As the name imply, the Lead Creation process aim to establish a direction and business case yielding a *Request for Quotation (RFQ)* or a *Request for Indication (RFI)*. The potential lead is identified by three major inputs, i.e., *Market Research and Analysis*, *Propulsion Solution Engineering* or *customer*, which has identified a *potential business*, *potential products* or *filed an inquiry* respectively (see figure 10).

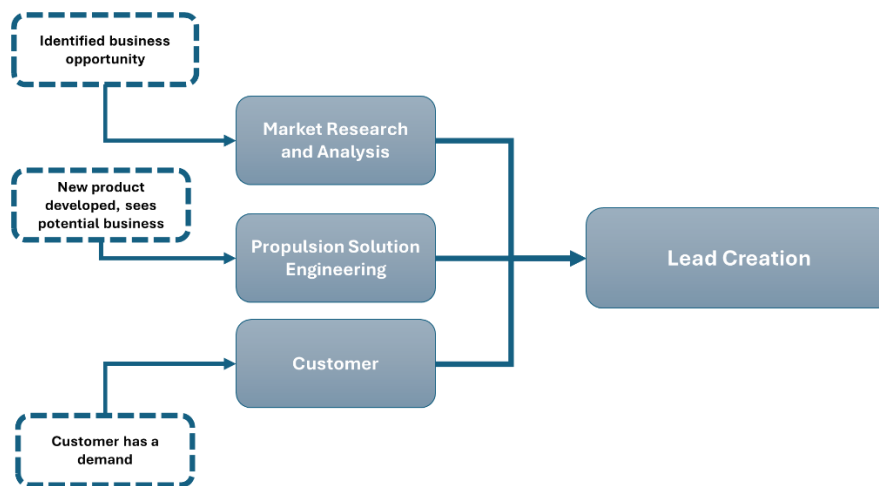


Figure 10: the inputs to the Lead Creation process.

After a lead has been created and the initial customer requirements have been identified, the *Manage Opportunity* is initiated. The Manage opportunity is a rather comprehensive and detailed process and its main purpose is to ensure that the RFQ or RFI is sufficiently answered. Several key milestones exist and must be achieved and acts as a safeguard of ensuring that no crucial aspect of the quotation process is overlooked. The process is successful if the process leads to an internal handover. The overall aim of *Internal handover* essentially concerns providing prerequisites to the rest of the organisation after the previous process has presented a business case which the customer and Aurobay has agreed upon. Briefly, the Internal handover is a step which intends to provide all necessary inputs for the proceeding development work.

Despite the process described appears to be equal to smooth sailing, this MSc thesis has revealed multiple potential shortcomings. Before becoming a stand-alone company, Aurobay was part of the R&D organisation at Volvo Cars and had the responsibility to develop and enhance the internal combustion engines, providing propulsion to the cars developed by other R&D divisions at the company. Today, Aurobay needs to understand their customers on their

own, implying that a new approach may be required in order to face the new challenge. Yet, interviews with the Customer Proposal Leaders reveal the mindset indeed still is present within the organisation, which has to some extent, impaired the process of defining customer requirements and expectations. The mindset virtually nurtures a spinal cord reflex of knowing *what to do* and replying *how to do it*. Historically, the customer demands and needs have already been defined and identified meaning that the engineers “only” had to answer *how* the demands could be realised, however, as the knowledge of identifying the needs etc., has transited to Aurobay, the organisation must develop new skills.

Both the interviews with the Customer Proposal Leaders and Quality Assurance Specialists points at the fact some customers require more help than others to define and articulate their requirements and expectations, whereas others are more procedural. As of today, some checklists have been developed in order to help identify customer needs, yet the checklist is rather technical and could first be utilised when the main characteristics of the product has been set. Additionally, not fully understand the business case and its implications can also lead to late rejection, meaning the customer inquiry is turned down when the process has proceeded quite significantly. Late rejection could be negative since the customer has the perception, thus expectations, that the inquiry could be fulfilled. The Customer Proposal Leaders implies during the interviews this has been the case on some occasions as mentions a request to develop and manufacture a V12 engine. In the eleventh hour was the call made to decline the request due to reasons like economic viability since the volumes were judged to be too small for Aurobay, therefore pushing the unit price to an undesirable level. Although the project itself engineering wise would be plausible, it did not align with the organisation’s overall capabilities. However, the later the rejection comes, the more convinced the customer is that the inquiry is doable. Consequently, when defining and understanding the customer expectations, requirements etc., the better the prospect is to early understand whether the business case aligns with the business strategy, capacity etc.

The quotation process involves many different kinds of expertise and resource in order to drive the process forward. For instance, the quality assurance and R&D departments contributes with experts and engineers to help answer to questions. However, it can be unclear when in the process the resource should participate, leading to questions are asked prematurely, uncertainties arise, or the wrong type of questions being asked. This can be interpreted as an inefficiency according to Quality Assurance Specialists.

The current state study and the interviews have disclosed the importance of properly understanding the customer demands and needs is recognised in several ways at Aurobay today. It could be of urgent matter due to some customer requirements, needs etc., directly are governed by legislation or other formal requirements imposed by authorities. Likewise, if it concerns safety and welfare, it is indeed of importance too. Moreover, requirements that could directly impact critical functions is also recognised. In order to assure those requirements of stronger importance are compiled to and addressed adequately, Aurobay has articulated a definition, *Special Characteristics* (SC), with a subset of characteristics to help capture the importance of the requirements. The subset contains *Critical Characteristics* (CC) which concerns compliance with legislation, regulations and risk of life and limb, whereas *Significant*

*Characteristics* (SC) regards the risk of impact of critical function. CC is assigned a severity equal to 1 and SC a severity of 3, respectively. The characteristics are utilised as inputs to the *Failure Mode Effect Analysis* (FMEA) conducted for both design, system and process.

During the interviews is Aurobay's new role as a tier-one manufacture in the automotive business frequently referred to being a challenge for the organisation. In the past have other departments at Volvo Cars performed market intelligence operations and inquires of what the customer wants, desire and expects of the manufactured products. However, today the mission of analysing the market and deriving the wants, desires and expectations have become a major concern for Aurobay after becoming a standalone company. The discussed issues are, among others, not having adequate ability to derive the correct products attributes and not understanding the needs and expectations of the customer as well as not comprehending the organisations limitations.

To assure customer satisfaction, Aurobay arrange regular meetings with customers to ensure alignment with expectations and requirements and discuss how to proceed in the future. In addition, other tools are frequently used to measure satisfaction concerning quality, cost, service etc. Inquiries regarding discontent customers are handled by the Quality Assurance Department who oversees the corrective actions and ensures the initiatives enhance the experience. One of the Quality Assurance Specialists, in particular, stresses how customer alignment largely concerns the perception of Aurobay, thus how the customer perceives them. One could argue the customer alignment process influences the overall perceived quality since it could be linked to the VPQ, i.e., brand image, heritage, social values etc.

Despite the process is thoroughly described and organised, the execution of the process is far from spared from rework and uncertainties as it the customer expectations seems to not be understood enough, leading to additional inquiries apparently investigating the same things. The general interpretation of the current state is the ability to know *what* and *how* to do things is good, however, the understanding *why* customers file inquiries for certain solutions or *why* the customer has a particular need, or expectations appears to be inferior.

The author defines the problem, based on the inquiry of the current state analysis and with leverage from the Theoretical Framework, as:

*Failing to understand the underlying why in the initial product development phases could lead to important factors contributing to customer satisfaction and value are bypassed in the subsequent steps in the quote- and product development process.*

*Thus, Aurobay is jeopardising customer satisfaction and value proposition by not comprehending what, how and why value is created*

### 4.1.2 Voice of the Customer

While inquiring the current state, the Voice of the Customer, or VOC, became evident during interviews and discussion and is presented below (see table 2). The VOC is outlined in the Methods chapter under *Six Sigma*.

Table 2: the thesis VOC.

Voice of the Customer		
Customer	Deliverable/issue	Needs/expectations
Quality Assurance department	Participating in the quote process and hence participating in defining customer requirements and expectations. New knowledge on the matter is required	At present, there is a limited availability of tools or methods specifically designed to identify and define quality attributes and the factors influencing customer expectations. This highlights a need for further development of methodologies and the generation of new knowledge in this area.
R&D	The R&D is likewise participating in the quote process. New knowledge on the matter is required	Currently, there is a lack of widely established tools or methods specifically designed to identify and define quality attributes and the factors that shape customer expectations. Therefore, there is an opportunity to develop new approaches and generate insights in this area.  Understanding the underlying reasons—why current operations create value—remains a key objective.
Chalmers	Three deliverables: planning report, final report and oral presentation and opposition	The report and work must conform with governance guideline for MSc thesis works

## 4.2 Affinity Interrelation Method – AIM

In the proceeding chapter will the result from the AIM workshops be presented. The workshops followed the ten-step approach as outlined in the methods chapter (see [chapter 3: Six Sigma](#))

### 4.2.1 AIM Workshop 1

In the first AIM workshop did in total eight persons participate. The workshop was performed in the outset of the project in January in Skövde and recall the first problem statement. Following the drafted approach was the subsequent concluding sentence derived:

- *Perceived quality varies, as each customer has distinct emotional expectations of the provided products and services. Hence, it is essential for Aurobay to understand customer expectations both in normal situations and when things go awry to comprehend why perceived quality varies.*

In total were three second level groups derived in the second level grouping and headings describing the content and essence were subsequently produced and the connections between the groups were also assigned. The concluding sentence was obtained after an analysis of the connection of the groups. The first group concerns Aurobay's awareness of customer expectations which directly yields the importance of understanding the customers emotional expectations. This leads to the last group, which regards the ability to meet the customer expectations when issues arise. The entire AIM workshop can be found in [Appendix C](#).

The detailed analysis of the workshop presents several plausible factors that influence why the quality perception varies between customers. The first factor is *the emotional expectations* as expectations may be formed, influenced and governed by elements like culture and background, previous experience, the relationship between cost and emotional expectations and lastly the importance of sustainability. For instance, culture and background equips the customer with a unique set of predefined values of what, how and why to expect of the delivery of the product. The second factor can be identified as *problem handling and customer voice*, which is constituted of the elements *efficient problem solving, structured process, responsiveness to customer feedback* and *differences in agreements and contracts between customers*. The third factor is *perceived quality and segmentation*, alluding the quality expectations depends on *product characteristics, market segmentation* and the subsequent *brand repetition and positioning*. Hence, the reason to why customer perceive quality differently seems to be multidimensional and depend on array of factors.

## 4.2.2 AIM Workshop 2

The second AIM workshop was performed in the beginning of February with four participants (see figure 11) and subsequent to an analysis made by the participants could the concluding sentence be derived: *Interest, reference, experience, intended application area and knowledge influence the expectations of perceived quality*. The entire workshop is depicted in [Appendix D](#).

Common words in the workshop are *interest, expectations, experience, reference, intended application area and knowledge*. The essences appear to be in the individual perception of what to expect from the product or service, based on the reference and previous experience. The reference is to be interpreted as the earlier encounters with similar products or services, meaning that someone who has driven ten unique cars from different brands will have a greater reference value compared to one who only has driven four. Likewise, previous experience is a contributing factor to why the perceived quality varies between customers since if the perception of the earlier encounter with the company's product was overall good, will the customer's mindset be positively tuned before the next encounter. Vice versa is true.



Figure 11: to the left – one of the first steps, brainwriting, is ongoing. To the right – first level grouping which is done in silence.

Moreover, the intended application area has an influence since customers might have unique intentions on how to utilise the product, which may be outside the designed use area. Thus, if the product does not conform with the expectations of what the product should be capable to handle, the experience is likely to be negatively influenced, and in extension, badly influence the reference value and indubitable affect the knowledge. Knowledge regarding the product would per se contributes to the perception of quality. Customers, like automotive journalists, with good and exhaustive knowledge of cars have a vantage point in reference value and will have greater or different anticipation how the car will perform.

In conclusion, the bottom line is expectations which are based on the interest, reference, experience, intended application area and knowledge. Managing to surpass expectations relies on the ability to conform or excel on the customer experience, interest, reference, knowledge and intended application area regarding the product. In cases when the encounter falls short of surpassing the expectations, the customer perception of quality will be negatively influenced.

#### **4.2.3 Aggregated Analysis of AIM Workshops 1 and 2**

The aggregated analysis discloses potential causes to why perceived quality varies and differentiate between customers. The bottom line is perceived quality is created from the inherent expectations a customer has and is unique, including the factors generating them. Five factors are believed to constitute the foundation for how expectations are created, i.e., interest, experience, reference, intended application area and knowledge. Awareness of the customer and the customer segment, including culture background and their brand perception, is an enabling factor for understanding and deriving the expectations. Emotional aspects must also be considered as perception relies on interest, reference and experience which drives the emotional expectations on the customer has of the product.

Customers' past interactions with similar products, their cultural background, and their perception of a brand further influence how they evaluate quality. Understanding these dynamics is crucial for businesses like Aurobay to effectively manage customer expectations. By aligning product performance with, or exceeding, these expectations, companies can enhance perceived quality and foster positive customer experiences. Conversely, failing to meet expectations can lead to a diminished perception of quality, underscoring the importance of continuous customer insight and engagement.

Based on the initial two AIM workshops, current state analysis and the information revealed in the theoretical framework chapter, it became evident *expectations* presumably had a major influence on how customer expect to perceive the delivery of the product. Additionally, the current state analysis did disclose a heavy “*we know how to do it*”- thinking, however, the reason to “*why we are doing it*” was absent. Thus, the implications of not understanding “*why we are doing it*” appeared to be insufficient and two additional AIM workshops aiming to inquire the implications of not understanding “*why*” were consequently proposed and performed.

#### 4.2.4 AIM Workshop 3

In the beginning of March was the third workshop held at the Aurobay's headquarters in Gothenburg and the assigned problem statement was *"What is the greatest problem with the absence of the question 'why' in the customer case description?"*. Only three individuals had the opportunity to accept the invitation for the workshop. The concluding sentence was *"unclear requirements and responsibility distribution make it impossible to track time, cost, and quality, which negatively affects customer satisfaction and collaboration since we may misunderstand needs and expectations"* and the subsequent analysis highlights the jeopardy of the absence of the question *why* in the customer case description which could impair the customer satisfaction and collaboration due to the expectations and needs are not fully understood nor covered properly. For instance, decisions could be based on a false perception of what the customer wants and what the customer needs which leads to misalignment between the customer and supplier potentially yielding late minute changes. The misalignment could also lead to that the intention does not match with is expected which has a resemblance with *information asymmetry*. The entire workshop is depicted in [Appendix E](#).

#### 4.2.5 AIM Workshop 4

The fourth and final workshop had a slightly different problem statement compared to the preceding, third workshop. Nevertheless, the theme and intention of the inquiry remained the same. With “*what is the greatest problem of not understanding ‘why’ in the customer case description?*” the group felt empowered to take on the workshop (see figure 12). After trying different angles of attack yield a concluding sentence, capturing and articulating the essence. The sentence was: “*Not understanding why will yield product characteristics that will not fulfil the customer expectations and consequently risking a decrease in demand and products with erroneous or incorrect quality, function or do not comply to legalisation*”. The entire workshop is depicted in [Appendix F](#).



Figure 12: the participants battling the final stages of the workshop.

The overall interpretation is that not understanding *why* yields an insufficient understanding of the customer wants, needs and expectations subsequently impairing performance in terms of a decrease in demand, quality perception and expenditure. According to how the participants have interpreted the connections between the groups, the customer does not always understand themselves what they request or why they need it. Thus, not recognising *why* and the subsequent reasons have the potential to give characteristics that do not comply with the expectations since they were not sufficiently articulated from the start. The same line of reasoning could yield the inability to achieve the right level of quality which gives a decrease in demand since poorly articulated and defined requirements and expectations composes an inadequate fundament to base decisions on. Besides, the inability to achieve the right level of quality does impacts the selection of characteristics due to reason like poor understanding of the underlying attributes and factors constituting the expectations of the customer. The characteristics are, subsequently,

based on an erroneous perception of expectations. Another statement, *inadequate knowledge regarding laws and regulations could yield a product not complying with the customer expectations*, does likewise cause inadequate characteristics. The line of reasoning that apply is that certain laws and regulations governs and control the framework a supplier is allowed to operate in to ensure quality, safety or emission levels, for instance.

