Master thesis

Manufacturing strategy for start-up company electrifying Africa one vehicle at a time

MIOM05

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Abstract

Kenya stands at the forefront of Eastern Africa's economic growth, showcasing potential driven by a robust economy, a vast market, and commendable progress in education and infrastructure. Central to Kenya's transformative agenda is Vision 2030, a blueprint to accelerate the country into a newly industrialized, middle-income country by 2030. However, the country's industrial experience is often overshadowed in comparison to the global north. Therefore, companies manufacturing high-tech products will face different challenges, when establishing and scaling up manufacturing in Kenya, compared to other industrialized countries.

The purpose of the thesis is to describe and analyze the manufacturing strategy for a Kenyan electric mobility company, taking the local setting and demands into account. Startups who manufacture high-tech products in Kenya and aim to scale their operations, face several challenges. With the backdrop of these challenges, the paper will propose strategic and operational improvements for more efficient processes to facilitate scaling.

Through a comprehensive approach, which includes having an explorative and problem solving section of the study, the purpose will be addressed. Furthermore the study has been iterative and included the identified stakeholders. By using several different well established frameworks collectively, a platform for systematically uncovering root causes across both broad and detailed dimensions within manufacturing strategy has been developed.

The analysis investigates critical insights of the alignment within the context of corporate, market and manufacturing strategies in order to make processes more efficient. Strategic recommendations are proposed to improve operational efficiencies, emphasizing quality control and information flows. Furthermore this research contributes to both academia as well as practical application in the field of production economics, particularly for high-tech manufacturing in emerging markets.

Key words: Manufacturing strategy, electric vehicle, Kenya, Africa, emerging market, startups, scaling, process, industrialization, operations

Sammanfattning

Kenya är i framkant för den ekonomiska tillväxten i Östra Afrika, och visar på potential genom sin robust ekonomi, en stor marknad och anmärkningsvärda framsteg inom utbildning och infrastruktur. Kenyas Vision 2030 är central för landets omvandlingsagenda och är en plan för att påskynda landets utveckling till ett industrialiserat, medelinkomstland till år 2030. Dock hamnar landets industriella erfarenhet ofta i skuggan när den ställs i jämförelse mot det i globala norr. Därmed kommer företag som tillverkar högteknologiska produkter att möta andra utmaningar när det etablerar och skalar upp tillverkning i Kenya, i jämförelse med andra industrialiserade länder.

Syftet med examensarbetet är att beskriva och analysera tillverkningsstrategin för ett kenyanskt företag inom elektrisk mobilitet, med hänsyn till den lokala miljön och unika kraven som ställs. Startups som tillverkar högteknologiska produkter i Kenya och strävar efter att skala upp sin verksamhet står inför flera utmaningar. Mot bakgrund av dessa utmaningar kommer arbetet att föreslå strategiska och operativa förbättringar för mer effektiva processer för att underlätta skalning av tillverkningen.

Genom ett övergripande tillvägagångssätt, vilket inkluderar en utforskande samt en problemlösande del av studien, kommer syftet att bemötas. Dessutom har studien varit iterativ och inkluderat berörda intressenter. Genom att använda flera olika väletablerade teoretiska ramverk gemensamt har en plattform för systematisk identifiering av grundorsaker, både för breda och detaljerade dimensioner, inom tillverkningsstrategi utvecklats.

Analysen undersöker de mest kritiska aspekterna för samspelet mellan företagsmål, marknads- och tillverkningsstrategier, för att göra processer mer effektiva. Strategiska rekommendationer föreslås för att förbättra operativ effektivitet, med fokus på kvalitetskontroll och informationsflöden. Dessutom bidrar denna forskning både till det akademiska sammanhanget och praktisk tillämpning inom området för produktionsekonomi, särskilt för tillverkning av högteknologiska produkter i tillväxtländer.

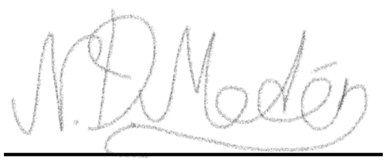
Nyckelord: Tillverkningsstrategi, elfordon, Kenya, Afrika, tillväxtmarknad, start-up, skala, process, industrialisering, operativt

Preface

The Master Thesis was written by Fredrik Cullborn and Niklas Dahlsten Modén during the spring semester of 2024, marking the end of studies in M.Sc. in Industrial Engineering & Management at the Faculty of Engineering at Lund University, specializing in Business & Innovation. The thesis represents a seamless collaboration, spanning from inception to completion. Thus, both authors equally contributed in crafting every section.

We would like to give our sincere gratitude to Ms Ingela Elofsson, our supervisor at Lund University, whose outstanding support has been paramount. Her scholarly rigor, academic principality and stringency has profoundly shaped our academic development, whilst the endless positivity and valuable life experience sharing filled the work with great joy.

In addition, we would like to thank the people at the company, notably Fabian Ecker, Johanna Ålander, Brett Mangel, Filip Lövström and Joseph Ndolo, for making the thesis possible. During our time at the company in Kenya, we were welcomed with open arms and received invaluable support throughout the research process, enlightening a passion for electric mobility and Africa.



Fredrik Carl William Cullborn

Lund, 15^{th} May. 2024

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Concept list

Activity: The operation which enhances either objects in, or any other input (Ljungberg & Larsson, 2001).

Bill of material (BOM): A list generated by the ERP system which specifies the material needed to complete a product (Person 3, 2024).

Boda Boda: A motorcycle used as a taxi for carrying either passengers or goods (Person 1, 2024).

Corporate objectives: The overarching goals and ambitions of a company, guiding its strategic direction. These objectives typically include targets for growth, market share, profitability, sustainability, and innovation (Hill, 2000).

Environmental high-tech product: Manufacturing industries with a higher R&D intensity are considered high-technology industries, for example electrical equipment, machinery and equipment n.e.c., motor vehicles, trailers and semi-trailers (UNIDO, n.d). For it to be considered environmental the aim has to be sustainable, energy-efficient, or resource-conserving, aligning with ecological goals.

Hill's framework: A strategic model developed by Terry Hill which links the corporate objectives, market strategy, and manufacturing strategy of a company. It emphasizes understanding the relationship between these elements to create 'order winners' (factors that make a product more appealing to customers) and 'order qualifiers' (minimum standards required to compete in the market) (Hill, 2000).

Infrastructure: In the context of manufacturing, infrastructure refers to the foundational physical and organizational structures, systems, and facilities needed for the production process. This includes manufacturing plants, machinery, technology systems, logistic networks, and the organizational framework to support production activities (Hill, 2000).

In process quality check (IPQC): Quality controls integrated into the mainline to ensure quality step by step when the assembling process progresses.

In quality check (IQC): Quality control before goods are stored in the warehouse, to ensure that no damaged or faulty goods are brought into the main assembly.

Manufacturing process: This is the specific sequence of value-adding activities and operations. It includes steps such as assembly, machining, painting, welding, and quality control, tailored to the nature of the product and the production strategy (Hill, 2000).

Manufacturing strategy: This refers to the overarching plan and approach a company adopts to produce its goods efficiently and effectively. It involves decisions regarding the use of technology, choice of production methods, allocation of resources, and integration of processes to meet business objectives and market demands (Hill, 2000).

Market strategy: The approach a company takes to position and sell its products in the market. This involves identifying target markets, understanding customer needs, analyzing competitors, and determining pricing, promotion, and distribution strategies (Hill, 2000).

Outgoing quality check (OQC): Quality control with the finished product, to ensure high quality output.

Process: In a general sense, a process is a series of actions or steps taken to achieve a particular end. In a manufacturing context, it refers to the distinct operations or phases in the production line, each contributing to the creation of a product (Ljungberg & Larsson, 2001).

Quality control: The process of ensuring that procured components and manufactured products meet specified standards and requirements. It involves systematic measures and tests. The quality control can be conducted at various stages of the manufacturing process, depending on a company's strategy and/or activities (Hill, 2000).

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1. Background & Purpose

In recent decades, global production has undergone significant changes, shifting towards low-cost countries and prompting a reevaluation of manufacturing landscapes. Traditionally, North America, Western Europe, and Eastern Asia dominated global production. While still major players, they are now accompanied by emerging economies, driven by technological advancements, trade liberalization, cost and production efficiency (Rose et al., 2014). This transformation has led to a more interconnected network of manufacturing hubs (University of Manchester, n.d.). The rise of low-cost countries has not only reshaped economic landscapes but also challenged traditional ideas about competitiveness and innovation. As the world economy navigates this evolving landscape, the lines between developed and developing economies blur, giving way to a new era where a singular epicenter is replaced by a polycentric and interconnected reality (Rose et al. 2014).