The overall consequence of not understanding “*why*” an inferior understanding and interpretation of customer expectations is concerning quality, cost and function yielding characteristics incapable to articulate and incarnate the expectations of the customer. Consequently, one is jeopardising the whole product development project on erroneous assumptions made in the outskirts of the project.

The overall interpretation of the workshop the absence of the question *why* in the customer case description could impair the customer satisfaction and collaboration due to the expectations and needs are not fully understood nor covered properly. For instance, decisions could be based on a false perception of what the customer wants and what the customer needs or leads to misalignment between the customer and supplier potentially yielding late minute changes. The misalignment could also lead to that the intention does not match what is expected which has a resemblance with *information asymmetry*.

#### **4.2.6 Aggregated Analysis of Workshop Three and Four**

The aggregated analysis of workshops three and four revealed the critical importance of understanding the underlying reasons behind the customer’s wants, needs and expectations and a cardinal error is to not entirely understand the “*why*” behind the expectations. The consequences could be several and with different degree of severity to performance and customer satisfaction. When customer expectations are misaligned with the delivery of the product, the potential to impair the performance and market response are increased as the demand of a product not fulfilling the expectations presumably will return less revenue with regard to the number of sales. Likewise, an increase in late minute changes aiming to correct the inferior performance and a decline in the quality perception is also likely to occur due to the poorly defined requirements. Moreover, poor articulation of requirements and expectations leads to inadequate foundations for decision-making, which in turn results in suboptimal design choices and characteristics. Misinterpretations leading to invalid perception of expectations are also more likely to occur if not “*why*” is understood thoroughly. Such erroneous perception could impair the characteristics.

An error that has the potential to make a whole product development project useless is when not understanding “*why*” leads to development of non-compliant products with laws and regulations. Further, misalignment does additionally impose inefficiencies like rework, for instance, due to the development team needs to correct decisions made on invalid assumptions and facts. Customer satisfaction will presumably be affected negatively, and demand decreases as products falls short of meeting expectations and requirements.

Ultimately, a failure to thoroughly understand the why behind customer expectations jeopardises product development by introducing assumptions, inefficiencies, compliance risks, and misalignment. This, in turn, threatens market success due to incorrect product

characteristics, quality misjudgements, and poor collaboration between stakeholders. However, successfully deriving and articulating customer expectations in terms of requirements by understanding the underlying “*why*” will likely empower the business to excel on customer satisfaction but as well as induce a leverage to create market vantage and propel performance (Sinek, 2009; Lindstedt & Burenius, 2016; Nussem & Starker, 2019).

#### **4.2.7 AIM workshop – What to Aim At**

The first two AIM workshop aimed to inquire the problems if perceived quality varied between customers and its implications, while the latter two investigated the implications of not understanding the underlying *why* of customer inquiries and request. The main concern to either be unsuccessful to understand the factors influencing and shaping the quality perception and expectations, or not understand the underlying *why*, mutually yields poor performance concerning customer satisfaction, demand and customer experience. However, the underlying *why* and the factors are highly connected and mutually dependent are deemed to have central importance to the formation of expectations and selection of characteristics. Yet, the risks can be mitigated by successfully deriving the expectations and the underlying *why*. Thus, the interpretation is, subsequently, in order to derive and understand the underlying *why*, the organisations must develop a method or strategy capable of defining and articulating the factors, i.e., *interest, knowledge etc.*, forming and establishing the expectations.

To conclude, failing to comprehend either the factors influencing quality perception or the underlying reasons behind expectations, i.e., failing to understand *why*, leads to poor customer satisfaction, decreased demand, and a diminished overall experience. However, organisations can mitigate these risks by developing strategies to clearly define and articulate these factors, such as interest, knowledge, and experience, that shape customer expectations. Successfully doing so can not only reduce risks but also provide a strong market advantage by improving customer satisfaction and experience.

### 4.3 Proposed Method

The analysis of the AIM workshops disclosed the integral nature of comprehending the underlying “*why*” in order to obtain maximum customer value and satisfaction. The findings are supported by the Theoretical Framework chapter, as expectations and the power to satisfy customers profoundly governs the perception of quality and the overall quality experience. Nature of *why* is framed quite well by Simon Sinek (Sinek, 2009):

*“It all starts with clarity. You have to know WHY you do WHAT you do. If people don’t buy WHAT you do, they buy WHY you do it, so it follows that if you don’t know WHY you do WHAT you do, how will anyone else?” (p.65-66)*

Moreover, the effectiveness to subsequently rank the identified expectations, attributes and requirements can be utilised as a leverage to understand the inherent importance between them and how to prioritise and make trade-offs. The tools and methods outlined in the Theoretical Framework chapter, e.g., the Kano Model or the Golden Circle, have the plausibility to identify and articulate *why* and rank the expectations, attributes and requirements accordingly (Matzler et al., 1996; Chen & Chuang, 2008; Sinek, 2009; Južnik Rotar & Kozar, 2017; Nussem & Starker, 2019). Besides, the literature review highlighted the potential effects of failing to comply and deliver on customer expectations, both articulated and non-articulated, due to poor performance of identifying them. Customers perceive quality differently and failing to deliver on expectations yields modest perceived quality. According to the line of reasoning will inferior perceived quality lead to an overall poor-quality judgement. The current state analysis did also point at the organisation’s strong ability to know *what to do* and *how to do* while understanding the underlying *why we do it* seemed inferior.

Therefore, the author postulates a method that could help to identify the underlying *why* and facilitate the inherent prioritisation of attributes, expectations and requirements as well as understanding the value proposition and key factors driving customer satisfaction. The method builds on the Golden Circle as described by Sinek (2009) and synergy effects between inside-out- and outside-thinking in the Value Definition Model as outlined by Nussem and Starker (2019), combining and mixing in which order *why*, *how* and *what* should be asked. To mitigate push-thinking, or in other words when solutions, products etc., are enforced on the customer rather when basing the proposed solutions on the actual need, are total twelve sets of questions proposed and arranged in a pull-thinking manner starting questions inquiring the origin of need. However, the method is not intended to reveal all necessary answers that the project presumably will need during the project, but to rather give the project the possibility to *do the right things* from the beginning. Additionally, the method aims to force to the partakers out of the comfort zone and undertake a novel way to approach issues at hand. The method is presented in [Appendix H](#).

The questions initiate an exploration of the potential value offering, key activities and the customer’s customer and gradually turn to explore the intended usage area, expectations, requirements- and expectations fulfilment and articulation of a potential solution. To end, the final set of questions ensure consistency by asking an additional set of *why-questions*. In the proceeding step should the identified expectations, attributes and requirements be prioritised

with the Kano Model. The crescendo is to write a concluding sentence, capturing the essence through answering the *why*, *how* and *what* one final time. Hence, the intention is to foster pull-thinking over push-thinking and discover the *why* of *what* is done, recalling Sinek (2009).

According to the inquiry performed thus far, the author has identified a list of requirements and expectations the method must comply to. They are as follows:

- I. Overall aim: it needs to nurture and encourage *why* thinking to derive *why* the customer wants something and subsequently what creates value
- II. Detect the underlying reasons constituting the elements and factors of customer expectations and needs
- III. Understand *why* the existing need cannot be accomplished with the existing product, solution or concept
- IV. Understand *why* a need exist
- V. Understand *why* the customer is interested
- VI. Understand *why* it can create value for the customer
- VII. Detect the differences of *what* create of value for each unique customer
- VIII. Understand *what* creates value for the customer
- IX. Understand *how* value is created for the customer
- X. Understand the factors influencing and shaping expectations
- XI. Understand the authority of what to influence and change
- XII. Facilitate the everyday work for the persons involved in the quote process

The list above showcases *what* the method should be able to perform, however, *how* and especially *why* are essential to understand. Thus, an articulation of *how* and *why* is necessary. Although the author has applied an outside-in-thinking to formulate the method, i.e., starting with *what* to subsequently answer *how* and *why* rather than starting with *why* and propagating outwards, the method will be verified with an inside-out approach. *How* the method will accomplish *what* it is intended to do is by a method with a clear pull-thinking with questions utilising the synergy effect between inside-out- and outside-in thinking, the philosophy of the Golden Circle and the vantage of the Kano Model. The method fulfils its purpose by encouraging a novel approach to handling customer inquiries. It reveals both the rationale behind value creation and the reasoning for why the proposed solution adequately addresses the customer's concerns

As mentioned, the methods comprise twelve sets of questions based on the Golden Circle (Sinek (2009) and the Value Definition Model (Nusem & Starker, 2019) and the nature and aim with each set of question will be explained accordingly. The first set has the objective to discover why the customer has need, thus the underlying reason for filing a RFQ or RFI, the how the need was created and what kind of implications it induces for the customer. Further, the first set also contains an outside-in approach asking how the need impacts the customer and why it does so. In the proceeding set of questions is the potential value proposition explored by taking customer perspective to why the customer regards the organisation as potential supplier, how the customer believes value could be created and what concrete actions constitute the value creation. The questions then undertake outside-in approach towards the customer by inquiring

how value can be provided and why value could be offered to subsequently reverse the line of questions by investigating how the customer perceives the value and what potential value is offered. Question sets three and four have pure outside-in thinking as they intend to discover concerning the already existing key activities yielding value for both the customer and supplier. Moreover, the set of questions five and six aims to provide additional insight regarding the customer by inquiring why the performed key activities by the customer offers value to their customer, how they do so and *who* the customer's customer is. The sixth set intends to learn more about the usages area, how it will be applied in a particular context as well as why it will be used in such as manner. The aspiration is to broaden and encourage outside the box thinking since it introduces the team using the method to undertake a different angle of attack in order to enhance the understanding of why the customer has filed a RFQ or RFI.

After the first six sets of question, the intention is the team has acquired sufficient knowledge regarding underlying reason for the customer submitting a RFQ or RFI. Hence, in the succeeding set of questions the aim is to discover the postulated expectations and requirements, both directly-and indirectly articulated, and why they have value. The seventh set of question does directly aim to reveal the expectations by starting with the inside-out approach and then undertake the outside-in perspective and hopefully increase the understanding of the value the expectations creates value for the customer and why the customer has the expectations. On the contrary, the eight set is more focused on why, how and what make the expectations fulfilled. Proceeding to the ninth set which intend to elaborate on the extent previous knowledge and experience governs the customer's expectations and how the expectations potentially fulfil them today. The tenth and eleventh set of questions, respectively, assumes a more solution leaning approach, applying both inside-out- and outside-in thinking. Even though the eleventh set of questions alludes the team already solution to propose, the intention is to reveal why a future proposed solution convey value, how it does it and what it does. The last set of questions, the so-called *final questions*, is completely comprised with *why* questions. This to ensure the red thread through-out the method is maintained, and that team has managed to capture the essence.

The outcome of the set of questions should be used as input to the subsequent Kano Model ranking step. The approach is straightforward, and the team rank the needs, requirements and expectations according to the Kano Model philosophy of different attributes, sometimes referred to as qualities, have different importance to customer satisfaction, recalling must-be, attractive attributes etc. The intention with the method, according to the author, is to utilise the collective outcome as direct input to the continuing product development process and enhance the efficiency of it by *do the right thing all the time*, consequently embracing a Design for Six Sigma thinking to create a robust development process. Additionally, the outcome could be utilised to ensure the project stays in track and safeguard the *critical of customer satisfaction* (CTC) is incorporated accordingly.

### 4.3.1 “I was an impossible case...”

In order to evaluate the method and determine whether the method is capable of doing what it designed to do, the author outlined a fictive case as described in the [method chapter](#). Therefore, the author proposed Aston Martin (see figure 13) to be the company submitting a RFQ to Aurobay (see [Appendix I](#)). The case contains a description of Aston Martin and its values as well as a description of the typical Aston Martin customer. Likewise, the existing product portfolio is outlined and an executive summary of Aurobay is also provided (see [Appendix I](#)). The reasons for the Aston Martin case pushing the limits are due to Aston Martin is contending in a completely different market segment than the customer of Aurobay do today. Volvo Car Corporation is major customer and did in 2024 submit an inquiry for the next generation of petrol engines worth 1,9 billion Swedish Crowns (Nilson, 2024), however, as highlighted in the background chapter and its issues have been elaborated on in the current state chapter, Aurobay has been part of Volvo Cars before becoming a standalone company. Thus, the “average” customer is known to the extent that Volvo Cars is a premium car manufacture, not a luxury- or sports car manufacture.



*Figure 13: an Aston Martin DB12 during the press release in 2023 in South of France. Courtesy to Aston Martin (Aston Martin, 2023).*

### 4.3.2 “The Name of the Game” – Method Instructions

The author proposed an instruction to the method in order to ensure the method was approached- and utilised correctly (see tables 3 & 4).

Table 3: the first part of the instructions.

<b>Instructions</b>		
<b>Task</b>	<b>Objective</b>	<b>Instruction</b>
General	To present the overall approach and thinking	The work order is from right to left (think pull-thinking) starting with question set 1. Each question set shall be answered starting at the top and progressively replying to all questions. The answer is left in the box directly below the question.
Warm-up	To let the participants share the initial thoughts regarding the customer problem	Each participant share their initial reflections/thoughts about the customer for 1 to 2 minutes. The other participants are not allowed to argue or disuss - just listen
General how to respond to the questions	To present how the questions in general should be approached	The method is composed on 12 sets of questions. Each set contain a varying number of why, how and what questions. Try to disuss and respond to the question within 3 minutes and letting everyone come to speak
Assign a secretary	Assign a secretary who has the main responsibility to fill in out the question	Assign a secretary who has the main responsibility to fill in out the question

Table 4: the second part of the instructions.

How to respond to the questions?		
Replying to the WHY questions	To present in which style and manner the WHY questions should be answered in and what they intend to discover	<p>The WHY questions should capture the underlying reason to WHY.</p> <p>When replying have the question in mind <i>"Why does the customer have a need?"</i>, for instance, and reply in the style <i>"since the customer is experiencing this..."</i> or <i>"because of a new demand the customer needs to adapt to..."</i>.</p> <p>Thus, the answer should be able to define WHY</p>
Replying to the HOW questions	To present in which style and manner the HOW questions should be answered in and what they intend to discover	<p>The HOW questions intend to discover HOW things are done or HOW the WHY:s impacts the customer. HOW is that realise the WHY:s</p> <p>When replying have the question in mind <i>"How was that need created?"</i>, for instance, and reply in the style <i>"because of the new demand the customer needs to develop a new product..."</i>.</p> <p>Answer in verbs and not nouns as nouns describe value rather than action, e.g., <i>excellence (noun) vs Go above and beyond in everything you do"</i></p> <p>Thus, the answer should be able answer HOW why was created or HOW things are done</p>
Replying to the WHAT questions	To present in which style and manner the WHAT questions should be answered in and what they intend to discover	<p>WHAT is the direct result of HOW, i.e., the things that are said and things that is done. WHAT are the consequences or WHAT are the concrete things we do, for instance? WHAT is more tangible than HOW and WHY.</p> <p>When replying have the question in mind <i>"What does the need do to the customer?"</i>, for instance, and reply in the style <i>"the customer must develop a new product"</i>. The answer should contain the concrete implications and/or the things done.</p> <p>Thus, the answer should be able answer WHAT things are done or WHAT the consequences or implications are</p>
Ranking the attributes	The method did hopefully reveal several attributes, qualities, requirements and expectations and their inherent importance to customer satisfaction should be ranked with the help of the Kano Model	<p>List the expectations and then rank them according to whether they are <i>must-be, attractive etc.</i></p> <p>The intent is to indicate the potential key factors driving customer satisfaction</p>
Write a concluding sentence	Why, how and what	<p>The concluding sentence should capture the essence of the outcome of the method by applying the thinking WHY, HOW and WHAT</p>

### 4.3.3 Method Evaluation and Assessment

The proposed method and the outlined fictive case, as depicted in the preceding section, were tested on the 23rd of April 2025 at the Skövde plant with the aim to evaluate and assess the capability and potential of the method accordingly. The participants for the workshop were selected to represent the quote team, meaning R&D, Quality and the Manufacturing Engineering (ME) department was supposed to be present during the workshop. However, due to late cancellations had only representatives from two Quality departments the possibility to participate. The utilised case is to be described as an *intrinsic case*, implying the aim is to inquire the insight of a given situation of other cases and based on the anticipation of what to learn, i.e., the performance of the method (Bell et al., 2019).