1.1 History of manufacturing globally

The shift in manufacturing has been particularly evident in the migration of production capacities from the West, notably North America and Europe, to the East, with Asia and China emerging as dominant hubs for outsourced manufacturing (World Economic Forum, 2023). However, a new trend has emerged in recent years, indicating a reverse flow of production activities as companies increasingly start to relocate their manufacturing processes closer to their customers. This strategic move reflects the companies' understanding of the benefits of proximity to the market and regaining control and ownership over the manufacturing process (Burke et al., 2021).

Global outsourcing and manufacturing for companies stemmed from the pursuit of cost efficiencies and economies of scale. By leveraging lower production costs in countries with abundant labor resources, particularly in Asia, companies were able to enhance their competitive advantage in the global marketplace. China, with its vast pool of skilled and low-cost labor, quickly became the epicenter of this global shift (World Economic Forum, 2023). The arrival of globalization facilitated the seamless movement of goods, capital, and information across borders worldwide. Other factors such as improved transportation infrastructure and advancements in technologies further accelerated the trend toward outsourcing and off-shore manufacturing (Trimbath, 2010) (Yu, 2008). As a result, supply chains became more interconnected, and companies increasingly relied on a network of suppliers and manufacturers spanning the globe (Seong et al., 2022).

However, the drive towards global outsourcing was not without its challenges. Companies faced logistical complexities, increased lead times, and vulnerability to geopolitical and economic fluctuations. In recent years, these challenges have been ramped up by the COVID-19 pandemic and trade wars, especially between the USA and China. In addition, concerns regarding intellectual property protection have increased (Swanson, 2022). These challenges prompted companies to reevaluate their global manufacturing strategies, and to look back home. (Burke et al., 2021)

Since the pandemic, a new trend has emerged as companies are beginning to reconsider their manufacturing strategy. A growing number of firms are repatriating production activities, moving away from a singular focus on cost efficiency to prioritize factors such as quality control, supply chain resilience, and proximity to markets. This shift reflects a strategic decision to enhance control and ownership of the manufacturing process, mitigating the risks associated with a highly interconnected global supply chain. There are several strategic factors that contribute to the shift to national and regional manufacturing. Companies recognize the strategic advantage of being closer to their customer base, allowing for quicker response times and customization of products. Advances in automation and digital technologies have also enabled the localization of production without sacrificing efficiency, further bolstering the case for onshoring (Burke et al., 2021).

To summarize, the trajectory of production strategies from national to global outsourcing and now back to national and regional manufacturing underscores the dynamic nature of the global economy (Rose et al., 2014). The evolving landscape highlights the importance of a nuanced approach, wherein companies weigh the advantages of cost efficiency against the benefits of proximity to market, control and ownership. It is increasingly evident that a balance between global and local manufacturing will be crucial for companies seeking sustainable and resilient production strategies in the future (Burke et al, 2021).

1.2 Manufacturing in Africa

From a principal point of view it is important to understand why manufacturing when being outsourced from the western world ended up mostly in eastern Asia and not in Africa. The understanding of this shift is important since this has significantly impacted these continents' manufacturing industry function today. There are many reasons behind these transformative decisions. While there were vibrant artisanal manufacturing activities in pre-colonial Africa, especially in regions like Sokoto Caliphate in Nigeria, the adoption of modern manufacturing processes, like power looms, did not occur. The introduction of machines using fossil or electric energy was led by foreign firms, creating a technology gap that local entrepreneurs found challenging to bridge. Additionally, the structure of African economies posed big obstacles, with constraints on raw materials like coal and suitable trees for charcoal affecting iron production. In West Africa, the preference for narrow looms and limited yarn supply due to environmental constraints further hindered large-scale manufacturing development (Austin et al., 2017).

Furthermore, high labor costs relative to other potential areas such as British India (represented by Bombay and Calcutta) can be seen in Diagram 1.1, which showcases wages (pence per day) on a logarithmic scale for different capitals. This high labor cost presented a fundamental obstacle to the competitiveness of factories in Nigeria (Lagos) and other colonies in Africa (Accra, the capital of Ghana and Nairobi, the capital of Kenya).

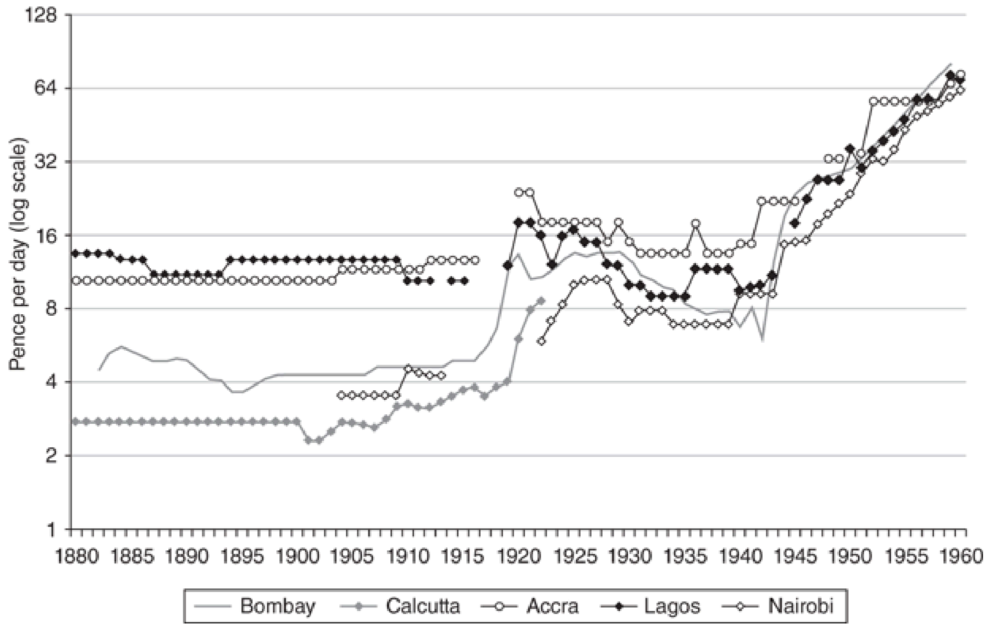


Diagram 1.1: Unskilled urban laborers' wages in pence per day, 1880–1960 (Austin et al., 2017).

The scarcity of labor and capital, coupled with abundant land, shaped Africa's comparative advantage but hindered the growth of manufacturing enterprises due to the associated high costs. Further, the colonial division of labor, driven by European interests, further perpetuated Africa's role as a primary product exporter, hindering the growth of modern manufacturing in the continent (Austin et al., 2017).

It is clear that the countries in Africa historically mainly produce items that are mainly low-tech, low-cost and mass produced. Furthermore much of the production stems from foods and consumer goods such as clothing. However when looking at the Global Competitiveness Index (GCI) some countries such as South Africa and Kenya Africa rank high on capacity for innovation (33th and 34th). This hints that companies and individuals in these countries often can find the best ways to deal with constraints, and being able to identify and exploit any potential gaps in the market. Furthermore countries as such have been identified to have a strong manufacturing potential (KPMG, 2014).

In order to gain a better understanding of Africa in regards to medium- and high-technology manufactured goods, Diagram 2 showcases the global distribution. It is important to note that the diagram represents the value of exported goods and therefore it may differ from the manufactured value, however it showcases continents' relative positions. The value of Africa's exported medium- and high-technology manufactured goods is only a fraction of the other continents. Medium- and high technology manufactured goods mainly represents goods with many moving parts or advanced manufacturing such as boats, motor vehicles, electronics and pharmaceutics while low technology manufactured goods represents for example foods, furniture and base materials (UNIDO, n.d.). However the continent boasts a growing, youthful workforce and increasing foreign investments, fostering a conducive environment for technological advancements. Moreover, a commitment to improving the quality of education is underway, providing a skilled talent pool crucial for sophisticated manufacturing. As Africa embraces innovation and sustainable growth, it positions itself as an emerging hub for higher-value manufacturing, despite current export disparities with other regions and historically mainly manufacturing low technology goods. Africa's vast potential is furthermore backed by the large and increasing population. According to the International Monetary Fund (IMF) Africa will by 2025 be the world's fastest growing region, outstripping Asia, measured by GDP. (MO Ibrahim foundation, 2023).

Diagram 1.2: Presents the value of exported medium- and high-technology manufactured goods in USD, billions (UNIDO).