In addition to the instructions, the author had prior to the workshop drafted a comprehensive strategy of how the workshop should be conducted in order to ensure and facilitate the workshop progressed in a smooth manner. The expected duration of the workshop was estimated to be approximately two hours. The participants had also been encouraged to thoroughly read the case, which had been dispatched by mail one week before. The strategy was:

- a) Explain the purpose and the intent with the method and the workshop. Hence, describe why the method is required and why it was needed to be tested.
- b) Give the participants time to read through the instructions and case for as long as required.
- c) Let the participants to ask any questions related to the workshop to ensure the purpose, intent and execution of the workshop were clear.
- d) Test the method according to instruction.
- e) Summary and final questions before parting.
- f) Follow-up meeting after the workshop to receive feedback.

The author accepted the role as secretary and acted as facilitator and guide throughout the workshop. Due to exhaustive discussions, the participants did not manage to complete the method in time and had to answer the questions on their own and submitting the answers afterwards. However, they completed the method according to the instructions and it presented the possibility whether they made similar conclusions. To further evaluate the method, one participant who could not be present during the test was asked to solve the case without the help of the method. Consequently, the difference in replies could be observed and outcomes could be compared.

The author was required to coach the participants in the beginning of the workshop as the participants when answering the first question set (see figure 14), “*why does the customer have a need?*” etc., quickly started to drift away from the case, made loosely based assumptions and discuss the current issues facing the organisation. Thus, the author had to remind in which style the *why* questions should be answered, in accordance with the instructions, and urged them to justify their arguments with facts from the case. As a result, the partakers started to discuss the proceeding questions according with the intended style, i.e., in verbs describe direct action rather than nouns describing values or a state for the *how* questions. Moreover, a behaviour that

could be noticed in the beginning was that the partakers habitually started to elaborate on *what* Aurobay do today and *how* they perform what they do today, however, as the workshop progressed the discussions changed, with support of the case and what is publicly know regarding Aston Martin, towards undertaking a new angle of attack to the problem at hand. The author did at times, in order to encourage the new angle of attack, ask whether the participants could reformulate their thoughts and discussions according to *why*, *how* and *what* depending on the nature of question replied.

Question set 1	Supportive questions
<b>Why does the customer have a need?</b>	<p><b>Reflect whether the need for a new product might come from:</b></p> <p><b>Physical life</b> implying the product is beyond what is plausible to repair due to monetary reasons.</p> <p>In case the need for the products cease to exist, the product has reached its <b>functional life</b>.</p> <p>When new advances in technology, leading to old products are outpaced in terms of performance, <b>the technical life</b> of the older products comes to an end.</p> <p><b>The legal life</b> is governed by directives, legalisation, standards etc., and revision of those can make the product illegal.</p> <p>As time goes by fashion, taste and aesthetics develops and could yield the existing products become unattractive. Thus, the product has reached the end of its <b>desirability life</b>.</p>
New market demands New leg. Demands Kept brand heritage/image Making money for the owners and satisfy customers	
<b>How was that need created?</b>	
New world legislation, Euro 7 - European Because of over 100 years of production To be able to handle future challenges How AM has developed their brand over years Risk of futures customers with Mercedes AMG engines in competitive brand	
<b>What does the need do to the customer?</b>	<p><b>List the impacts the need create</b></p>
It creates a customer split between customers who does not want to drive an AM with a Mercedes engine Improve sustainability for the customer "Berika" AM's heritage with the Volvo heritage for enviromental concern	
<b>How does the need impact the customer?</b>	
Cannot sale any new cars after Euro 7 introduction Adjusted sales argument by the "new" enviromental thing also contributes to brand image Need to search for new suppliers	<p><b>Define the impact</b></p>
<b>Why does the need impact the customer?</b>	
By creating a new positive energy around the AM brand contributing to innovation that could attract existing customers as well as new	

Figure 14: the first set of questions. The author had to initially coach the team in order to ensure conformance with instructions.

Recalling the method’s intended purpose and potential vantage points, i.e., identify the underlying *why* and facilitate the inherent prioritisation of attributes, expectations and requirements as well as understanding the value proposition and key factors driving customer satisfaction. The workshop indicated that the method has the possibility to resolve the problems that have been outlined, and exhaustively elaborated on, thus far in this MSc thesis. The arguments for this are several and as suggested in [chapter 4.3](#), an inside-out approach will be

applied to provide arguments to *why* the method does it, *how* it do so and *what* it does, replying to the list of requirements. The list of requirements is presented in [chapter 4.3](#).

The first reason to why the method has the power to convey value and advantages to the organisation is since it compels the participants to articulate their answers to the questions in a manner that help them to follow a predefined route, augmented by the inside-out and outside-in line of reasoning. This alludes each line of reasoning builds on a concrete idea, already formulated, rather than ad-hoc statements and arguments leading to discussions getting stuck in never-ending discussion circles as well as providing a red thread. Consequently, the arguments are more based on facts and augments each other. For instance, the participants had in question set 1 (see figure 14) identified that Aston Martin quite extensively utilises Mercedes AMG V8 engines (Mercedes-AMG GmbH, 2025) in their cars, which could negatively impact the Aston Martin brand and heritage as the analysis of the case description implied that certain Aston Martin customers do not consent to a V8 engine from AMG in an Aston Martin. Thus, the reason why Aston Martin would consider Aurobay as a potential supplier is due to Aurobay is regarded to be a more *neutral* supplier, not biasing how customers perceive the brand or heritage. Suddenly, the reason to why customer had expressed an interest for Aurobay been revealed in plain sight. The partakers did also manage to identify what creates value for the customer in terms of key activities. In this instance manufacturing of cars with a profound heritage and in addition, the partakers started to explore how and why the key activities are performed.

The final set of questions does show that the thinking regarding the customer's inquiry has evolved with help of the deployment of the method. Reviewing the first set of questions (see figure 14), the answers are more anchored on tangible aspects, like new market- and legislative demands for instance, however, in the final set are the answers more connected to intangible aspects, e.g., proven expertise in design and production, yet, a red thread can be observed through the method, highlighting how the answers were derived (see figure 15). This alludes the following line of reasoning: Aston Martin believes Aurobay has the potential to help them keep customers and even increase the market share through expertise, brand reputation, ability to fulfil demand and being a reliable business partner, thus the argument to *why* Aston Martin select Aurobay over competitors. *Aston Martin believes why Aurobay do things; not in what they do.*

Although the method appears to have several advantages, the method could be refined. One of the participants expressed the partakers might influence each other when openly discussing the subject, thus potentially biasing the discussion and replies, but imply the potential problem could be mitigated if the participants first write short replies on post-its, for instance, in resemblance with AIM. AIM emphasises brainwriting rather than brainstorming, before having an open discussion. Moreover, the participant suggest that the method must be performed in closer collaboration with the customer in order to mitigate the risk of making decisions on erroneous assumptions, and likewise, aspects like previous experience and reference value must be regarded. Consequently, when questions arise should the customer be consulted and the method should be supplemented with additional supportive question encouraging the team to explore important aspects like previous experience of the customer. Furthermore, the participant

allude the workshop leader should emphasis more precise whether the end-customer or the customer to Aurobay that is being discussed, or both, as it might have importance to how the question is interpreted. The vastness of the method, referring to the number of questions and questions sets, may lead to the method becoming ineffective and unutilised as it become inconvenient even though the questions are well formulated and have potential to investigate deeper. According to the other participant, an important factor for the success of the method, whenever it is applied, is the input in terms of a rigorous case description, entailing essential insights and facts regarding the customer. Additionally, the method must be thoroughly described in a detailed instruction to make it applicable and to constitute a lasting improvement for the organisation. How the output of the method should be utilised must be thoroughly described in order for the output to be applicable.

<b>Final questions</b>
<b>So why does the customer have a need?</b>
To keep end customers, add a few more and increase profit without risking any business
<b>So why can we offer a solution that solves the need?</b>
Proven expertise in design and production
<b>So why are we considered as a supplier?</b>
Background and reputation
<b>So why do we provide value to the customer?</b>
Fulfilling demands Reliable Future business partner Bringing additional value

Figure 15: the final set of questions is completely comprised with why questions. This to ensure the red thread through-out the method is maintained, and that team has managed to capture the essence and why value could be offered.

#### 4.3.4 Method Refinement

The evaluation and assessment of the method presented several advantages and proved the method's potential performance, however, the subsequent interviews with the participants revealed areas of improvement. Consequently, the author proposes the extensive parts of brainstorming henceforth should be replaced with brainwriting, in addition to supplement the method with more supportive questions. Despite the good intentions with brainstorming, such as empowering creativity and breaking isolation in problem solving expeditions, three major shortcomings can be identified, starting with *blocking*. Blocking refers to the human brain's short-term memory limitations to effectively handle and develop new ideas and at the same time listen and reflect on what others elaborate on. The problem becomes particularly evident in larger groups and the jeopardy is the participants start to judge and discussing the already stated idea instead of generating new ones. The second problem concerns *the fear of being judged* by others since individuals tend to avoid express "wild" or "avantgarde" ideas in the presences of authorities and colleagues, for instance. The third major shortcoming is the brainstorming session might start to replicate Colosseum where a *contest between the greatest personalities unfolds*, containing the bystanders and suppressing creativity. Fortunately, the vantage with brainstorming can be observed in brainwriting as well. People still come together to resolve a problem, unleash creativity but records it on a piece of paper before sharing. Five major advantages advocate the deployment of brainwriting:

- I) The ideas can still be augmented and cross-pollinated though the discussed shortcomings can be mitigated.
- II) The ideas are directly documented.
- III) No contest between the greatest personalities unfolds.
- IV) Ideas are generated more in private and thus limiting the fear of judgement.
- V) The participant may perform in their own pace with limited to no time pressure to be creative (Nonprofit World, 2024).

Consequently, to ensure the quality and a cohesive way to perform the brainwriting, the author suggest the brainwriting should build on principles for brainwriting as outlined by Alänge (2009). However, the author will not put forward a condensed method even though the feedback during subsequent interviews after the case alluded so. The Theoretical Framework highlighted even product development processes are subject to rework and other waste full activities which could be diminished if the inputs to the process are robust and adequately defined (Ward et al., 1995; Yang & Basem, 2009). One key prerequisite is the word *defined*. Poorly defined problems statements, needs and expectations will likely lead to inquires solving symptoms and not root causes. Rushing through the define phase of any project, regardless of a Six Sigma venture or not, jeopardises the key factors for project success are bypassed and only recognised later, if fortunate. Hence, spending time and methodologically defining the issue will save time downstream even though it can appear the little progressed is made. *Hurry like the tortoise, not the hare* (Liker, 2020). Consequently, the author argues, with support from literature and the thesis findings, a condensed method will not be able to advance the organisation's capabilities.

The current state analysis reveals when the method should be applied. It should be utilised directly after the step *Lead Creation*, thus before any concepts, solutions or similar have been

proposed. Recall, the method is not intended to reveal all necessary answers that the project presumably will need during the project, but to rather give the project the possibility to do the right things from the beginning.

#### *4.3.4.1 Enhanced Instructions*

As stated by the author will the brainwriting activities in the proposed method be based on the principles in the AIM method (Alänge, 2009). Additionally, the revised and enhanced instructions will take inspiration from the AIM method instructions since the performance and advantages of the method are known and widely recognised. To ensure the instruction will be applicable and the method will be useful in the future, the improved instruction was developed in close collaboration with the representatives from the company.

The instruction starts with a general description of the method, its objectives, approximative time duration and vantage points. In the main part of the instruction will a detailed step-by-step approach be outlined with examples and figures in order to convey how the method should be utilised. The instruction is presented in [Appendix J](#).

#### **4.3.5 Second Method Trial**

The initial method trial had pointed at the advantageous prospects the method could convey, and hence it was determined a second trial should be executed but, however, this time with a non-fictive case. The aim with the second trial was to inquire whether the suggested refinements were feasible and subsequently could enhance the method as intended. The collection of data to the case complied to the enhanced instructions and the results and interpretation were conjoined with result with the results from the first trial. Due to confidentiality the company name cannot be disclosed and the resolution of details that can be presented in the report is consequently limited. Nevertheless, the case is presented as a masked version in [Appendix K](#).

The results from the second trial showed the method had indeed the advantages that had been revealed during the first trial and the participants expressed the method encouraged a novel approach to derive attributes and expectations as well as discussing the inquiry from a different angle. The method managed to derive multiple expectations and factors constituting the value proposition and what proceeding actions to take. However, the participants had at times difficulty to separate the essence of the question and asserted the same question was replied several times. Clarity for some of the question might be required, but a plausible explanation to why the partakers found it difficult to reply to some of the questions is the fact they are unused to the proposed method and especially the depth of inquiry the questions promote. Moreover, the partakers admitted it became easier to answer the question as the method progressed. The author argues the chairman must have comprehensive understanding of the method in order to facilitate the workshop and explain the questions.

Anyhow, the author suggests some of the questions in the questions should reverse order as it seemed baroque to answer *why* the expectations are fulfilled before presenting the concrete action on *what* can be done to fulfil the actions (see figure 16 & 17). Additionally, the author recommends time for a fika, which is utterly important in Sweden, since it can be quite intense to answer all twelve set of questions in row.

Question set 8	Question set 8
What are the concrete actions that make the expectations meet/fulfilled?	Why are the expectations meet/fulfilled?
How could the expectations meet/fulfilled?	How could the expectations meet/fulfilled?
Why are the expectations meet/fulfilled?	What are the concrete actions that make the expectations meet/fulfilled?

Figure 16: to the left is the sequence of questions reversed, conversely to the picture to the right.

Question set 10	Question set 10
What are the technical requirements?	Why does the technical requirements fulfill the expectations?
How can the technical requirements fulfill the expectations?	How can the technical requirements fulfill the expectations?
Why does the technical requirements fulfill the expectations?	What are the technical requirements?
How can the technical requirements be fulfilled?	How can the technical requirements be fulfilled?
Why are the technical requirements fulfilled?	Why are the technical requirements fulfilled?

Figure 17: to the left is the sequence of questions reversed, conversely to the picture to the right.

#### 4.3.6 Does the Method Have the Power?

As part of the method evaluation and assessment, the author assigned an employee at the R&D to solve the fictive case without the suggested method by deriving *what the customer wants*, *how the customer wants it* and *why the customer wants it*. The author arranged a meeting with the employee to discuss any eventual questions concerning the case. A three-day limit to submit the solution was set (for the full solution, see [Appendix L](#)).