The economic landscape in Africa is evolving, spurred by demographic trends such as improved infrastructure and an increasing middle class. These elements contribute to the continent's appeal internationally, as a strategic location for manufacturing and production activities. As traditional manufacturing hubs face challenges such as increased supply chain risks, rising costs and saturation, Africa offers a new frontier for companies seeking avenues for expansion and diversification. Together with Africa substantial forecasted growth in population there is no doubt that the potential for production in Africa is great, especially when considering its vast amount of natural resources (MO Ibrahim foundation, 2023).

Furthermore, the pressing global concerns regarding the environmental development and the increasing use of transportation solutions in Africa underscores the need for a sustainable solution. With urbanization on the rise and the demand for personal and commercial transportation escalating, the environmental impact of traditional vehicles becomes a critical consideration. Introducing more climate friendly alternatives, such as electric motorcycles, aligns with these narratives to address climate change and air pollution while still catering to the evolving needs of mobility in this emerging continent (Asare, 2024).

This convergence of global production trends, Africa's rising prominence, and the environmental imperative creates a natural but yet compelling context for exploring the continuation of the industrial growth in Africa (Austin et al., 2017). One of the most intriguing regions when considering environmentally industrial growth is Kenya with its impressive access to green, geothermal, energy (Ministry of Environment and Natural Resources, 2016).

1.3 East Africa & Kenya

As noted Africa has historically been on the periphery of globalization while still maintaining a distinct relation with manufacturing and industrial systems. Unlike regions that have experienced substantial shifts in production dynamics, Africa’s role in the global economic landscape has been unique (Austin et al., 2017). As can be seen in Diagram 1.2, the African production is low in comparison to other continents. In order to comprehend this perspective it is necessary to do a further exploration, shedding light on Africa’s emergent role in the evolving dynamics of global production.

East Africa has had an impressive economic performance and potential, as it has been the fastest-growing region on the African continent for several years. According to the African Development Bank (2023), East Africa's real GDP grew by an estimated 5.7% in 2018, 5.9% in 2019, and 6.1% in 2020, despite the challenges posed by the Covid-19 pandemic. Kenya is the leading economy in the region, and makes up more than 50 percent of the region's GDP, growing approximately 5 percent yearly (World Bank 2022a). It is an interesting country for foreign investors for several reasons. Firstly, it has a strategic location as the gateway to East Africa, with four international airports and two sea ports, as well as a standard gauge railway connecting Mombasa and Nairobi (Kenya Port Authority, n.d.) (Reuters 2017). In addition, it has a large and growing market. Kenya’s population exceeds 54 million people, growing approximately 2 percent yearly (World Bank 2022b) (World Bank 2022c). Also, Kenya’s educational system is ranked as the 7th in Africa 2022, as well as a high level of proficiency in English (Nduka, 2022) (EF, 2023).

1.3.1 Kenya Vision 2030

To harness the potential of Kenya, the government has developed the program Kenya Vision 2030 which aims to transform the country into a newly industrializing, middle-income country by 2030. It has three pillars: economic, social and political (Ministry of Planning and National Development, 2007). The text will focus on some of the economic and environmental aspects of the Vision, namely the Silicon Savannah, the manufacturing industry and the energy sector.

The Silicon Savannah is a term used to describe the growing ICT hub in Kenya, especially in Nairobi. It is one of the flagship projects of the Vision 2030, which seeks to make Kenya a leading knowledge-based economy in Africa (Ministry of Planning and National Development, 2007). The Silicon Savannah has attracted local and international investors, entrepreneurs and innovators, who have developed applications and solutions for various sectors. One prominent example is M-Pesa, which is a phone-based money transfer service (Swiss Business Hub Southern Africa, 2021). Another one is Ushahidi, a crowdsourcing platform for activist mapping (Ushahidi, n.d.).

The manufacturing industry is another key sector that the Vision 2030 aims to develop and expand. The Vision aims to increase the contribution of manufacturing to GDP to 20 percent by 2030. To achieve this, the Vision proposes to improve the business environment, enhance productivity and competitiveness, diversify the product range and markets, and promote small and medium enterprises (SMEs) (Kenya Association of Manufacturers n.d.). Some of the priority sub-sectors are agro-processing, textiles and apparel, leather and leather products, metal and engineering products, chemicals and pharmaceuticals, and construction materials (Ministry of Industrialisation and Enterprise Development, 2013).

The energy sector is also vital for the Vision 2030, as it provides the power needed for industrialization and economic growth. The Vision aims to increase the installed electricity capacity from 1 765 MW in 2013 to 23 000 MW by 2030. To achieve this, the Vision plans to exploit the country's renewable energy potential, such as geothermal, wind, solar and hydro power. At the moment, 80 percent of Kenya’s energy när is generated from renewable sources. Geothermal energy additionally remains relatively unexploited with an installed capacity of less than 863MW and an estimated potential of 10 000MW. The Vision also intends to reduce the cost of electricity, improve the reliability and quality of supply, expand access to rural areas, and integrate with regional power markets (International Trade Administration, 2022).

One of the key pillars of the vision is environmental sustainability, which recognizes the need to adapt to the impacts of climate change and reduce greenhouse gas emissions. According to the Ministry of Environment and Natural Resource (2016), Kenya faces several climate hazards and vulnerabilities, such as droughts, floods, landslides, and diseases. These affect various sectors, such as agriculture, water, energy, health, and tourism. The plan proposes sectoral adaptation actions that are aligned with the vision's goals and objectives. Some of these actions include promoting climate-smart agriculture, enhancing water harvesting and storage, increasing renewable energy sources, improving disaster risk management, and strengthening institutional coordination and capacity. The plan also identifies resource mobilization strategies and monitoring and evaluation mechanisms to ensure effective implementation of the adaptation actions. By pursuing these actions, Kenya hopes to achieve its vision of becoming a resilient and low-carbon economy that can cope with the challenges of climate change (Ministry of Environment and Natural Resources, 2016).

1.3.2 Summary

In summary, Kenya stands at the forefront of Eastern Africa’s economic growth, showcasing remarkable potential driven by a robust economy, a vast market, and commendable progress in education and infrastructure (World

Bank 2022a) (Kenya Port Authority, n.d.) (Reuters 2017) (Nduka, 2022). Central to Kenya's transformative agenda is Vision 2030, a blueprint to accelerate the country into a newly industrialized, middle-income country by 2030 (Ministry of Planning and National Development, 2007). In Vision 2030, manufacturing takes center stage with a target of a 20 percent GDP contribution by 2030, supported by initiatives to enhance productivity and diversify markets (Kenya Association of Manufacturers n.d.). The Silicon Savannah initiative further solidifies Kenya's status as a knowledge-based economy, attracting investments to the thriving ICT hub in Nairobi (Swiss Business Hub Southern Africa, 2021). At the same time, the vision's commitment to renewable energy and environmental sustainability makes Kenya an attractive prospect for businesses aiming to produce environmentally conscious high-tech products (International Trade Administration 2022) (Ministry of Environment and Natural Resources 2016). However, the country's industrial experience is often overshadowed in comparison to the global north (Austin et. al, 2017). Therefore, companies manufacturing high-tech products will face different challenges, when establishing and scaling up manufacturing in Kenya, compared to other industrialized countries.

1.4 Purpose

Based on the conclusion above, the purpose of the thesis is to:

Describe and analyze the manufacturing strategy for a company in Kenya that produces environmental high-tech product(s), taking into account the demands set by its product(s) and market strategies, and propose strategic and operational improvements for more efficient processes.

2. Methodology

The following chapter outlines the methodology used in the paper. It begins by defining the research purpose, followed by an explanation of the research methodology, which consists of a case study. The research approach is detailed through an overview of the research process and how qualitative analysis methods were used. Later, the data gathering process is showcased, which includes literature reviews, interviews with people from the selected case company, as well as observations of processes within the company. Then, the credibility of the study is assessed by examining its reliability, validity, generalizability, and objectivity. Finally, the chapter highlights the paper's focus on research ethics, with the purpose of ensuring the integrity of the research process.

2.1 Research purpose

In line with the theory of Höst et al. (2006), the purpose of the research is a hybrid between exploratory and problem-solving methodologies. The first part of the thesis is focused on getting a deep and wide understanding of the research subject's function. As stated in 1.4 Purpose, the first part of the thesis is as follows: "*Describe and analyze the manufacturing strategy for a company in Kenya that produces environmental high-tech product(s), taking into account the demands set by its product(s) and market strategies* [...]". The depth of the purpose, investigating how several factors affecting the manufacturing strategy, is what makes the study exploratory, and not descriptive.

The latter part of the thesis' purpose, "[...] *propose strategic and operational improvements for more efficient processes.*", focuses on solving issues identified during the exploratory phase, by suggesting strategic and operational improvements for relevant processes that affect the manufacturing. Together, the nature of the exploratory and problem-solving purposes will showcase how a research subject can be described and analyzed thoroughly, which will set the stage for concrete problem-solving.