The employee starts with a description and analysis of the typical customer. Generally, the voice of the typical customer is judged to be understood since a detailed analysis and interpretation is presented, however, it contains additional insights regarding expected driving- or acoustic characteristics, for instance, in comparison with the case solved with the method. The reason to why the customer has a need, recalling the first set of questions in the method, was equally interpreted with respect to the new legislative demand which implies Aston Martin needs to adjust to the new reality in order to keep customers. Yet, the identified value proposition made by the partakers solving the case with the method is not fully recognised in the solution made without the method. For instance, Aurobay's potential ability to create something unique due to the history of environmental awareness or history of manufacturing internal combustion engines appears to not have been identified, however, the fact that craftsmanship, distinctness and uniqueness create both value and are expected are mutually recognised. The employee moreover presents a rather detailed solution, such as a suggested engine displacement, type of fuel and how the delivery process should be performed, in contrast to the case solved with the method which discuss the solution of a more general level. Furthermore, the proposed solution is restricted to a V8 configuration.

Does the method have the power then? The author allude the method has the power to provide enhanced interpretation of the expectations and needs of the customer as well as developing an improved understanding of the value proposition. Although the employee successfully managed to derive parts of the expectations, needs and why value is created for the customer without the method, the case solved with the method inquired additional aspects and dimensions, like key activities or why Aurobay is considered as a supplier in the first place, thus implying the method yields an extended picture of the customer. Moreover, the method inquires further aspects to why and how the expectations could be fulfilled since, for example, the case solved with the method allude the expectations could be fulfilled by non-technical orientated characteristics like "*continuity in car design*" or "*new supplier of the engine cannot standout too much*", suggesting the end-customer focus remains on Aston Martin rather on the powertrain supplier.

Additionally, the author asserts the method can advert *information asymmetry*. Information asymmetry was recognised as a phenomenon when the designers and engineers envision, and intention of a product do not align with the expectations of the customer. Information asymmetry can occur when decisions concerning the product or service are based on flawed assumptions and consequently, the product cannot convey sufficient value. The method mitigates the jeopardy of information asymmetry since the method successfully can identify and define the underlying factors establishing value and satisfaction.

The overall quality experience and perception would presumably benefit and be enhanced with the deployment of the method as the method addresses aspects and factors which constitute the foundation for what the customer expect, need and demand of the product or service. The author implies the method increase the chances to detect the required characteristics to create a positive experience since the method will inevitably inquire the factors constituting the foundation of expectations, like knowledge, intended usage area and reference value.

Another essential aspect, identified by Wheelwright and Clark (1995), is the cross-functional integration which enhances the efficiency in product development. During both method trails, and especially during the later one, the author could notice the workshop acted as a natural meeting place and arena for discussing the inquiry between departments who normally would not discuss inquiries in this manner. Hence, the author asserts the method and workshop as the possibility to enhance the cross functional integration.

#### 4.4 “It’s easier to walk away” – How to make C-phase adhere

Hitherto, the thesis has covered all phase of the DMAIC approach except the Control phase. As presented in the [Methods Chapter](#), the C-phase’s main intent is to confirm the suggested improvement perform as anticipated and the change becomes embedded accordingly. Thus, the author outlines an action plan. The dissertation has yielded new and, perhaps sometimes, avantgarde and alien insights to how the organisation behaves, performs and what the shortcomings are regarding the creation of customer value and satisfaction. Therefore, the author asserts the first step of the action plan need to concern informing and sharing the insights with the rest of the organisation and thoroughly explain *why* the identified issues and proposed improvements are important to comprehend. Consequently, explain what the consequences of the current state are. The second action is to outline an approach to how it effectively can be resolved, i.e., adapt a method that can facilitate structure and coherence when handling customer inquire. The third step is deploying the proposed method, which has been tested and verified, and continuously enhance the method and quote process. Hence, the third step is *what to do*. Consequently, the outlined action plan follows the inside-out thinking.

What can concretely be done? Start deploying the method in the initial phase of the quote process. How can it be done? By agreeing on the method should be applied and the advantages of it but discuss which is the most appropriate step. Why should it be done? It would create a common point to base discussions on and a foundation to base improvements. Moreover, the workshop, in which the method is performed, constitutes the ideal starting point for sound and balanced discussions between departments. The cross-functional integration is thus enhanced.

Although one should not be lured the lasting change come without effort or the voyage does not come with challenges. However, the first step milestone has been reached. The major shortcoming of not understanding *why* and consequently what creates value for the customer has been identified and method has been outlined. Elton John (John & Taupin, 1990) frames it quite well when faced with a challenge that can be perceived as paramount:

*“It’s easier to walk away  
Better off to face the facts  
When love holds you up for ransom  
Walk away and don’t look back”*

Thus, stay and face the facts!

## **5. Discussion**

The chapter reviews the experimental uncertainties and sources of error, in addition to reviewing the adequacy of the selected research methodology in addition to highlight the prospect for future research. The identified void of research will be addressed as the research performed will be consolidated with existing research by reporting major findings and relate and evaluate the findings to previous research. Finally, a revised benefit assessment will be presented.

### **5.1 “It’s a human sign when things go wrong” – Experimental Uncertainties and Sources of Error**

The proposed method by the author has been evaluated, assessed and then refined according to the outcome of the first trial. The refinements have been subsequently tested and analysed in order to validate or reject the advised improvements. However, experimental uncertainties, or error-sources, must be identified and the cause and potential influence shall be examined and discussed accordingly.

The first identified source of error is the case. The case is, evidently, fictive and the possibility to ask supplementary questions directly to the customer submitting the inquiry were not possible which could be a shortcoming in the evaluation. This was also expressed by the participants in the subsequent interviews. Although the fictive case partially was based on a RFQ submitted by a real customer and had a foundation in the current state analysis, the inherent limitation of not having the possibility to ask supplementary questions could lead to flawed assumptions or conclusions and results were judged to be exhaustive, alluding the method’s performance is perceived to be more powerful than it actually is. Yet, the intent of the method’s test was to investigate whether the method could convey a new way for the organisation to approach a customer inquiry, thus the intention with the trial was not check if the outcome was strictly in align with Aston Martin. However, the risks and any potential influence are mitigated by the awareness of the implications and that the results and the drafted refinements were validated with an additional case trial.

Another potential error-source could be that not all departments normally participating in the quote process were represented during the workshop when the method was tested, implying a different outcome could have been reached. However, the author argues any impact of the identified error-sources is limited since the method trial only intended to show the potential of the method and although it would have been favourable to have more departments represented, the impact is presumably restricted to not deliberating the technical requirements more like the R&D employee did. Moreover, the author suggests the presented refinements in terms of an enhanced instructions will make the method applicable in the organisation and will achieve the intended advantages. As mentioned, the outlined enhancements were validated with an additional case trial.

## 5.2 Adequacy of Research Methodology

The selected research methodology for this MSc dissertation, the Six Sigma methodology, was outlined and described in the [Methods Chapter](#). The advantages and capabilities were conveyed, and all the five distinct phases were presented, and the reader was given a comprehensive look-out of the method. However, the question that remain is: the methodology adequacy for the thesis.

The author believes the selected methodology was appropriate for the thesis. Although Six Sigma is habitually associated with, as discussed, improvements of existing, and tangible, processes enhancing product quality Six Sigma can, nevertheless, be deployed in virtually all contexts (Yang & Basem, 2009) and the structured and highly data driven DMAIC approach ensure correct method deployment. The structure of the method has been highly beneficial since the issue to solve was intricate and surrounded in a densely forested jungle of question marks, believes and wishes. Likewise, the structure has mitigated the risk of jumping to conclusion and instead relied on that the findings, facts and analysis have presented how to proceed next. Although the phases of the method, recalling *Define, Measure, Analyse, Improve* and *Control*, not explicitly have been stated in the report do the Theoretical Framework, AIM workshops one and two, and the current state analysis constitute the D-phase while AIM workshops three and four have constituted the M-phase, the outcome of them have been analysed in the A-phase and the proposed method make out the I-phase. The action plan and recommendations will constitute the C-phase. However, the application of the method has been far from linear and have involved many iterations of the phases since the analysis of a new finding may have led to redefinitions and so on. For instance, the proposed method has involved both D, M, and A-phases since different findings and analysis have led to iterations to refine and enhance the method. Yet, the iterations should not be regarded as disadvantages, rather on the contrary, as a major vantage, referring to the combined utilisation of the abductive, deductive and inductive approach respectively can surpass their inherent shortcomings. The abductive, deductive and inductive approach are conveyed and discussed in the [methods chapter](#).

### 5.2.1 Evaluation of Quality Criteria

The *General Research Strategy- and Design* section in the [methods chapters](#) does as well outline three quality criteria and four sub-criteria. The author allude the thesis generally complies to the criteria, however, the replicability criteria and the external validity criteria, respectively, could be asserted to be either irrelevant or non-valid for the thesis. The replicability criteria mainly concern quantitative research, and the dissertation is arguably qualitative. Anyhow, the author recognises the necessity of thoroughly describe all the tools, methods and execution increase the transparency of research. When outlined and describe, the likelihood for replicability increases. The external validity criteria, however, is relevant for the dissertation but one could argue it is not fulfilled since the proposed method only was evaluated at Aurobay; thus, the outcome is potentially restricted to the context of the company. Yet, the method builds on previous research regarding customer satisfaction, expectations, value proposition etc., and the phenomena that previous researchers have observed have also been observed at Aurobay. Consequently, the conclusions that can be made concerning the outcome could with possibility be external valid as well. Moreover, the author is a trained and certified

Six Sigma Black Belt which adheres to the likelihood of successful deployment of the methodology. The measurement validity is indeed relevant for the research and the author argues the applied method and tools have been adequate and had the necessary resolution to capture the intended measure. As outlined, ecological validity has relevance to the dissertation and since the author mainly has studied the organisation when it operates as normal, the author believes the ecological validity criteria is fulfilled as no controlled test environment, or similar, has been set-up for the dissertation.

### **5.2.2 Research Ethics**

The method chapter highlighted the importance of research ethics and the principles as outlined by Bell et al (2019). The author asserts the performed research has complied to the ethical principles. The author has masked and anonymised the interviewees to allow them to speak freely about the topic and have at all times informed about the research intent and purpose in order for the participants to make a decision to respond or be involved. Moreover, repeated information has been broadcasted concerning the research purpose, intent and progress to allow any question and concern regarding the research to be addressed properly. The author has as well signed a confidentiality agreement with the company which cover many of the aspects.

### 5.3 The Void in Research – Why the Dissertation Yields Consolidation

The Theoretical Framework revealed the input to the existing methods applied to interpret, analysis and prioritise the customer expectations, needs etc., constituting the value proposition, has an inherent void, namely the intricate issue of identifying and articulating them. For instance, the utilisation of the Kano Model requires the attributes and expectations already have been mapped and understood since the Kano Model intends to solve the issue on how to learn and prioritise which attributes that matters the most to customer satisfaction. Even the Voice of the Customer, which is described to be an important step in the Define-phase of the Six Sigma methodology, aims to articulate and categorise the customer need, wants and expectations but the prerequisite is the needs, wants and expectations are recognised accordingly. The Theoretical Framework highlight that wrongly interpreting the customer desire could impair customer satisfaction and the quality perception. However, the Theoretical Framework did additionally highlight that the existing methods do not concern *why* the customer has a need or *why* value is created, although Sinek (2009), Lindstedt and Burenius (2016) and Nusem and Starker (2019) heavily implied the underlying reasons to the value proposition are essential to understand in order to create maximum value. Consequently, the author had recognised a void and alluded the research performed in the MSc dissertation should overcome the defined void. Likewise, the implications for the organisation were also recognised in the problem definition made by the author (see chapter 4.1).

The author asserts that the method has the ability to bring new and needed research. The outlined method has showed the required inputs to the succeeding product development process are yielded and present a feasible way to decipher the customer's value proposition. As presented, the method comprises twelve sets of questions and is augmented by combining outside-in- with inside-out thinking. The questions explore and investigate the necessary dimensions of the customer, including why the customer has a need, why the potential supplier has the prospect to yield value to the customer, key activities, expectations and requirements. The method output establishes a foundation which can be utilised as an input to the succeeding steps. Likewise, the author suggests the method provides the foundation to *Critical to Quality* (CTQ) for the customer inquiry, recalling CTQ are attributes that directly has a major impact on the quality perception (Yang & Basem, 2009). What is the rationale? The rationale is the method derives why value is created by exploring concrete actions on how that could be achieved and what can be done in order to yield the desired value proposition.

Nevertheless, one could allude the AIM method, which have been utilised in the thesis, can be applied to approach a customer inquiry and facilitate the identification of key factors driving customer satisfaction and the value proposition since it offers a structured, button-up analysis of a problem and yields an exploration of the problem's underlying nature, thus successfully managing to close the identified void in knowledge. However, AIM emphasis problem solving and aim to obtain a deeper understanding of an occurrence and does not necessarily explore the value proposition nor the factors propelling customer satisfaction. Consequently, the proposed method is tailored to the context of product development and the Design for Six Sigma thinking, i.e., *do the right thing from the start and do it all the time*.

Ultimately, the author put forward a novel quality definition based on the findings and subsequent analysis of the results:

*The minimum level of satisfactory Quality can be defined as the ability to align, or surpass, the delivery of a product or service with the explicit, and implicit, articulated expectations of the customer by understanding the underlying why.*

*Thus, Quality is judged on the performance to deliver on expectations.*

The outlined definition completes the void that exist for the existing quality definitions. The definition progress from the necessity that quality should be judged upon objective and subjective terms respectively and alludes quality rather should be appraised on how well customer perceives that the product or service successfully have managed to deliver on the expectations. Consequently, the quality of a product can be deemed to be superior if the execution of the product surpasses what was being expected of the product, meaning that even in instances there a similar product objectively performs superiorly with regard to durability, for instance, the quality of the product will be judged regardless of the objective performance and exclusively on the ability to align, or surpass, the expectations.

## 5.4 Process Robustness

Edward Demming allegedly said, “*a process or an organisation is perfectly organised and capable of delivering what it does today*”, implying if an organisation sells ice cream it is already optimised to do so in the way they perform the key activities. This alludes if an organisation strives to enhance their process by doing something else, e.g., an enhanced quote process, the process needs to be fundamentally reorganised since, remembering Demming’s statement, the process is already perfectly tuned and arranged to do what it does today, regardless of what it might be. In the case of Aurobay, the quote process, which has been inquired in this dissertation, is seamlessly organised and capable of delivering *what* and *how* they do today, however, the process is less proficient of delivering *why* customer value and satisfaction is created. Thus, in order to enhance the process, Aurobay must embrace a process redefinition and undertake measures to improve the process in a favourable direction. Frankly, it is naïve to believe the much-needed change of understanding, and delivering on, the underlying *why* would appear from the process as it is organised and executed today.

The whole line of reasoning essentially can be condensed to *process robustness* and *common and special cause of variation*. One could argue a robust process is more effective, predictable and insensitive to variation. The quote-process of today, the author would assert lacks robustness to handle the incoming variation in terms of different customer inquiries. Yet the proposed method and improved understanding of what, how, and why customer value is created and what, how, and why certain factors propels customer satisfaction, alluding the process becomes more resilient and capable of handling the inherent variation of incoming inquiries. What is more, the common cause of variation is *what* and *how* since virtually every inquiry concerns the manufacturing of an automotive component or solution. A bakery would not submit a request to Aurobay to make bread, for instance, suggesting the special cause of variation is *why* different customer within the automotive world submit request. Consequently, it only when understanding the special cause of variation, the process can be tailored and optimised to deliver something avantgarde and fundamentally different compared what the process do today. The system must change by actions from management and there is no quick fix or easy way to improve the situation (Gitlow & Gitlow, 1987). The author asserts the dissertation has revealed the special cause of variation and feasible measures to improve the process and system.

## 5.5 Future Work & Research

The section intends to present where future work and research might be required.

### 5.5.1 Does the Method Have the Power Elsewhere?

The proposed method does, as thoroughly discussed, convey value to Aurobay. The author has alluded the method likely can convey value for other organisations, but it would be wise to evaluate the performance elsewhere in order to adhere the method’s generalisability.