2.2 Research methodology

The research methodology refers to how the research can be conducted to address the purpose in a purposeful way. A case study will be used, with selected criterias for a suitable case company.

2.2.1 Case study

Due to the thesis' purpose, and its nature of exploratory and problem solving, the methodology of conducting a case study is appropriate according to Höst et al. (2006). A case study allows for a deep understanding, in this case how a manufacturing strategy in a Kenyan company is formed, and how it is impacted by the demands of the Kenyan market and its expectations on products. Furthermore, a case study will bring forth challenges for a company manufacturing environmental high-tech products in Kenya, which might be shared with other high-tech manufacturing companies in the region. By using a case study, concrete solutions to address both company specific and general challenges for manufacturing in Kenya can be made.

2.2.2 Criteras for selecting the case company

Selecting a suitable case company for the thesis is crucial. Listed below are criterias a company needs to fulfill for the thesis to be able to address its purpose:

- Manufacturing company, operating in East Africa and Kenya
- Manufacturing environmental High-tech products
- Relates in some context to Kenya vision 2030
- Serving, but not restricted to, customers on the Kenyan market

The selected case company will be referred to as “the company”. The name of the company’s main product will be referred to as “the product”.

The company was found to be suitable for achieving the before mentioned criterias of the case company. The company, founded in 2017, is a Kenyan electric mobility company. It focuses on delivering innovative transportation solutions that correspond to the emerging markets’ needs, starting with Kenya. The company’s foundation was formed from a Swedish research initiative aimed at introducing electric mobility to emerging regions (Doll, 2022a). The Swedish heritage of the company also facilitated the initial contact.

The company is rapidly expanding, with different revenue streams and business areas, for example buses, charging stations and motorcycles (Boda Bodas). Due to time limitations, the focus area of the thesis was delimited to solely the motorcycle section of the company. The reason behind is that motorcycles currently stand for most of the operations at the company Park and therefore are the most suitable to study. The process of manufacturing a motorcycle can at a first glance seem straight forward, considering it is the assembly of one product with few customization options. However, in such an operation there are many linkages between the processes, which is why the complexity quickly increased.

2.3 Research approach

In this study an abductive research has been undertaken. Abductive approach in research is particularly valuable for its ability to bridge the gap between theory and empirical observations which enables a dynamic interplay that fosters the development of new theoretical insights and the refinement of existing concepts. Furthermore an abductive approach is compelling for several reasons, which includes for example: to generate new insights from empirical evidence, it is an iterative approach to theory and observations and to address practical problems (Kovács & Spens, 2005). In this study abductive reasoning helped in refining and adapting theoretical frameworks to better capture the multi-faceted empirical evidence observed. The outlines of the process is more specifically described under the following chapter, 2.3.1 Research process.

2.3.1 Research process

When the question was handed to the company, a discussion was held to identify a critical yet interesting area with potential for refinement in an otherwise rapidly growing and thriving company. The authors possessed preliminary theoretical knowledge about the subject matter. However, in order to produce meaningful results and direction of the thesis, it was essential to conduct a systematic review of existing theories and align these with observations from real-world scenarios.

The incorporated literature study identified theoretical frameworks useful for describing, analyzing and mapping the organization as well as its processes. Additionally, the discussion with the case company was extended to ensure the relevance of these theories in a real-world scenario. These frameworks were applied in empirical settings through interviews and on-site observations. As illustrated in Figure 2.1, the research methodology was iterative; theoretical frameworks that did not initially lead to conclusive or complete insights were refined, removed or added and retested in the empirical context to ensure their effectiveness and relevance.

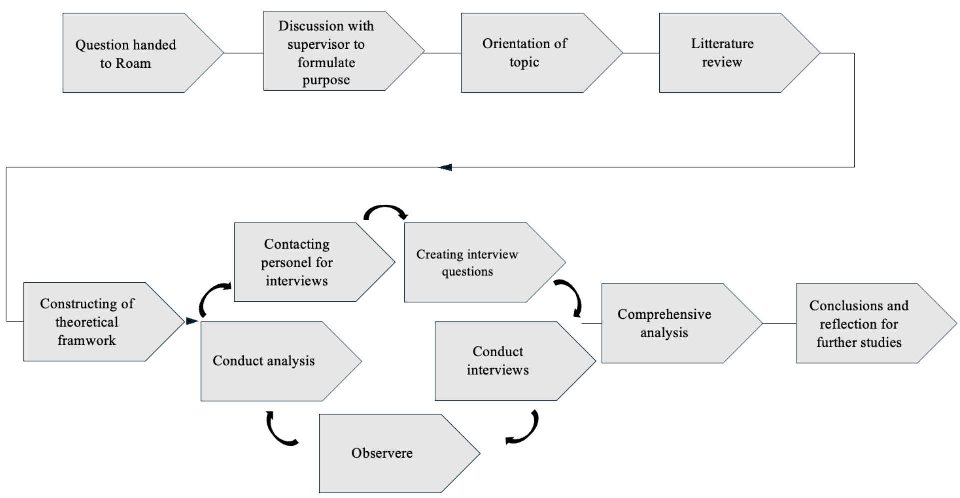


Figure 2.1: Descriptive illustration of the research process followed.

2.3.2 Qualitative analysis

Qualitative data consists of words and descriptions that are rich in nuances and details. In line with theory, the qualitative data have been structured in theoretical frameworks, where it has been categorized and formed structures for the gathering data (Höst et al, 2006). Thereby, such an approach is effective since it captures the complexity of human experiences and behaviors that quantitative data might overlook. By focusing extensively on detailed narratives and subjective insights, a deeper understanding of the context and the subjective interplay of factors that influence that specific phenomena can be gained. Something that has proved to be particularly valuable in the context of organizational structures where the culture differs from the one of the theory's origin.

2.4 Data gathering

The data gathering for the thesis was conducted using primarily three different methods: literature review, interviews and observations. The purpose for the methods differ. Literature reviews laid the groundwork for the theoretical frameworks, interviews were the main source of qualitative data from the research subject, and observations were used to confirm the information from the interviews and to understand the linkages between the different processes in the manufacturing.

2.4.1 Literature review

Literature reviews were performed with the purpose of gaining a deeper knowledge within the relevant areas of the study. Due to the general nature of the purpose, with focus on manufacturing in Kenya, different manufacturing strategies and process improvements, a wide range of literature was used. Therefore, the nature of the literature used derives from books, such as Terry Hill's Manufacturing Strategy, reports from industry experts as well as published articles. This multi-facet approach allows for a combination of older proofed concepts as well as new findings from the industry.

2.4.2 Interviews

Interviews at the selected case company were conducted with the purpose of getting a deep understanding of the company's manufacturing, market and product strategy, as well as its corporate objective and operational processes. As presented by Höst et al. (2006), the concept of an unstructured interview was used throughout the interviews. The method was selected with the purpose of asking open-ending questions which would allow the interviewees to share their opinion and perspective on the different operational processes at the company.

Initially, interviews with the company's COO were conducted to get a broad understanding of the company's strategies and objectives. Then, several interviews were conducted with different heads of departments, in order to get a deeper understanding of how the different operational processes in practice reflect the manufacturing strategy. This approach allows for a comprehensive analysis with the purpose to identify strategic and operational improvements. Furthermore, it is important to note that there has not been any restrictions for who to interview.

2.4.3 Observations

Observations were conducted to study manufacturing processes and their linkages between each other (as were explained by the heads of the departments in interviews). It worked as a complement and confirmer to the interviews, to make sure that the processes had been correctly compiled.

The method used was complete observation, in line with the theory of Höst et al. (2006).

2.4.4 Workshop

In addition to the observation and interviews, a workshop was held with all the interviewees and other stakeholders at the company, such as the CEO. The purpose of the workshop was to present the empirical findings, to make sure the information had been interpreted correctly. This is important to make sure that the credibility of the study is solid.

2.5 Credibility of the study

Reliability and validity are cornerstones of research methodology that ensure the accuracy and credibility of the findings (Höst et al., 2006). Understanding these concepts and how those have been integrated in the research is imperative for both researchers and readers in order to trust the integrity of the study's results. Following, under 2.5.1 Reliability, and 2.5.2 Validity, an exploration is done of why these concepts matter, how they are assessed, together with their critical role in establishing the robustness of the thesis.

2.5.1 Reliability

To ensure the reliability of this thesis, several measures have been implemented and undertaken. Initially, an extensive review was conducted through various sources to identify and select theoretical concepts that are relevant and have been effectively implemented in similar research contexts. This selection process ensured that the foundation of the thesis was robust and well-grounded.

Further steps were taken to verify the outcomes of the data collection activities. Descriptions of manufacturing processes were cross-checked with multiple employees from different divisions, and follow-up interviews have been held to ensure consistent accuracy throughout the gathered information. During these interviews and during informal conversations with employees, a trust was built. These trust-based relations were imperative for being able to talk about sensitive topics and show data that could potentially be sensitive. The observations which were done, could also further strengthen and confirm what was said during interviews.

Additionally, to aid in the understanding and assessment of the research methodology by readers, a detailed illustrative description of the activities conducted is provided. This includes methodology in data gathering allowing readers to see the exact tools used in data collection. This level of transparency is critical for assessing the reliability of the research, as it demonstrates the thoroughness, accuracy, and detail of the data collection and analysis processes.

2.5.2 Validity

The validity of this thesis is considered to be high, supported by the utilization of multiple data collection methods which includes interviews and observation, to ensure comprehensive findings. The method of triangulation, viewing the same phenomenon from different perspectives, enhances the accuracy and depth of the interpretations.

Additionally, the assessment of processes, crucial for understanding key objectives in the efficiency optimization, was approached using two distinct methods: interviews and observations. This dual approach serves as another layer of triangulation, reinforcing the validity of the findings.

Moreover, the thesis also aims to address generalizability and objectivity, to ensure a credible research approach. Generalizability is considered through the application of findings across similar contexts and objectivity is maintained via systematic data collection. Thereby many of the findings have the potential to be generalized to other industries.

2.6 Research ethics

Denscombe (2010) states that researchers are expected to follow the following four principles when conducting research.

- Protects the interest of the participants
- Ensures that participation is voluntary and based on informed consent
- Avoids deception and operates with scientific integrity
- Complies with the laws of the land

Protecting participants' interests creates the foundation for maintaining ethical standards and builds trust between researchers and participants. In this thesis, the interests of the participants were protected by ensuring confidentiality and anonymity of the collected data. Furthermore, measures were taken to minimize any potential discomfort or harm to participants during the research. Voluntary participation and informed consent are furthermore fundamental principles. Consent was obtained from each participant before any data collection began, ensuring that their participation was voluntary.

Avoiding deception and upholding scientific integrity are crucial principles to maintain credibility and reliability of research. This thesis adhered to high standards of scientific integrity by transparently reporting all methods and procedures. Compliance with legal requirements is essential in order to ensure that the research does not violate any laws or regulations. This research does not infringe on any international laws relevant to data protection and human rights.

3. Theory

In order to be able to answer the purpose: Describe and analyze the manufacturing strategy for a company in Kenya that produces environmental high-tech product(s), taking into account the demands set by its product(s) and market strategies, and propose strategic and operational improvements for more efficient processes, one approach is to categorize the different activities from a theoretical perspective. Firstly, one needs to understand the different value adding levels of the product since this represents what needs to be produced. Understanding the fundamentals of the product thereby sets the scope of the requirements for the manufacturing. Kotler's three levels of product provides a theoretical and comprehensive approach of creating a fundamental understanding of the product (Kotler et al., 2016).

When the understanding of the product is created, the next step becomes to understand what requirements there are for the manufacturing strategy to create the product. Finding a suitable framework that can precisely represent the manufacturing strategy is therefore vital. Furthermore it is necessary to not only understand what manufacturing activities that are taking place presently but also what activities that need to take place in order to coherently fulfill the company's goals regarding the market strategy. Since the market strategy forms the needs of the manufacturing strategy, Hill's framework will enable this analysis (Hill, 2000).

From Hill's framework it is clear that a deeper understanding of a company's manufacturing strategy is needed in order to conclude a relevant analysis. In "Research in the Process and Content of Manufacturing Strategy" Leong et.al. (1989) it is discussed whether a process or content approach to manufacturing strategy is the most relevant when identifying and critically evaluating manufacturing strategy on a fundamental basis level. Furthermore, it is clear that this fundamental approach to the manufacturing strategy is needed in order to enable improvements to the existing activities. The conclusion of Leong et.al. is that basic, descriptive research is needed on how processes are conceived and implemented in order to further research manufacturing strategy. Great emphasis will therefore be on understanding and mapping each of the processes to be able to identify where the biggest impact can be achieved. Process-based business development by Anders Ljungberg (2001) will be a great asset in order to break down and analyze each and every process.

3.1 Kotler's Three levels of product

To describe and analyze the manufacturing strategy, with the purpose of improving processes within the manufacturing, it is crucial to understand the company's product. The products' characteristics affect the manufacturing's infrastructure and process choices. By analyzing the product thoroughly, a company can understand what is needed from their market- and manufacturing strategy in order to create order winners (Hill, 2000). Kotler's three levels of product is a framework with the purpose of analyzing the product's features and how it creates value for customers. The framework suggests three levels that represent different dimensions of the product. The levels are the Core Product, the Actual Product and the Augmented Product and are showcased in Figure 3.1 (Kotler et al., 2016).

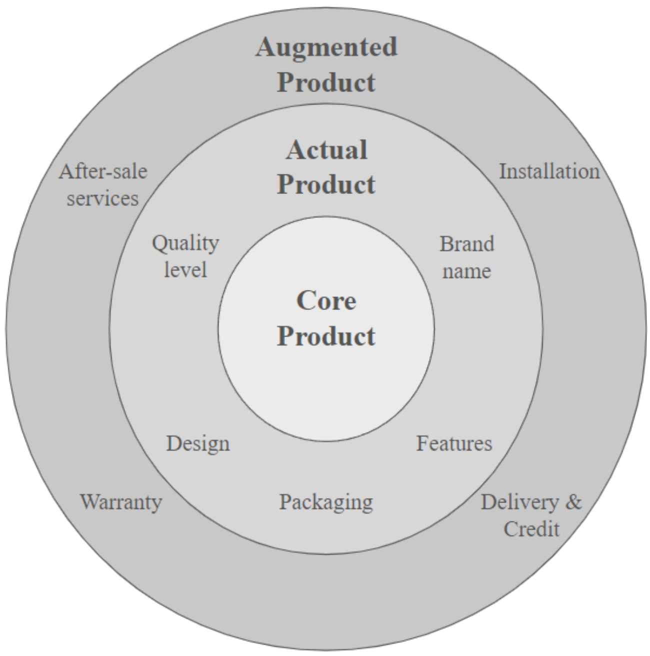


Figure 3.1: Kotler's three levels of product (Kotler et al., 2016).

3.1.1 Core Product

The core product represents the fundamental essence and utility that a consumer seeks when choosing a product. It overlooks physical attributes and features, focusing on the intrinsic value or solution the product provides to meet the consumer's primary needs or desires. At this level, businesses aim to understand and fulfill the essential purpose for which customers consider their product for (Kotler et al., 2016).

3.1.2 Actual Product

The actual product is the tangible aspects that a customer can see, touch, or experience directly. This level includes the specific features, designs, specifications, brand and physical attributes that make up the product. It includes elements that customers can directly interact with and experience. Businesses emphasize optimizing these tangible aspects to create a product that is not only functional but also aesthetically appealing, aligning with consumer preferences (Kotler et al., 2016).

3.1.3 Augmented Product

The augmented product extends beyond the physical form and function. This level includes intangible elements that enhance the overall customer experience of the product. It includes additional services, benefits, or support that accompany the product. Businesses focus on providing value-added services, such as warranties, customer support, or complementary offerings, to create a more comprehensive and satisfying product offering. These added elements can significantly influence a consumer's decision-making process and contribute to brand loyalty (Kotler et al., 2016).

3.1.4 Summary

In summary, understanding and effectively managing these three levels of product is crucial for businesses to create a comprehensive and appealing offering of their product. By aligning the company's marketing strategy with each level, companies can not only meet the functional needs of their customers but also create a compelling overall experience that differentiates their product from competitors in the market (Kotler et al., 2016).

3.2 Hill’s framework of Manufacturing Strategy

When a company understands its product’s inherent value, it is necessary to develop a deeper understanding of the manufacturing strategy’s current state, and more importantly how it should be formed. In successful companies, the manufacturing strategy supports the company’s value proposition. While the market strategy outlines how the company’s products will compete in the market, the manufacturing strategy details how the manufacturing process and infrastructure should be designed to achieve the company’s goals. From a manufacturing perspective, there is often a need to concretize the market strategy into qualifiers and order winners. Qualifiers and order winners thus establish a link between the company’s overarching objectives and its strategic management of manufacturing. At the manufacturing strategic level, the focus is on positioning the company’s manufacturing within the value chains it operates in and shaping the individual processes to collectively align as efficiently as possible with the company's value proposition (Hill, 2000).