### 5.5.2 Ensure the Method’s Advantages Are Permanently Embedded in Practice

As outlined in the method chapter, the Control-phase of any Six Sigma venture aims to present adequate measures to understand whether the suggested improvements do what it supposed to do and ensure the improvements becomes embedded in practice and not put in an archive and forgotten for time and eternity. Although the authors with support of the findings and facts of the dissertation, the author emphasises the integral importance of the Control phase and encourage the organisation to adhere to the outlined action plan and continue to enhance the method.

## 5.6 Revised Benefit Assessment

The author asserts the identified benefits still are valid and the dissertation has yielded both the soft- and hard benefits. However, one new soft benefit could be asserted, that is *enhanced cross-functional integration* (see table 5). For the first Benefit Assessment, see [Chapter 1.4](#).

Table 5: the Revised Benefit Assessment.

Revised Benefit Assessment	
Hard	Soft
Tools and method capable of assisting the scoping of customer req. and exp	Increased pull-thinking for deriving customer needs and expectations
Reduction in costly late minute changes	How defining customer requirments and expectations in early phases of prod.dev. influnces perceived quality
Reduce the amount of rework in the product development process	Increased awariness why requirments varies between customers
	Understanding the underlying why
	Enhanced understading of the value preposition and customer satisfaction
	Enhanced cross-functional integration

## 6. Conclusion

The final chapter of the MSc thesis intends to give a comprehensive and exhaustive conclusion of the performed work and present the most essential findings. This is achieved by answering the four research questions. Recalling the purpose of this MSc thesis work which was to inquire how the understanding of the underlying *why* could foster greater customer value and satisfaction by deriving the expectations, qualities and attributes propelling value and satisfaction. Additionally, the thesis inquired how the fulfilment of expectations, qualities and attributes influence the quality perception and the overall quality judgement. Recalling the presented research questions:

### RQ1:

- What is the current state in the quotation process and how does the current state influence business operations today?

### RQ2:

- What importance does the alignment with customer expectations induce on the quality perception?

### RQ3:

- How could the gap between the current state and future state be bridged?

### RQ4:

- What methods and tools can be developed to assist Aurobay's quality assurance department in identifying and defining customer requirements and expectations in the early stages of product development?

## 6.1 RQ1

As of today, the *Strategic Value Pathway* (SVP) handles the customer inquiries and the subsequent effort to investigate the customer needs, demands and expectations prior to the hand-over to R&D- and ME departments, respectively. The current state analysis depicted the four distinct processes of the SVP, and the analysis displayed a standardised process and approach to handle the incoming inquires. Each subprocess had corresponding objectives and deliverables. Since the SVP is standardised, can continuous improvements be applied. The analysis showed that the *Customer Acquisition and Retention* (CAR) process played an important role in the SVP as it virtually defines what the project should concern and how to proceed achieve the project objectives. An initial understanding of the customer's expectations, requirements and needs should be made in the CAR. However, the process performance is far from satisfactory. The process is much indeed focused on knowing *what to do* and *how to do it* and emphasises less *why to do it*, subsequently, the process lacks clarity of direction and is not optimised nor tuned to inquire the value creation and the factors propelling satisfaction. Frankly, the organisation is stuck on a single way track with the knowing what and how to do it and prevents Aurobay to develop and enhance their potential value offering to customers. As the author put it in the current state analysis chapter:

*“The mindset [of being an in-house R&D department] nurtures a spinal cord reflex of knowing what to do and replying how to do it”*

One of the potential reasons is the heritage from Volvo Cars, which Aurobay has been part of in form of an in-house R&D department, focusing on internal combustion engines.

The implications on the business operation are several. Flawed assumptions regarding the value proposition can lead to that a redundant product or service is developed since the process fails to articulate and understand *what, how* and *why* value is created and subsequently does not yield a desired product complying to customer expectations. Consequently, failure of understanding the underlying *why* leads to an impaired understanding of value creation and customer satisfaction. A product developed under such circumstances could have characteristics the customer does not want or deems to be inferior which could lead to a discontent customer, rework or even lost business opportunities. In the end Aurobay will, in best case, manage to fully comprehend what the customer wants but the effort to correct the issue will be more paramount the further the process has progressed as the associated amount of rework and expenditure will increase due to more parameters of the project have been set and locked. Conversely, awareness of the issue and succeeding to understand the value proposition would yield higher satisfaction and less rework. Although the process is standardised, the interpretation of the current state does also point at a non-standardised routine to when, how and why a resource, e.g., a quality engineer, should participate. With the outlined method, it might be plausible to bring the required clarity to when the correct resource should be deployed since if the needs and expectations are known will the plausibility increased to determined what kind of expertise that is needed.

To conclude, the current state analysis has highlighted a standardised process, the Strategic Value Pathway, regarding how to handle and address customer inquiries and standardisation is

an integral enabler for continuous improvement. However, regardless of the intent of the process, the process unfortunately has deficiencies concerning how to identify the customer requirements, expectations and needs since the mindset is locked on to knowing what to do and how to do it but put less emphasis on understanding the value proposition and value creation for the customer by not comprehending the underlying *why*. The potential implications for business operations could be lost revenue, increased expenditure and customer discontent.

## 6.2 RQ2

The dissertation has inquired several aspects concerning customer expectations and the importance of successfully aligning the expectations with the execution and delivery of the product or service. The extensive and all-encompassing *Theoretical Framework* chapter elaborated on the augmenting significance of perceived quality and its impact on the overall quality experience due to the factors like fiercer competition and scattered market. The customer will perceive, interpret and judge a product or service within a matter of seconds; thus, the initial interaction needs to align with how the customer expected the product or service to be or behave. Hence, the customer expectations govern the perception of quality which directly affects whether the customer will be content or discontent with the delivery. The findings in the thesis supports the presented line of reasoning as the conjoined analysis of the AIM workshops highlighted insufficient understanding of the factors influenced perceived quality, along with the underlying drivers of customer expectations, can significantly impair customer satisfaction, reduce demand, and degrade the overall user- and quality experience. However, these risks can be effectively mitigated through the development of strategic approaches that explicitly identify and communicate the elements shaping expectations, including interest, knowledge, and prior experience. By doing so, organisations are better positioned to enhance customer satisfaction and experience, thereby gaining a sustainable competitive advantage.

Ultimately, the author asserts the expectations are explicitly linked to the how the customer shall perceive and judge the quality and products performance. Thus, if the organisation cannot understand, define nor articulate the customer's expectations, how will the organisation be successful in the instance of delivering value and create a positive quality experience? The answer is: *presumably not*.

## 6.3 RQ3

The author argues, with support of the findings of the dissertation, the gap between the current state and future state can be bridged through an enhanced understanding of what creates value and satisfaction for the customer by successfully deriving and defining the underlying *why* and identify the expectations, requirements and needs the customer has by comprehending *how* and *what*. As the expectations, requirements, and needs may not hold equal value for the customer, they must be prioritised accordingly. Consequently, if identified and articulated correctly, can a subsequent ranking resolve the inherent importance of them, enhance the understanding of *why*, *how* and *what* creates value and the factors driving satisfaction. Conversely, failing to do so will yield discontent and poor value creation.

## 6.4 RQ4

The dissertation has yielded a method offering the plausibility to help recognise and define the value proposition through exploring and comprehending the underlying *why*. Therefore, the method is designed to support the identification of the underlying *why* behind customer expectations and to facilitate the inherent prioritisation of attributes, expectations, and requirements. The method also aims to enhance understanding of the value proposition and the key factors driving customer satisfaction. It is conceptually grounded in Sinek's (2009) Golden Circle framework and draws on the synergistic interaction between inside-out and outside-in thinking as outlined in the Value Definition Model by Nussem and Starker (2019). Central to this method is a reordering and integration of the questions of *why*, *how*, and *what* to encourage a more customer-centric, needs-driven approach. To counteract push-thinking, where solutions, products, or services are imposed on customers without adequate understanding of their actual needs, the method introduces twelve sets of questions. These are arranged according to a pull-thinking logic, beginning with inquiries into the origin of the need. While the method does not claim to provide all answers that may be required throughout the course of a project, it is intended to help guide early-stage decision-making and ensure that the right problems are being addressed from the outset. Additionally, the cross-functional integration between departments is enhanced. Furthermore, the method encourages participants to step outside their comfort zones and adopt a novel, reflective approach to problem-solving. A detailed presentation of the method can be found in [chapter 4.3](#) and [Appendix H](#).

## 6.5 Overall Conclusion

This MSc thesis has explored how a deeper understanding of the underlying *why* behind customer expectations can enhance value creation and customer satisfaction within Aurobay's product development processes. Through a detailed investigation guided by four research questions, the study has uncovered key insights into current organisational practices and offered a framework for improvement.

The analysis of the current state (RQ1) revealed that while Aurobay's Strategic Value Pathway (SVP) is standardised and structured, it lacks mechanisms to sufficiently explore and define customer expectations, particularly the reasoning behind them. This limitation stems from a legacy mindset focused on *what* and *how* to deliver, with insufficient emphasis on *why*, which has led to misaligned value propositions and potential inefficiencies in fulfilling customer needs.

Addressing RQ2, the thesis demonstrates that perceived quality is closely linked to how well a product or service aligns with initial customer expectations. Misalignment not only diminishes satisfaction but also erodes competitive advantage. A customer's perception forms rapidly and is influenced by past experiences, knowledge, and initial impressions, underlining the importance of accurately identifying these factors early in the development process.

In response to RQ3, the study suggests that bridging the gap between the current and desired future state requires a shift in focus toward understanding the full spectrum of customer expectations—*why*, *how*, and *what*—and their relative importance. Prioritising these insights allows for more informed decisions, better resource allocation, and improved value delivery.

The thesis responds to RQ4 by presenting a practical method rooted in Sinek's Golden Circle and the Value Definition Model. This tool supports the early identification and prioritization of customer expectations, promotes cross-functional collaboration, and introduces a structured, reflective approach to challenge conventional thinking. It is designed not to replace existing processes, but to enhance them, particularly during the early stages of product development, by integrating customer-centric thinking.

Ultimately, the author outlined a new quality definition- The proposed definition addresses a critical gap in existing quality frameworks by emphasising both objective and subjective dimensions of quality assessment. It is grounded in the premise that quality should not only meet measurable standards but also align with how customers perceive the product or service in relation to their expectations. Accordingly, a product may be regarded as high quality if it exceeds those expectations, even when a comparable product demonstrates superior objective performance in areas such as durability. This highlights that quality is ultimately determined not by absolute performance metrics, but by the degree to which expectations are met or surpassed.

In summary, this research underscores the necessity of evolving from a task-driven approach to one that is value- and needs-driven. By fostering a deeper understanding of customer motivations and expectations, Aurobay, and similar organisations, can improve product alignment, increase satisfaction, and drive long-term value creation.



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## Appendices

In the subsequent appendices are information, figures, diagrams etc. judged to give the reader additional insight and knowledge presented.

### Appendix A – Aesthetics and Craftmanship Influence on PQ

Tovillo et al (2024) have examined whether the combination of exterior- and interior colour has an impact on the perceived quality or not. Exterior- and interior colour is of interest following the line of reasoning that perceived quality is mediated, to some extent, by aesthetics (Stylidis et al., 2015). After formulating research questions regarding fixation duration, i.e., for how long the customer view each combination, and how following subjective PQ assessment impact the attentional behaviour, the authors were able to draw several conclusions. First, the performed Chi-square test disclosed the combinations were statistically associated and second, certain colour combinations were perceived as unfamiliar and had consequently a longer fixation time. Third, if the following evaluation was negative, the fixation was indeed extended. Especially certain colours were perceived to represent lower quality when others. For instance, red interiors and red exteriors were generally deemed to be the least preferred ones, whereas the grey and black interiors and exteriors were more preferred. Thus, Tovillo et al (2024) argues that certain colour combinations are perceived as more harmonious or pleasant which influence the attentional behaviour and further appreciation. Furthermore, according to the authors, the subjective preference of aesthetics qualities, such as colour combinations, act as a factor that cannot be disregarded in the role of motivation and attentional behaviour, like purchase decisions. However, the conclusions that can be made are limited since the data is inadequate to distinguish whether a certain colour is unappealing per se or whether they do not fulfil their purpose of conveying reliability or high-quality, for instance. Yet, the study highlights understandings how the cognitive process when analysing colour combinations influences behaviours, motivation and intention, aspects are of great interest to automotive manufactures. Nevertheless, the colour combination of a car impacts the perceived quality of the car and how the customer perceives the rest of the product and its overall quality.

Craftmanship can be defined as how well the quality of design is executed in practice, with regard to fit and finish and material choice (Stylidis 2020). The methods utilised to manufacture products cannot be disregarded since the use of traditional methods, for instance, have positive influence of perceived quality. In the journal article, *How Traditional Production Shapes Perceptions of Product Quality*, do the authors elaborate how the utilisation traditional products methods help to increase the perceived quality. Wilcox et al (2023) suggest anecdotal evidence reveals that customers regards and perceives products manufactured with traditional methods to be of greater quality compared to products produced with modern methods and technologies. However, a rather broad interpretation of what counts as traditional method exist and may differ widely even within the same type of industry. What counts as a traditional method when producing natural wine, for instance, is one industry where consensus does not exist. Some wine producers imply harvesting grapes manually and avoid additives is enough in order to label the wine as manufactured utilising traditional methods, whereas others mean that the wine

must be fermented in clay amphoras, a method going back to the time of the Roman Empire, is an essential.

Wilcox et al (2023) defines traditional production methods as “*a method that relies on skills, knowledge, tools, or techniques that have been used by a group or society to make products for a long period of time*” and highlights the prominent aspect of the method is drawn from the past and not based on modern standards. Another important aspect is how modernisation has negatively influenced the need to have a skilled and specialised workforce, since the mass manufacturing methods, dominating production today, does not require the same amount of craftsmanship in each product as it once did. The decrease came to the point when it started to have a negative impact on culture, leading to UNESCO creating the *List of Intangible Cultural Heritage* in order to safeguard the cultural heritage around the world. On the list are products like the French baguette, silk and tea. Besides from UNESCO, there are several organisations actively working to preserve local culture and manufacturing methods. For instance, the authors mention *the Slow Food Movement* in Rome as one organisation attempting to preserve the culture food heritage against the rapid rollout of fast-food restaurants.

Wilcox et al (2023) put forward the hypothesis when customers become aware of a traditional production methods have been used, they regard the product an act of culture preservation. The hypothesis was tested in a pilot study and was subsequently analysed with *Analysis of Variance*, ANOVA for short, disclosing the participants regards companies utilising traditional methods to have a positive influence on cultural preservation in contrast to companies using standard methods. Moreover, the different factors influencing product quality is additionally elaborated in the article. Activities viewed by the consumer as *social beneficial* can have an impact on how customers perceive the quality, even though the activities may have a negative effect on perceived quality. This can be explained with brands concerned with sustainability is perceived or expected to perform better on sustainable aspects, however, they are often anticipated to have inferior performance on strength-related dimensions. Wilcox et al (2023) suggest that customer believes the brand is required to make a trade-off between social responsibility and product quality. Yet, customers are more keen to perceive a company’s social beneficial activities to have positive impact on the product quality if they at the same time regard the company is a moral actor in society, such as utilising traditional production methods, thus positively influencing the perceived quality.

Furthermore, Wilcox et al (2023) implies factors like authenticity could influence consumers perception of product quality, since authentically manufactured entail craftsmanship and a display of skills and expertise, in addition to being social beneficial since traditional methods have been applied. The stipulated theory is consequently the positive effect of traditional methods occur when a customer regards the method to contribute to cultural preservation. However, the effect should not be observed if customers believe is unbothered with cultural perseveration. Thus, the theory was tested in a series of experiments designed to test various dimensions, such as e.g., *willingness to pay (WTP)*, the effect on intent to purchase, how perceived quality is influenced by the use of traditional methods etc.

The results from the experiments disclose that perceived quality is enhanced by the use of traditional methods and a mere mention of its utilisation is enough to have a positive effect on quality perception and the intention to buy. The analysis does also reveal that the size of the business nor the number of products produced with traditional method does not interfere with the effect on perceived quality. However, multinational companies were not as likely to draw positive effects since they were generally regarded to not be concerned with cultural preservation. Additionally, products mainly manufactured by machines do as well benefit from the traditional method effect as it appears the effect is mediated by the convention that the brand is socially beneficial. As long as the product is being described as *manufactured with traditional methods* a positive effect can be noted. Besides, the products were appraised to be beneficial for society since the company utilised traditional methods which speaks to cultural preservation, in addition to the labelling “made with love” seems to be beneficial. The opposite effect, i.e., negatively influence perceived quality, can on the contrary be observed if the company only uses traditional methods as a follower strategy. The study does also disclose that perceived uniqueness does not influence perceived quality. Hence, customers’ view of products and its perceived quality is positively influenced by the utilisation of traditional methods as long as they are described as manufactured according to traditional methods and if the company in question is concerned with cultural preservation (Wilcox et al., 2023).

Wilcox et al (2023) has inquired how the utilisation of traditional production methods influence product- and perceived quality. Before doing so they offered a definition of traditional production method, and the authors discuss the broad range of the term within different sectors and industries. The findings disclose that cultural preservation is an important aspect for the use of traditional methods since the positive effects can be observed if the use of the method is determined to be deployed to aid preservation. Additionally, both WTP and intent to buy benefit from the mention of its deployment has been inquired.

## Appendix B – Global Perceived Quality

Hitherto, perceived quality has been discussed in the context of pre-purchase situations, product development, influence on brand image-and heritage, but Souki et al (2018) has inquired perceived quality's influence on post-purchase behaviour. Soucki et al (2018) have investigated the impact of *Global Perceived Quality* (GPQ) in post purchase context and the performed study managed to identify the main quality aspects a customer deliberates on when acquiring a car and as well design and test post-purchase behaviour model. The authors imply total quality can be defined as the sum of both tangible- and intangible product attributes and quality perception, regardless of product or service, depends on multiple factors consisting of soft values, like beliefs, emotions, symbolism etc., associated with the product, in addition to more concrete elements, for example functionality, frequency of use etc. Previous research discloses the customer satisfaction does not only rely on the delivery of the product or service, but likewise the execution of delivery, setting the expectations on what the service or product should accomplish. Hence, inquiring what factors and elements affecting satisfaction is instrumental for understanding how to prioritise them accordingly in order to achieve the optimal quality perception.

The proposed model by Socki et al (2018) comprises five elements, namely *satisfaction, regret, trust, pride* and *word of mouth* connected through eight hypotheses in total, designated to describe GPQ in a post-purchase context. Additionally, seven factors had by earlier research been identified to affect GPQ. The seven factors are *power and status, drivability corporate responsibility, brand and company tradition, resale and maintenance, automobile's resistance and internal space and trunk capacity*.

The hypotheses were:

- I. Satisfaction and perceived quality have positive monotonic correlation
- II. If the perception of quality is not attained, the customer might regret the acquisition. Thus, perceived quality has negative monotonic relationship with regret.
- III. Regretting an acquisition, for instance, alludes the customer is dissatisfied. Consequently, regret negatively impacts satisfaction.
- IV. The consumers perception of trust related to a company, i.e., responsibility, kindness, honesty, has a positive relationship with the perception of global consumer quality.
- V. Satisfaction with the company and its provided products or services can flavourily promote higher trust.
- VI. Additionally hypothesised is that regret has a negative relationship with trust.
- VII. Customer talking positively of their experience with the company and the acquired product will promote the referrals and word-of-mouth.
- VIII. Finally, a person that fell trust in their acquisition does also fell pride of owning it.

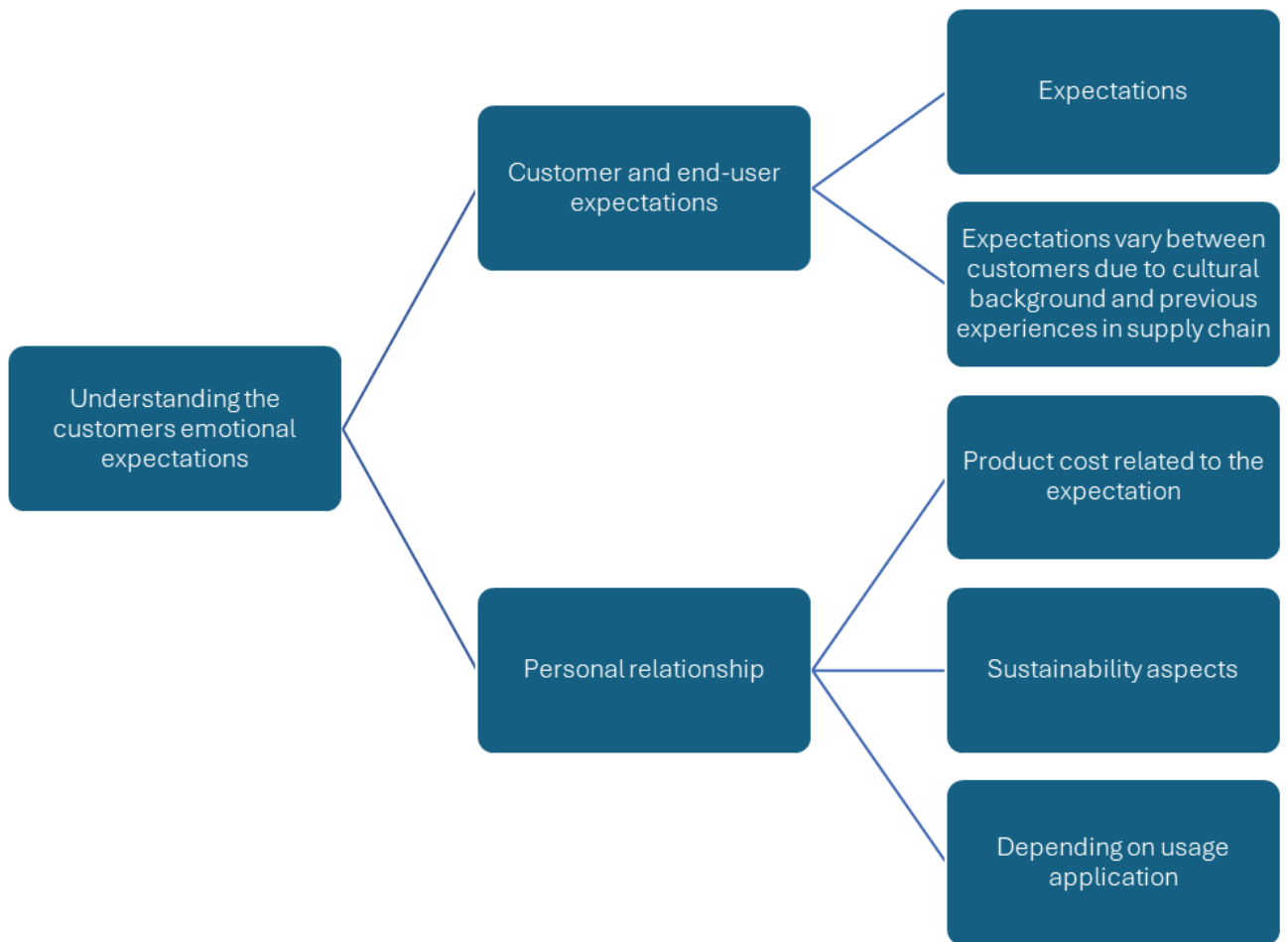
The study revealed all formulated hypotheses were supported. The study conclude perceived quality is a multidimensional construct, but the proposed model could aid to leverage the understanding of global perceived consumers quality.

# Appendix C – AIM 1

In this appendix is AIM workshop 1 displayed.

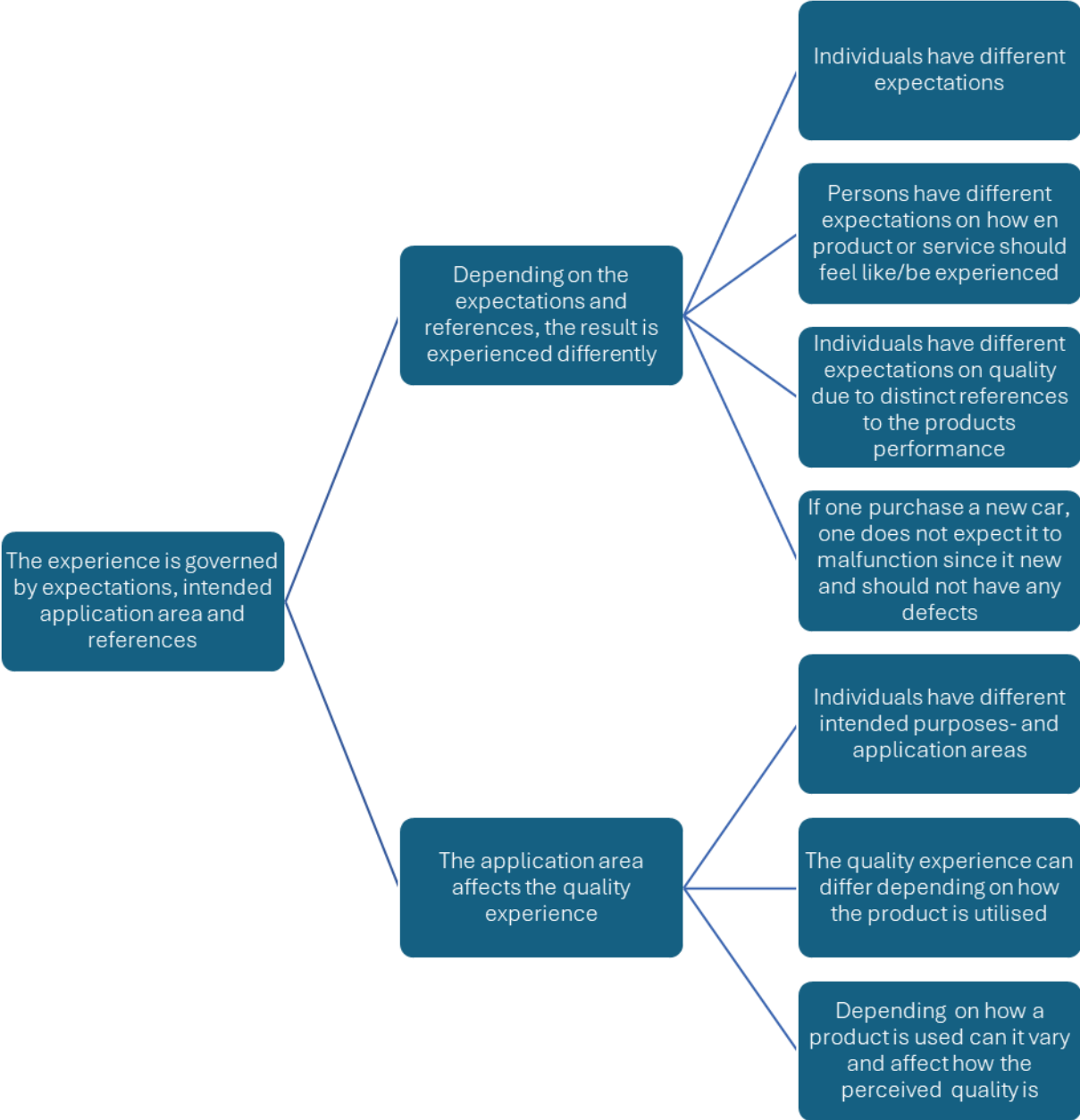


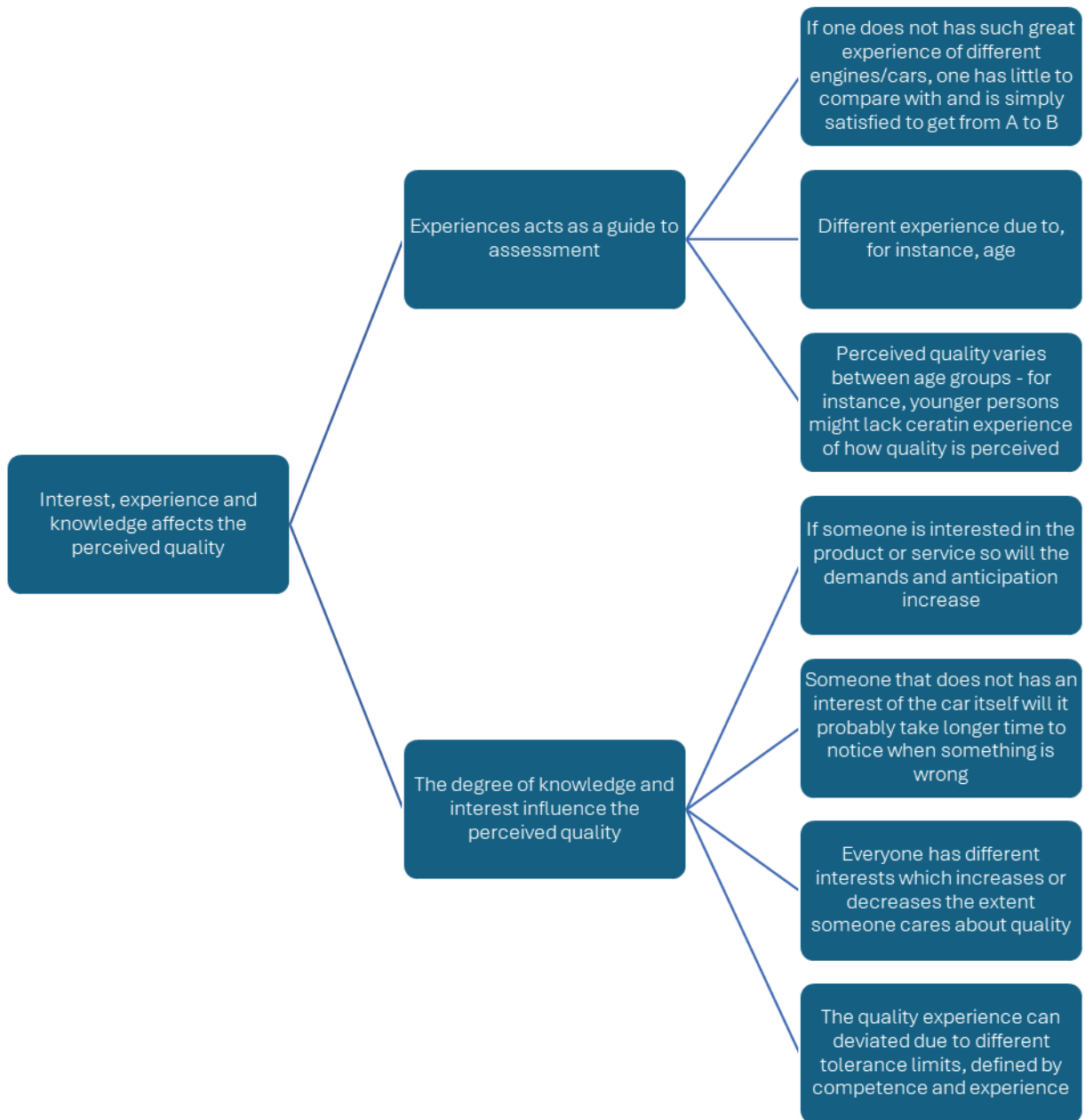




# Appendix D – AIM 2

In this appendix is AIM workshop 2 displayed.