To formulate a manufacturing strategy, it is crucial to comprehend the logistics in the system as a whole, as well as the logistics of the system’s various subsystems and subprocesses. This ensures a beneficial connection between market strategy and the intricate formation of manufacturing strategies and processes. Hill’s framework (Figure 3.2) showcases how corporate objectives, market strategy and manufacturing strategy works together to create order winners for a company (Hill, 2000).

Market → ← Production

Corporate objectives (3.2.1)	Market Strategy (3.2.2)	How do products qualify and win orders in the marketplace? (3.1)	Manufacturing strategy (3.2.3)	
			process choice (3.2.3.1)	infrastructure (3.2.3.2)
- Growth - Survival - Profit - Return on investment - Other financial measures	- Product markets and segments - Range - Mix - Volumes - Standardization versus customization - Level of innovation - Leader versus follower alternatives	- Price - Quality conformance - Delivery speed reliability - Demand increases - Color range - Product range - Design - Brand image - Technical support - After-sales	- Choice of alternative processes - Trade-offs embodied in the process choice - Role of inventory in the process configuration - Make or buy - Capacity (size, timing, location)	- Function support - Manufacturing planning and control systems - Quality assurance and control - Manufacturing systems engineering - Clerical procedures - Compensation agreements - Work structuring - Organizational structure

Figure 3.2: Hill's framework for reflecting manufacturing strategy issues in corporate decisions (Hill, 2000)

Furthermore Hill (2000) has described the steps to link manufacturing to the marketing with corporate strategy development as the following:

1. Define corporate objectives.
2. Determine marketing strategies to meet these objectives.
3. Assess how different products qualify in their respective markets and win orders against competitors.
4. Establish the appropriate process to manufacture these products (process choice).
5. Provide the manufacturing infrastructure to support production.

In order to follow these steps successfully, companies need a deeper understanding of each respective area. When a company has determined its manufacturing strategy, investment needs and time period for change, it will take part in the corporate strategy debate, as shown in Figure 3.3. By incorporating Hill's framework, a company is now required to review their business in both manufacturing and marketing terms. As a result, it will change the style and content of corporate decisions. It will move from functionally based arguments to the ones that address the functional differences by resolving at the business level the trade-offs involved. The corporate resolution results in a more agreed level of understanding of the business objective, marketing strategy and manufacturing strategy (Hill, 2000).

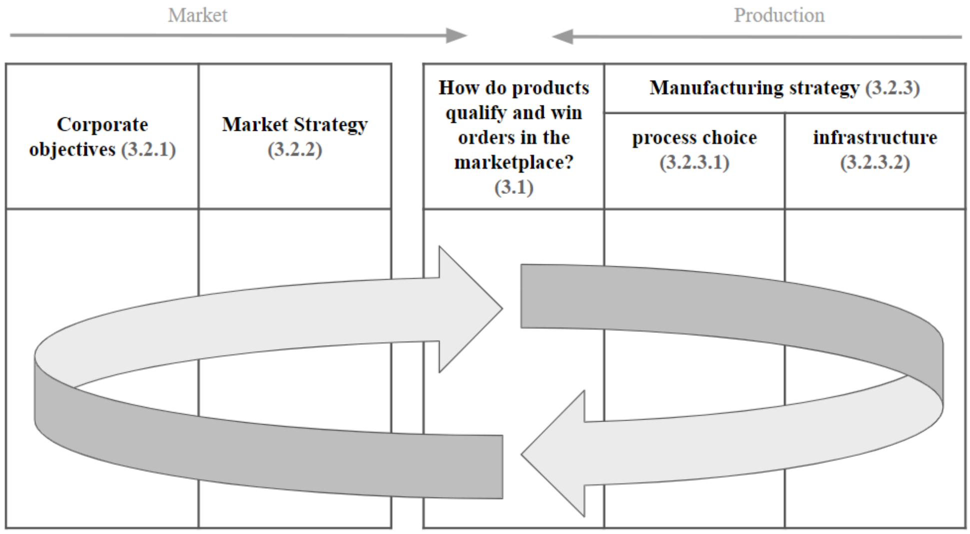


Figure 3.3: Manufacturing's input into the corporate strategy debate (Hill, 2000).

In practice, there are five different states a company can be in regarding the degree of fit between the marketing and manufacturing strategic interface, showcased in Table 3.1 (Hill, 2000).

Table 3.1: Different states a company can be in regarding the degree of fit between the market strategy and the manufacturing strategy (Hill, 2000).

State	**Description**
1	The interface is close enough and requires little to no adjustments.
2	The interface is not close enough, but the corporate decision is not to invest the time and money needed to close the gap.
3	The interface is not close enough, but the corporate decision is to change the market strategy to reduce the gap and move closer to state 1.
4	The interface is not close enough, but the corporate decision is to allocate investment and time to enable the manufacturing to bring its processes and infrastructure to the required level to support the marketing strategy (to reach state 1).
5	The combination of state 3 and 4 (allocating time and investment to reach state 1).

State 2 stands out, a situation where the company knows there is a mismatch, but decides to not do anything about it. Therefore, it is crucial that the mismatch is translated into the manufacturing targets and budgets, to showcase an achievable, manageable and controllable task. As a result, the insufficient manufacturing performance against the budget is separated from the consequences of the corporate strategy decision to accept the mismatch involved (Hill, 2000).

As markets differ, the order-qualifiers and order-winners of different markets will also differ. As a result, manufacturing needs to be developed after different strategies to support the needs of unique markets. However, companies tend to not recognize this, and instead set a corporate strategy that supports a generic manufacturing strategy, which usually results in a mismatch with the market strategy. Therefore, it is important that the corporate debate and strategy give attention to differences in the inherent markets, with a clear distinction between order-qualifiers and order-winners. Market traction is key to growth and success, which is why companies should not spare any effort to identify potential gaps between the market and the manufacturing. Manufacturing is responsible for developing several strategic responses that are required to support a company's different markets. Therefore, a breakdown into the respective areas of market- and manufacturing strategy is needed to be able to identify disparities between the two, as well as the respective actual strategies and the ideal strategies (Hill, 2000).

3.2.1. Corporate objectives

Corporate strategy always needs to consider the corporate objectives of a business. This link is in its nature twofold, as it first provides the fundamentals for establishing a clear, strategic direction for a business. Furthermore, it demonstrates both strategic awareness and willingness vital for the success of a business. In addition, it defines the boundaries and marks the parameters that can be measured in order to provide a coherent corporate plan (Hill, 2000).

The objectives for each company will differ in its essence and emphasis, however those will reflect the nature of the economy, markets, opportunities and preferences. It is essential that these objectives hold logically together and that they form the necessary direction of the business. Typically these objectives concern; profit in relation to sales and investment and target for both absolute- and market-share growth. Businesses may also want to include other issues such as employee policies and environmental targets as part of their overall sets of objectives. (Hill, 2000)

3.2.2 Market strategy

Closely linked to the corporate objectives, a market strategy needs to be developed. The market strategy is, according to Hill (2000), often divided into three steps which consists of market planning, analysis and identifying target markets:

1. Firstly, market planning needs to be done and control units introduced. This is done in order to help to identify a number of manageable units that have similar marketing characteristics and share a marketing programme. This first step is about identifying potential marketing synergies and creating a focus group for marketing strategy within the company's portfolio of products. If the target company already has clear segments or differentiated products this step is rather about selecting which one to focus on, enabling a narrow and precise analysis.

2. The second step of analysis is of more relevance to the manufacturing and consists of an analysis of product markets that includes:
    a. Determining current and future volumes
    b. Defining end-user characteristics
    c. Assessing patterns of buying behavior
    d. Examining industry practices and trends

e. Identifying key competitors and reviewing the business's relative position

With the scope of the thesis being on operations, the investigative approach regarding the market strategy is therefore mainly going to emphasize the five listed areas above. The reason is because it is mainly this part of the market strategy, and not marketing initiatives, that is affecting the set up of operation (Hill, 2000).

3. The third and final step is regarding the identification of target markets and determining the objectives for each market. This consists of a broader review of how to achieve the objectives as well as short-term action plans created to secure objectives of a more global character.

This analysis should result in a declaration regarding the business's product markets, segments which are proposed by the company's strategy and a compilation of the product range, mix and volumes. Other issues of relevance for this analysis is whether the business should be a leader or follower in each respective market, the degree of innovation for product development and the possible degree of standardization or customization involved. Furthermore the extent and timing of these strategic initiatives should be brought forth. Other objectives that are of essence for the market strategy is to understand the product's value offering and the metrics around the brand such as brand awareness and the brand's importance (Hill, 2000).