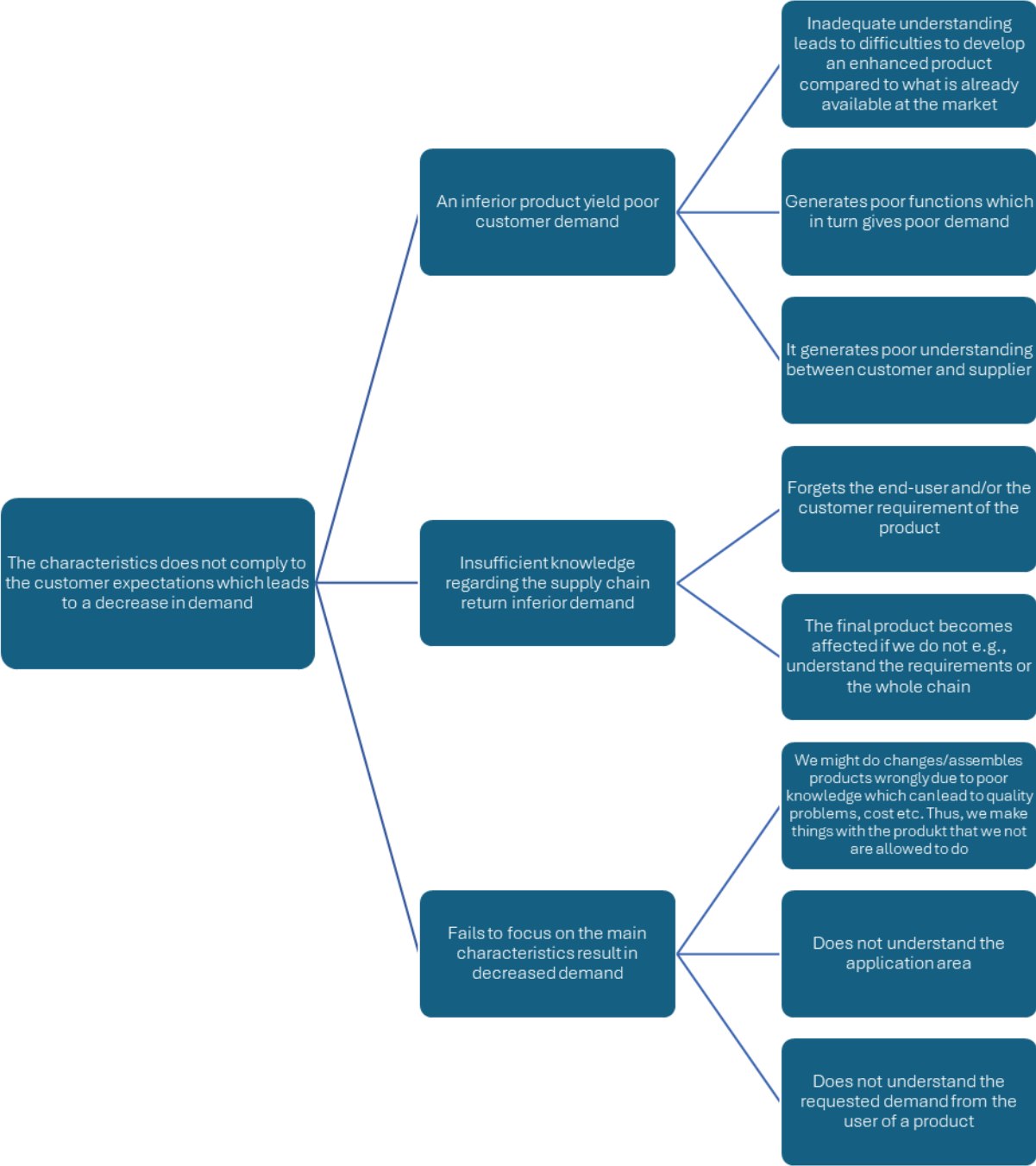
### Appendix E– AIM 3

In this appendix is AIM workshop 3 displayed.



# Appendix F – AIM 4

In this appendix is AIM workshop 4 displayed.





## Appendix G – Effective Scoping

The appendix G contains the Effective Scoping (see figure 18).

Supplier	Input		Process	Output	Customer	
8b. Who supplies the inputs?	Q8a. What are the inputs to the system?	Q9. What does the system require of the inputs?	Q7a. Team/project jurisdiction of changes	Q1. What comes out (of the physical flow) - OUTPUT?	Q3. What is required of the output from this particular user (List of big Y's and improvement proposals)	Q2. Who uses the output?
Aurobay Chalmers Research community	Customer inquiries Quotations	Need to investigate more	Can only propose new ways of working	Understanding how perceived quality attributes influences the quotation process  How to rank the attributes in a customer specific context  Understanding of the customer expectations  Common language of perceived quality  Understand why in the customer need	Knowledge on how to rank the attributes inherent importance to a specific customer  Awareness of the customer expectations  <b>Q4. What ONE MEASURE (y) should be understood and improved? The y that scope the project and drive further exploration. Each small y has its own underlying system of influencing parameters, sometime overlapping. Use one template per y to reduce complexity. Scope on y (not x - upstream) and don't proceed until Q1-Q4 is thoroughly understood!</b>	The quality assurance department  Aurobay
			Q7b. What competences are needed in the team (WHO)?			
			MSc			
			<b>Name of the underlying system that build up the y to be improved:</b>			
			Quotation process 5.2			
			From where is the physical output shipped?			
N/A	Q5. What is the baseline of the y and can that be measured today (and can old data be trusted)? In other words: What is the facts behind the problem that form the base for our improvement promise? Show the data/proof of a problem!  As of today, the current state is not fully mapped. There is no method or measurement system in place today. The literature review disclose that aligning with customer req./exp. is essential for the overall quality perception. Thus far, the inquiry has revealed that the customer req./exp. is estimated and not derived in a pull-thinking manner	Q6. What other Y can not be lost in the process (constraints)?				

Figure 18: the effective scoping.







## Appendix I – Case Study AM

The first version of the method used to solve the Aston Martin case is presented below.

The case, utilised to evaluate and analyse the proposed method, is presented below.

### Objective

The objective with the case is to effectively resolve a customer inquiry for manufacturing of an automotive component at Aurobay in the outset of the product development process, i.e., the quote process. Successfully deriving and comprehending the customer expectations could yield better satisfaction performance and an overall enhanced product development process in terms of reduced rework and other unwished redundancies.

Thus far the thesis has potentially showcased multiple factors capable of influencing how expectations are created and how aligning the delivery with expectations has a significant impact on the overall quality perception.

Furthermore, the objective is as well to inquire whether the suggested method improve the pull-thinking for acquiring the underlying *why* embedding the customer request before answering *how* the request should be meet. The understanding is comprehending *why* cast new light on the problem at hand and often leads to a completely redefined perception on what to actually solve. Asking *how* tends to lure the problem solvers that the problem already has been adequately articulated, defined and understood.

The aspiration is the outcome of the method can be used to ensure the succeeding quote- and development process incorporates the customer needs and expectations to achieve maximum customer value.

Please see the case on the next page!

Kind regards,

*Ludwig*

## Case

**Subject:** Confidential Inquiry: High-Performance V8 Engine Collaboration Opportunity

The company submitting an inquiry, in form of a *Request for Quotation* (RFQ), is renowned British car manufacture with a profound heritage, namely Aston Martin. The heritage builds on more than a century of innovation, is rooted in the belief that every Aston Martin must embody power, beauty, and soul. Aston Martin is now committed to embark on the next chapter of their high-performance powertrain strategy and is consequently searching for an esteemed engine manufacturer for the development and supply of a bespoke V8 power unit that aligns with brand heritage and values.

### Project Scope & Requirements

- **Power & Performance:** The engine must deliver an extraordinary blend of power, responsiveness, and efficiency, embodying Aston Martin's DNA while meeting modern regulatory standards. Preferably, the maximum performance output should fall within 30 %, plus or minus, of the V12 engines power output, that is 740 hp. Aston Martin intends to utilise the engine in various cars.
- **Quality:** The quality must comply, or excel, to the Aston Martin Quality Standards and the customers perception of quality.
- **Character & Emotion:** A defining characteristic of an Aston Martin engine is its unmistakable sound and engaging driving dynamics. This V8 must provide an intoxicating auditory experience, coupled with an engaging throttle response.
- **Exclusivity & Innovation:** The unit should be engineered with cutting-edge materials and technology, ensuring it remains lightweight while offering optimal durability and refinement.
- **Sustainability:** Aston Martin is highly committed to reducing the environmental footprint while maintaining thrilling performance. Thus, Aston Martin seek a powertrain solution that supports electrification integration or other forward-thinking advancements. The engine should be able to run on methanol and petrol fuel. Additionally, Aston Martin wishes to inquire the possibility of bio-gas integration and the material utilised should be of recycled origin as much as possible.
- **Volumes:** 15 000 – 35 000
- **Listed technical requirements:**
  - Emission class:
    - Euro 7
    - With the possibility to be further enhanced
  - Ambient operational conditions:
    - 2500 MSL

- Temperature -30 to +50 degrees Celsius
  - Weight:
    - Should preferably not exceed 200 kilograms
  - Maximum engine envelope:
    - Not yet defined
  - The internal combustion engine should be able to be integrated with the exhaust-and exhaust treatment system which is engineered inhouse.
- **Production requirements:**
    - Country of manufacturing:
      - Sweden
    - The components are sourced to 80-85 % from Europe
    - The process capability is 5 Sigma, i.e., *233 defects per million opportunities*

The inquiry concerns an already launched development project of a new car at Aston Martin, who strives to present the car within two to three years.

In the subsequent steps Aston Martin would appreciate intense, intimate technical and commercial discussion to assess synergies and potential collaboration.

## **The typical Aston Martin customer**

### **1. Affluent & Discerning**

Aston Martin owners are high-net-worth individuals, often successful entrepreneurs, executives, or professionals in industries such as finance, technology, and entertainment. They have the means to invest in an exclusive vehicle and are drawn to the brand's prestige and regards Aston Martin to be more than a mean of transportation.

### **2. Appreciation for Craftsmanship & Heritage**

Unlike those seeking pure utility, Aston Martin customers value artistry, bespoke design, and the brand's rich British heritage. They view their car as more than just a mode of transport—it's an expression of personal style and a statement of refined taste.

### **3. Passionate About Performance & Driving Experience**

While not necessarily racing enthusiasts, Aston Martin customers appreciate a thrilling drive with world class handling and response. They seek a balance between power and elegance, with an engaging yet comfortable ride that offers both excitement and refinement.

### **4. Lifestyle-Oriented & Socially Influential**

Many Aston Martin owners lead a sophisticated lifestyle, often engaging in luxury travel, fine dining, high-end fashion, and exclusive events like Formula 1 races or yacht shows. Their car

is an extension of their status and personal brand; yet, their customers are relatively young, averaging 45, in comparison the typical demographic seen at other luxury car manufactures.

### **5. Selective & Emotionally Connected to the Brand**

Unlike buyers of mass-market luxury brands, Aston Martin customers often feel an emotional connection to the marque. They admire its legacy of hand-built craftsmanship, exclusivity, avantgarde design and material selection, preferring a brand that reflects individuality rather than mainstream appeal.

### **6. Forward-Thinking but Rooted in Tradition**

Aston Martin customers embrace innovation - whether through hybrid, electric models or other avantgarde solutions propelling sustainability - but still cherish the traditional essence of a handcrafted, high-performance grand tourer. They seek a perfect blend of modern technology with classic automotive artistry.

### **7. Loyalty & Vision**

Aston Martin has a loyal customer base who expects Aston Martin to excel the expectations and deliver a unique experience. The customers have a clearly defined reference value and knowledge of the Aston Martin brand. The outlined brand strategy states Aston Martin to become the world's most desirable luxury performance brand.

## **Aston Martin product portfolio**

As of today, Aston Martin product portfolio comprises nine car models ranging from sportscar to grand touring oriented like the Vantage, DB12 or Vanquish, to a SUV, the DBX, and super cars like the Valhalla or Valkyrie, and even Formula 1 cars. Many of the cars are offered as cabriolets, denoted *Volante* in Aston Martin terminology. Aston Martin offers both V8 and V12 options, however, concern has recently been expressed regarding the V12 engine configuration since it may be difficult to comply to future emission regulations. Regardless of the fear, Aston Martin owners still demand the V12 and would presumably do so even after production has planned to cease in 2030.

## **Executive summary - Aurobay**

Aurobay is a global leader in the development and production of hybrid engines and transmissions, with manufacturing facilities in Sweden and China. Employing approximately 10,000 professionals, Aurobay is dedicated to delivering next-generation powertrain solutions that meet the evolving needs of the global automotive market.

In May 2024, Aurobay became part of HORSE Powertrain Limited, a newly formed global entity focused on advanced combustion and hybrid powertrain technologies. This strategic integration strengthens Aurobay's capacity to innovate and scale its solutions in line with global sustainability and mobility goals.

Aurobay is committed to engineering excellence and innovation, with a strong emphasis on developing efficient, sustainable, and technologically advanced powertrain systems. The company actively engages in industry partnerships and events to showcase its contributions to hybrid technology, reinforcing its position as a forward-looking player in the automotive sector.

The company's leadership team brings decades of industry experience, allowing Aurobay to effectively adapt to the rapid transformation of the global automotive landscape. Recognized for its strong internal culture, Aurobay was certified as a "Great Place to Work®" in December 2024, reflecting its dedication to employee engagement and organizational well-being.

In December 2024, Aramco completed a strategic investment by acquiring a 10% stake in HORSE Powertrain Limited. This investment is expected to accelerate innovation and expand Aurobay's reach within the global powertrain market.

### **Business objectives**

Aurobay's core business objectives are centered around sustainability, technological leadership, and global competitiveness. The company aims to:

- **Accelerate the transition to low-emission mobility** through the development of efficient hybrid and combustion powertrains.
- **Deliver scalable and cost-effective powertrain solutions** to meet the needs of automotive manufacturers worldwide.
- **Enhance innovation capabilities** by investing in research, advanced manufacturing, and strategic collaborations.
- **Foster a high-performing, inclusive workplace culture** to attract and retain top talent in the engineering and manufacturing sectors.
- **Support global climate goals** by aligning product development with long-term environmental and energy efficiency standards.

Through these objectives, Aurobay positions itself as a key enabler in shaping the future of sustainable mobility.

## **Appendix J – Enhanced Instructions**

In Appendix J is the enhanced instructions outlined.

### **Instructions**

#### **Introduction**

The method is based on the findings of Ludwig Almedal's MSc thesis performed during the final semester at the Master Program of Quality and Operations Management at Chalmers. It comprises the elements of the Golden Circle, that is the inside-out approach and take aim to effectively resolve a customer inquiry by deriving the expectations, needs and wants, constituting the foundation for the customer value proposition and the factors propelling satisfaction. The yield of successfully deriving and comprehending the customer expectations are better satisfaction performance and an overall enhanced product development process in terms of reduced rework and other unwished redundancies.

The method is performed as a workshop and should be applied as part of one of first steps. No concepts, solution or similar should preferably not be defined prior to the workshop.

The objective with the method is to effectively resolve a customer inquiry for manufacturing of an automotive component at Aurobay in the outset of the product development process, i.e., the quote process. Successfully deriving and comprehending the customer expectations could yield better satisfaction performance and an overall enhanced product development process in terms of reduced rework and other unwished redundancies. Furthermore, the objective is as well to inquire whether the suggested method improve the pull-thinking for acquiring the underlying *why* embedding the customer request before answering *how* the request should be meet. The understanding is comprehending *why* cast new light on the problem at hand and often leads to a completely redefined perception on what to actually solve. Asking *how* tends to lure the problem solvers that the problem already has been adequately articulated, defined and understood.

The aspiration is the outcome of the method can be used to ensure the succeeding quote- and development process incorporates the customer needs and expectations to achieve maximum customer value. To be noted, the method is designed and intended to send the subsequent development process on the right way, a direction, rather to reveal every necessary answer.

The ideal number of participants are two-five, excluding the chairman.

## **Step 1: General preparations**

One person is assigned chairman of the workshop and acts as secretary. The chairman must not have great knowledge regarding the customer or case since it actually can be advantageous as the chairman ask more questions and does not “buy-in” to vaguely defined assumptions, for instance. Anyhow, the chairman is responsible to book a meeting room with a projector or a TV-screen and with the capacity for four to eight people and send out a meeting invitation. All participants should be able to see the method sheet. The time duration for an unexperienced team is approximately three hours, but two hours for a more experienced team. The chairman must also acquire post-its as they will be used in the workshop.

### **Case preparation**

The chairman should prepare a case containing, if possible, information concerning the following areas:

- a) Business area
  - a. What is customer’s business area?
- b) The typical end-customer, i.e., the persons utilising the products.
- c) Technical information, if possible.
- d) What is the branch of technology?
- e) Product and/or service portfolio.
- f) What is the customer’s in-house design and development capabilities?
- g) Does the customer have its own manufacturing capabilities?
- h) At a glance, how is the customer’s financial situation?
- i) Concern for sustainability.
- j) Heritage and brand.

However, information should not be pushed-in since any potential information gap will be revealed during the workshop. The case description should be sent out to the participants in advance. Preferably at least two days before the workshop.

## **Step 2: Chairman describes the method**

The chairman should start the workshop by reminding the participants with the aim and goals of the workshop, in addition to present an overview of the workshop.

The work order is from right to left (think pull-thinking) starting with question set 1. Each question set shall be answered starting at the top and progressively replying to all questions (see figure 21). The answer is left in the box directly below the question and it is the chairman who is responsible to fill in the answer. There are 12 sets of questions, and the last part is to rank the attributes, expectations and needs according to the Kano Model.

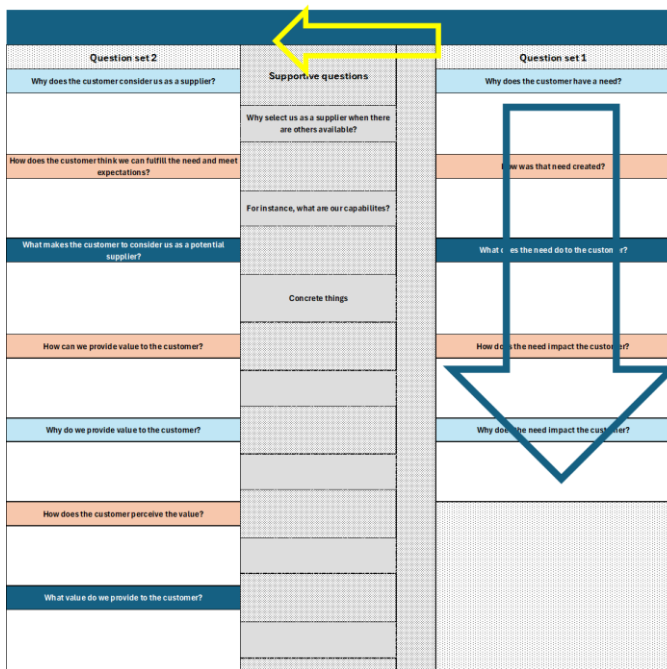


Figure 19: the arrows show in which order the questions should be replied.

### Step 3: In which style should the questions be answered

The chairman informs in which style should the questions be answered and must during the workshop remind the participants if required.

The WHY questions should capture the underlying reason to WHY. When replying have the question in mind "Why does the customer have a need?", for instance, and reply in the style "since the customer is experiencing this..." or "because of a new demand the customer needs to adapt to...". Thus, the answer should be able to define WHY

The HOW questions intend to discover HOW things are done or HOW the WHY:s impacts the customer. HOW is that realise the WHY:s.

When replying have the question in mind "How was that need created?", for instance, and reply in the style "because of the new demand the customer needs to develop a new product...".

Answer in verbs and not nouns as nouns describe value rather than action, e.g., excellence (noun) vs Go above and beyond in everything you do". Thus, the answer should be able answer HOW why was created or HOW things are done.

WHAT is the direct result of HOW, i.e., the things that are said and things that is done. WHAT are the consequences or WHAT are the concrete things we do, for instance? WHAT is more tangible than HOW and WHY.

When replying have the question in mind "What does the need do to the customer?", for instance, and reply in the style "the customer must develop a new product". The answer should contain the concrete implications and/or the things done. Thus, the answer should be able answer WHAT things are done or WHAT the consequences or implications are.

#### **Step 4: Warm-up**

It can be difficult to creative on demand and thus, the warm-up an essential step of the workshop. Each participant shares their initial reflections/thoughts about the customer for 1 to 2 minutes. The other participants are not allowed to argue or discuss - just listen. Yet, the chairman should use a stopwatch to ensure that the no one talks more than two minutes. After everyone has expressed their thoughts can a brief reflection be added, if needed.

#### **Step 5: Collect the data**

When the warm-up is complete, the workshop proceeds to the first set of questions. The participants are encouraged to write answers to the question in single full sentences. No questions or single words are allowed as answers and stay to facts and what is known rather than making assumptions. Only write one answer per post-it. Use the supportive questions to boost creativity.

If the team feels that they have too little information to reply to a question, the question should be replied anyway but in the following manner:

- The team interpret the question like this [answer] but the further investigation is required.

A reply to a why question could like this:

- *Why does the customer have a need?*
  - o Because/since/due to the change in market demand/the existing product is being outpaced by competitors.

A reply to a how question could look like this:

- *How is customers product typically used?*
  - o It is used daily by commuters and the customer segment is made-up by average Joe.

A reply to a what question could look like this:

- *What does the need imply for the customer?*
  - o Due to the new market demand, the customer needs to develop a new product or an enhanced version of existing one.

The chairman read the first question out loud and the team reply to the question according to instruction. The chairman utilises a stopwatch to ensure no more than three minutes is spent answering the question. After three minutes has passed, each and every one read their replies out loud. The subsequent step is to together formulate a sentence that capture the essence. The sentence is noted in the method's sheet.

The procedure is repeated until all questions have been answered. The chairman must remind the team to maintain flow and pace during the workshop and interrupt discussions that is out of context. Although not every question might not have been fully replied due to limitation of information, for instance, should the workshop be completed in one session.

## Step 6: Ranking

During the workshop has several attributes, needs and expectations most certainly been identified. These must now be ranked accordingly to effectively distinguish which ones that have the greatest importance to the customer. The Kano Model presents a plausible method. All the attributes must have been recognised during the workshop. The attribute is ranked with regard to whether it is a *must-be quality*, *performance attribute*, *attractive attribute* or a *reverse attribute* (see below):

- *Must-be quality* are attributes that must be fulfilled for the customer to be content with the product and could only yield dissatisfaction if the performance of the attribute is perceived to be subordinate. Even though the performance is superior for a must-be quality attribute can the satisfaction never rise above the neutral level. Thus, the customer is *indifferent* towards the attribute and regards the attribute as a prerequisite. Nevertheless, the integral importance of must-be attributes should not be evaded since if they are not fulfilled might the customer interest of the product be non-existing.
- The *performance attributes* are linear, meaning high attribute performance yields high satisfaction and the customer satisfaction is proportional to the level of fulfilment. Luckily, the performance attributes are normally articulated by the customer.
- *Attractive attributes* are non-articulated expectations that the customer has difficulties to define. Hence, products having attractive attributes will lead to an increase in customer satisfaction, however, in cases they are not defined and featured will the satisfaction not be affected negatively as they are not expected. They will be a delight for the customer, though (Matzler et al., 1996; Chen & Chuang, 2008; Južnik Rotar & Kozar, 2017).
- However, it may be qualities that have the opposite effect, i.e., qualities impairing customer satisfaction, so called *reverse attributes*. Thus, the more of the reverse attributes, the more dissatisfied the customer becomes.

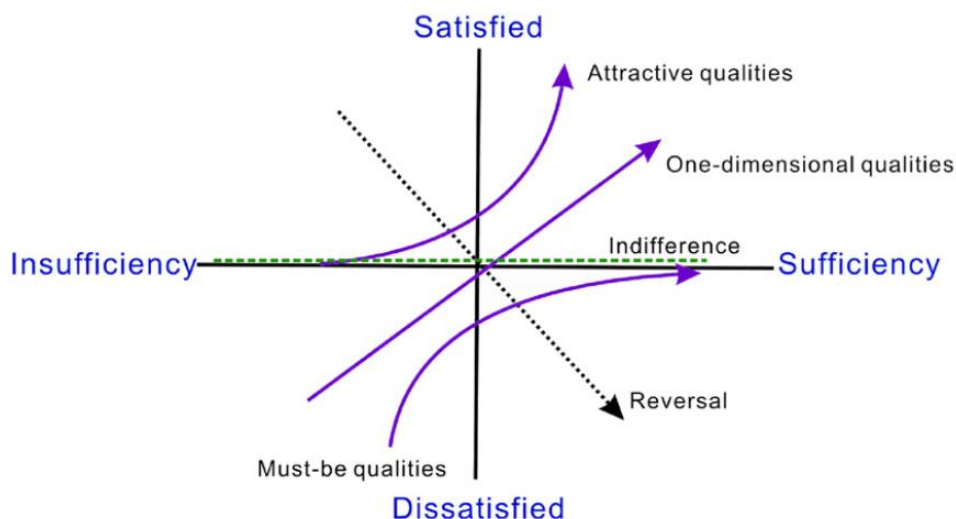


Figure 20: the Kano Model.

**Step 7: Concluding sentence**

In step 7 will the team generate a concluding sentence which emphasis *why*, *how* and *what*. The sentence will capture the essence of *what* creates value for the customer, *how* value is created and *why* value is created. Thereafter should the core values of the customer be formulated. A core value could be “*excellent quality*” or “*sustainability*”, for instance.

**Step 8: Sign-off**

In the final step is all the participants name noted and the date for the workshop is noted.

**How should the output be used?**

## **Appendix K – Second method trial**

Only limited information regarding the case can be published due to confidentiality.

### **Objective**

The objective with the case is to effectively resolve a customer inquiry for manufacturing of an automotive component at Aurobay in the outset of the product development process, i.e., the quote process, and understand why value could be provided. Successfully deriving and comprehending the customer expectations could yield better satisfaction performance and an overall enhanced product development process in terms of reduced rework and other unwished redundancies.

Furthermore, the objective is as well to inquire whether the suggested method improve the pull-thinking for acquiring the underlying *why* embedding the customer request before answering *how* the request should be meet. The understanding is comprehending *why* cast new light on the problem at hand and often leads to a completely redefined perception on what to actually solve. Asking *how* tends to lure the problem solvers that the problem already has been adequately articulated, defined and understood.

The aspiration of this trial is to inquire whether the outlined method has the potential to convey value to Aurobay when applied on a real case.

Please see the case on the next page!

Kind regards,

*Ludwig*



## Project Scope & Requirements

- **Power and performance:**
  - ICE, displacement [REDACTED] with high compression rate
  - Continuous effect of [REDACTED] to [REDACTED]
- **Listed technical requirements:**
  - Customised engine radiator
  - Customised radiator for the oil
  - Customised radiator for the generator
  - Control unit for the ignition and engine control
  - Customised silencer for the exhaust system. No need to concern the end tailpipe
  - Air filter with hose connection to the turbo's air intake. Can be delivered separately
  - Engine with a rig featuring dampened load relief, as demonstrated at the exhibition.
  - Start equipment
  - Output for RPM
  - Output for oil, coolant- and generator temperature
  - Output for oil- and coolant volume
  - Output for actual current output from the generator and current electricity supply
- **Volumes:** not stated
- **Production requirements:**
  - Presumably Sweden
  - [REDACTED] advertises, and emphasises, themselves as Swedish manufactures who has embraced Scandinavian design and production
- **Quality requirements:**
  - According to [REDACTED], the aim is to at all times achieve the best possible quality in all products, services and adherent support
  - [REDACTED] aims to maintain, develop and enhance its leading position in the industry towards contenders. The exceling on quality is one of the key enablers
  - Moreover, [REDACTED] strives to continuously enhance and develop their operations
  - [REDACTED] is ISO/IEC [REDACTED] certified
- **Concern for sustainability:**
  - [REDACTED] concern for sustainability regards both the environment and the well-being of employees and society.
  - As outlined by [REDACTED]:
    - Reduce waste and use of energy and water
    - Optimise the use of the natural resources utilised in operations and products
    - Have continuing strive to offer sustainable and positive actions for the environment in all value offerings

- **Delivery:**
  - [REDACTED] desires two packages of engines each containing three engines during 2025
  - Additionally, two packages of engines each containing one engine with the supplementary equipment with an inverter 800 [REDACTED] Hz during 2025
- **Areas of concern:**
  - What is the required cooling capacity for the engine?
  - What is the required cooling capacity for the generator?
    - What is the recommended cooling media?
  - What is the required cooling capacity for the oil?
  - What is the dimension for the air connection of the turbo?
  - What is the required current/energy to start the engine?
  - What is the noise level at a continuous power output of [REDACTED]?

### **The typical [REDACTED] customer**

The typical [REDACTED] customer acquiring [REDACTED] products is an [REDACTED] provider and is thus not a person purchasing the products. [REDACTED] has delivered products to [REDACTED], who performs mining activities, and the Swedish [REDACTED] for [REDACTED] [REDACTED] in the Swedish [REDACTED]. Moreover, smaller [REDACTED] are delivered to well-known market actors. Hence, the end-user could be an individual [REDACTED] their [REDACTED] or a major industry or authority.

## **Appendix L – AM case solved without method**

### **RFQ answer philosophy regarding**

Subject: Confidential Inquiry: High-Performance V8 Engine Collaboration Opportunity

Aston Martin has very discerning and quality-conscious customers who appreciate unique technical solutions in their cars. Aston Martin's customers also know that everyone knows that Aston Martin has a fantastic technical solution with future materials and is committed to being more technologically advanced than all other cars. The customer knows that everyone knows this. Anyone who sees an Aston Martin on the streets also knows that it is a unique object and anyone knows [author's note] who buys an Aston Martin knows that everyone knows that it is so. The end customer is also prepared to pay to get this opportunity to show that they have the financial muscle to live like that. Aston Martin also has a unique driving pleasure built in with good response and good road holding. The sound of an Aston Martin should have a special signature but should also be able to sneak in on a warm summer evening without waking up the whole neighbourhood.

Our customer, Aston Martin, wants a strong v8 engine that replaces the current v12 engine but must have the same or similar characteristics, meet EU7 legal requirements and be prepared for future legislation, as far as these are concerned. The product should also have technical solutions that are not found in other standard cars, but solutions that are found in extreme sports, such as Formula 1. The engine will also be partially electrified, so-called mild hybrid, mainly for emissions and drivability.

The end customer values the craftsmanship behind every part of an Aston Martin car, not entirely cost-optimal but it gives a more exclusive expression, which Aston Martin values.

#### **Suggested solution:**

We should aim for a supercharged 4-liter V8 which is combined with an electric machine, either crankshaft mounted or packed into the gearbox. In this way, we achieve the customer's desire for electrification but, with the right location, the possibility of pure electric operation, Full hybrid.

As these are fairly small series, these will be built more manually, which means that we can let each engine be signed, so that the manual craftsmanship reaches the end customer. After completing the delivery test, each engine can receive a protocol with the values presented and signed by the responsible engineer.

During development, we should seek solutions from our sister organization within Horse, which is deeply involved in Renault's F1 venture, so that Aston Martin can show a kinship with F1 racing.

For fuel selection we should recommend petrol or ethanol, E85, due to access. Biogas and methanol have a limited infrastructure for passenger cars around the world and in addition biogas demands an own space demanding tank system even though the engine can handle all fuels. If the end customer requests a CO<sub>2</sub> neutral fuel, E85 is the best choice for the type of vehicle.



## DEPARTMENT OF INDUSTRIAL & MATERIALS SCIENCE

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