3.2.3 Manufacturing strategy

It is not only the market strategy that determines the success of a product. A company's manufacturing strategy is as vital as the market strategy to create order-winning products. The manufacturing strategy can be divided into two parts, manufacturing process design and infrastructure. Figure 3.4 highlights the implications for the process design and infrastructure support based on the sales of products in current and future markets. A company needs to regularly evaluate the current fit of the manufacturing processes and infrastructures' features that is needed to create order winners on one's market. It is especially important to review the implication when the volume or characteristics of the order winner changes. Also for future product proposals or new customer contracts. In addition, by closely monitoring and analyzing the actions taken by competitors, alongside investigating shifts in customer preferences and emerging trends, a company can pinpoint specific and often overlooked changes that have occurred over time. The change of current and future requirements needs to be compared to the original decisions a company has made, in order to know how to redesign the process and infrastructure when the conditions for producing an order winner evolves (Hill, 2000).

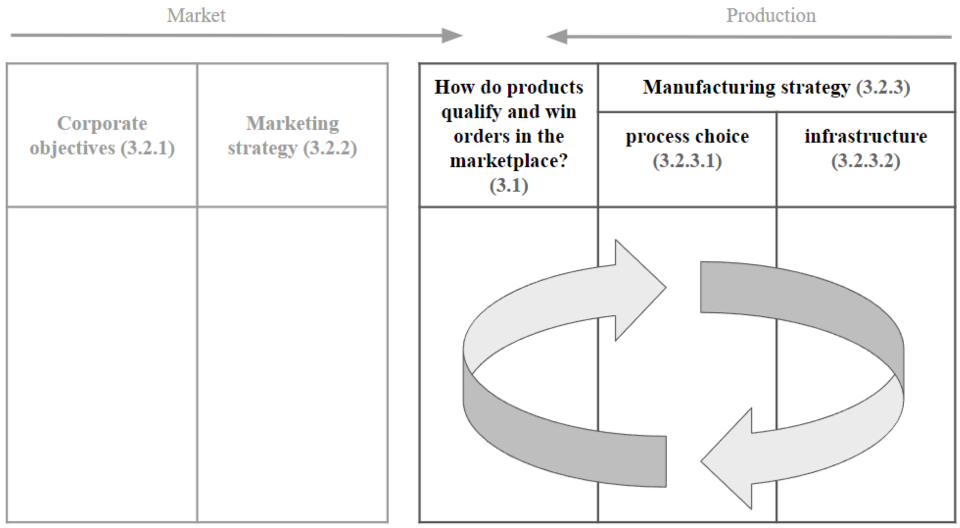


Figure 3.4: Assessing the implications of manufacturing processes and infrastructure for order-winning products (Hill, 2000).

3.2.3.1 Process choice

There are several ways a company can design its manufacturing process. A company should take the following steps to chose the process that suits best for their product and market strategy (Hill, 2000):

1. The company needs to decide to which extent they buy components since it determines what activities that will take place in the manufacturing site.

2. The company should identify the appropriate engineering-technologies that are required to complete the tasks that are embodied in the product. This concerns the merger of all components, bought-in and made-in, to create a finished product with the right specifications and quality.

3. The company chooses between different manufacturing options to successfully complete the task necessary to finish the product. The choice should depend on the market in which the product competes in, and the expected volumes that are needed to manufacture.

Step (3) decides the actual process design. Step (1) and (2) put constraints to the possible choices in step (3). However, it does not alter the nature of the choice. The essence of process design choices is linked to the most appropriate way to manufacture the product, based on the competing market and volumes. Depending on the three steps, a company can choose between five generic manufacturing processes: project, jobbing, batch, line and continuous processing. In practice, companies often use more than one process, or a hybrid between two or more processes. Figure 3.5 shows the appropriate process choice in regards to expected volume (Hill, 2000).

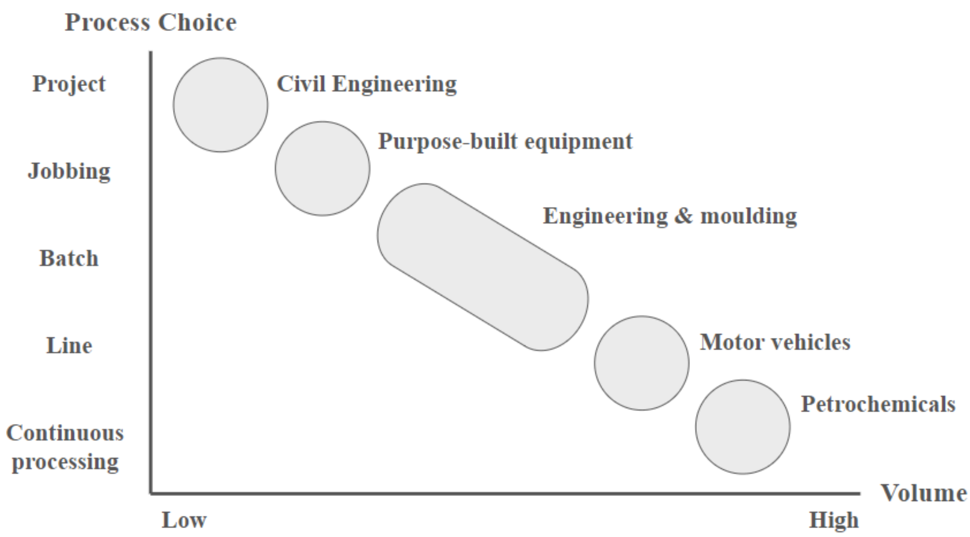


Figure 3.5: Highlights the appropriate manufacturing process choice in relation with expected volume, including examples of what type of products that are manufactured by the different processes (Hill, 2000).

As mentioned previously Figure 3.5 showcases the types of products and volumes that are appropriate for the different process choices (Hill, 2000). The purpose of the thesis makes the process choices of batch and line the only relevant ones. Therefore, those are the only two processes that will be focused on hereonforth.

3.2.3.1.1 Batch Process

The batch process is suitable for a company that manufactures similar items on a regular basis, but with a lower volume than that of a line process. The batch process allows a company to use a series of activities that are needed to complete a group of products. It allows companies to find the most cost-effective route, which makes them more competitive in the market. When a company uses the batch process, several identical items are being produced simultaneously. For example, ten products go through one step of the manufacturing together, and then the products are moved together to step two of the manufacturing and so forth (Hill, 2000).

Batch process is the link between low and high volume, special and standard products, and make-to-order and make-to-stock business. It is a process which is suitable when there is an indication that production volume will increase, and that the activities are repeatable, but not enough to dedicate a line process for them. Also, there is a spectrum of the batch process, low-volume and high-volume end of batch. For the low-volume end of batch, the process can handle a high degree of product changes and introductions of new, similar products. The focus will be oriented towards the company's selling capability, with more importance on price, because of the low volume and repeatable manufacturing activities. For the high-volume end of batch, the products have become more standardized, increasing order sizes and lower product changes. It is an indicator that the company is ready to shift towards the line process. As a result, the market's demand on quality and delivery time increases (Hill, 2000).

The manufacturing for batch processes deals with a wide range of products and volumes, which puts pressure on the processes to be flexible and of a general nature. A consequence of this is that the utilization of equipment and tools will fluctuate. To handle it, companies need to invest in tools that have high utilization, to achieve a higher efficiency in the manufacturing. To help with the total process investments, many companies have set up policies of increasing the utilization of a plant. The policies can be set up in three different ways (Hill, 2020):

1. Have different products being put through the same set of processes.

2. Produce the same products in a single order quantity, or batch quantity. As a result the number of activity set ups are minimized. It decreases the costs of setting and increases the effective capacity.

3. Letting the products wait for processes to become available. By combining this policy with the order-quantity decision, a company will have a significant work-in-progress inventory investment, which in relation to the size of the business, tends to be very high in comparison to other manufacturing processes.

If a company wants to be competitive in markets that are moving towards the high-volume end, it needs to invest in the batch process to have the low manufacturing costs that these markets require. However, many companies try to achieve a lower cost per unit by putting more products in the same process without investing in capacity. It results in a very high investment in work-in-progress inventory for companies (Hill, 2000).

When a company is moving from the low-volume end to higher volumes, centralized controls and a more bureaucratic style is the most appropriate fit. The increasing complexity of the volume growth will change the specialist functions. Design and production engineering will become an important support to manufacturing. At the same time, the production manager's role will focus on the most critical issues, to provide coordination throughout the production and lead the development of manufacturing systems (Hill, 2000).

3.2.3.1.2 Line Process

The line process is suitable for a single type of product with higher volumes, and with the possibility for small customizations. During the line process, the products are passed through the same activities in a certain order, one product at the time. It is possible due to the standardization of the product, with predetermined sets of options for certain features (Hill, 2000).

The process is designed for a set of products, which enables low manufacturing cost. The standardization of the manufacturing allows the company to easier maintain the necessary level of quality throughout the process. However, it makes the process inflexible and costly to modify the manufacturing process. The manufacturing level needs to be relatively high to achieve a high utilization rate to justify the investment needed (Hill, 2000).

To attain low manufacturing costs, a company must make substantial investments in processes, a characteristic of the line process. The increased volumes enable effective scheduling of component procurement and buffer stock management, potentially reducing work-in-progress inventory. However, contemporary manufacturing practices often involve producing goods based on customer orders to minimize inventory investments. The primary cost drivers are typically components and site overheads, with direct labor constituting a relatively smaller portion (Hill, 2000).

The line process, marked by its high volumes, has implications for the manufacturing infrastructure. A centralized organization controlled by systems proves to be the most suitable approach in this context (Hill, 2000).

3.2.3.2 Infrastructure

In 3.2.2 and 3.2.3, the importance of companies understanding that the manufacturing process must suit the needs of the market has been presented, for them to be competitive in the market. However, a company needs more than a good manufacturing process to have a successful manufacturing strategy. After the process design has been made, a company must shift focus to manufacturing infrastructure. Infrastructure refers to the non-tangible aspects of the manufacturing, such as supporting structures, controls, organizational structures, procedures and other systems within manufacturing. These are equally important for a company, as process design, to achieve successful and competitive manufacturing performance (Hill, 2000). Below the operational aspects of manufacturing infrastructure are presented since these align with the purpose of this paper which mainly circles around efficiency.

3.2.3.2.1 Control of Quality

Quality conformance is a qualifier in today's markets, and its impact on a company's market share is high. Therefore, it is an important factor in manufacturing strategy and infrastructure. If a company fails to meet the market's quality expectations, it can lead to an order-losing scenario or worse. It is most appropriate to have quality control to check the quality directly when an activity is done. But for batch and line processes, the quality check is done after the manufacturing is finished. This results in two possible parameters which have a direct impact on the company's ability to minimize the consequences of below-quality work. Either the length between manufacturing and quality conformance checks, or when quality checks are conducted. Furthermore, this causes two issues concerning quality conformance that need to be handled on a corporate level and trickle down in the manufacturing strategy and process (Hill, 2000):

1. Should the company have a reactive or proactive approach to quality? A reactive approach is when the company focuses on detection, with the main objective to prevent faulty work from being passed on to the next step in the process. Pros with this approach is that it will minimize costs in rectifications, scraped and returned products. A proactive approach focuses more on preventing quality faults from the very beginning, and less on detection. In contrast to reactive approach, this requires the company to allocate resources to make the products right the first time to a larger extent than for reactive approach. It can be achieved through reviewing the quality of design and conformance to identify factors affecting these two features. As a result, the quality assurance is designed around this analysis (Hill, 2000).

2. The responsibility for quality conformance includes two factors, the departmental responsibilities through the process, and the responsibility for measurement (Hill, 2000).

The common denominator of companies that have a reputation of producing high-quality goods is that they empower their employees across the organizational charts. On the other hand, companies that lack high quality often have the higher management emphasize the importance of quality, but fail to transfer it down and through in the hierarchy levels. To solve this issue, companies need to invest more in training, and empower the employees in the factory and transfer the responsibility to them. As a result, companies can go from being reactive to a proactive approach regarding quality, which is necessary to make sure the manufacturing meets the quality demands of the markets (Hill, 2000).

3.2.3.2.2 Control of Inventory

An additional aspect of infrastructure that is important for companies is managing and controlling its inventory. Inventory often represents a significant portion of a company's total assets, yet its control is frequently overlooked or under-emphasized in strategic planning. There, inventory management should receive the same level of attention and sophistication as other larger investments, like tools and equipment (Hill, 2000).

Inventory can be divided into two categories, corporate and operations. Corporate inventory refers to the stock that does not directly contribute to the manufacturing process but is held for various other business reasons. Examples of corporate inventory include sales inventory held to fulfill customer agreements, inventory accumulated due to lower-than-forecast sales, marketing inventory for product launches, purchasing inventory acquired to gain quantity discounts, and corporate safety stocks maintained due to supply uncertainty. Controlling corporate inventory effectively requires an understanding of the specific causes behind each inventory type. This enables a company to set appropriate targets, assign inventory control responsibilities to the right functions, and monitor the returns on these inventory investments (Hill, 2000).

Operations inventory is directly involved in facilitating the manufacturing process. Effective control of operations inventory hinges on understanding the types of inventory within this category and classifying them accordingly. There are several key approaches and principles that are involved in the effective control of operations inventory. One is the dependent/independent demand principle. It distinguishes between items with independent demand, like finished goods, whose usage rate is not directly linked to other items, and those with dependent demand, such as components and subassemblies, whose usage is tied to the manufacturing of other items. In addition, companies holding operations inventory provide distinct functions in the manufacturing. In Table 3.2, different function classifications of operations inventory is presented (Hill, 2000).

Table 3.2: Functions provided by operations inventory (Hill, 2000).

Functions	**Description**
Decoupling Inventory	This separates one process from another within the manufacturing operation, allowing for independent functioning of different stages. Essential in batch

	manufacturing, it is not required in jobbing, line, or continuous processing.
Cycle Inventory	Related to the decision to produce a certain quantity of products, reflecting factors like setup costs and production-run lengths. Its purpose is to optimize process capacity utilization and reduce setup costs.
Pipeline Inventory	Needed when parts of the manufacturing process are subcontracted, encompassing all inventory associated with this decision.
Capacity-Related Inventory	Used to balance production with fluctuating sales levels, often resulting in stockpiling during low-sales periods for use in high-sales periods.
Buffer Inventory	Held to manage variations in demand or supply availability, with the amount dependent on the desired service level and stockout risk.

To implement effective inventory control, a company does not need to review its entire business, but merely focus on areas where large blocks of inventory occur. This involves identifying inventory by its position in the process and its function. If inventory serves more than one function, an arbitrary division can be made for analytical purposes. In addition, companies should try to reduce inventory that does not add value. This approach involves identifying the reasons for excess inventory, changing rules and procedures to prevent recurrence, and using up existing inventory while curbing unnecessary inflows (Hill, 2000).

Moreover, companies can use Pareto analysis (the 80/20 rule) for inventory review. Typically about 20% of the items account for 80% of the inventory value. This analysis enables companies to focus control efforts on high-value items while maintaining simpler controls and minimal records for low-value items (Hill, 2000).

In essence, Hill's theory on inventory control offers a comprehensive strategy for managing this critical asset in manufacturing businesses. It underscores the importance of understanding the reasons behind inventory holdings, differentiating between various types of inventory, and adopting a targeted approach to control and reduction. By applying these principles, companies can optimize their inventory management, align it with their manufacturing strategy, and thereby improve overall operational efficiency and financial performance (Hill, 2000).

3.2.4 Summary

It is evident that a nuanced understanding of a company's manufacturing strategy is crucial for pinpointing areas for improvement (Hill, 2000). This notion is supported by Leong et al. (1989) in their exploration of whether a process or content approach is more effective in analyzing manufacturing strategies at a fundamental level. Their findings advocate for foundational, descriptive research on process conception and implementation as a key to advancing manufacturing strategy studies. This understanding is vital for identifying and enhancing existing operational activities. Thus, the emphasis on understanding of manufacturing strategy and processes is not just a methodological choice but a necessity in order to use Hill's framework on a detailed level (Hill, 2000) (Leong et al, 1989). This approach directly informs the focus of the next chapter on value chain and process flow.

3.3 Porter's Value chain and Ljungberg & Larsson's process flow

In the following chapter an introduction to Porter's value chain is first done in order to understand how different different value adding processes interact, then a detailed process understanding will serve as a critical tool for uncovering and addressing inefficiencies within manufacturing strategy.

3.3.1 Porter's value chain

A systematic approach of mapping and analyzing all the different value adding activities in a company is necessary in order to understand how the different processes interact and to gain an understanding of which processes lead to a competitive advantage (Porter, 2001). The value chain, Figure 3.6, is a basic tool for this since it disaggregates a company's strategically relevant activities to understand the sources of costs and how the potential competitive advantage of a firm can be created (Porter, 2001).

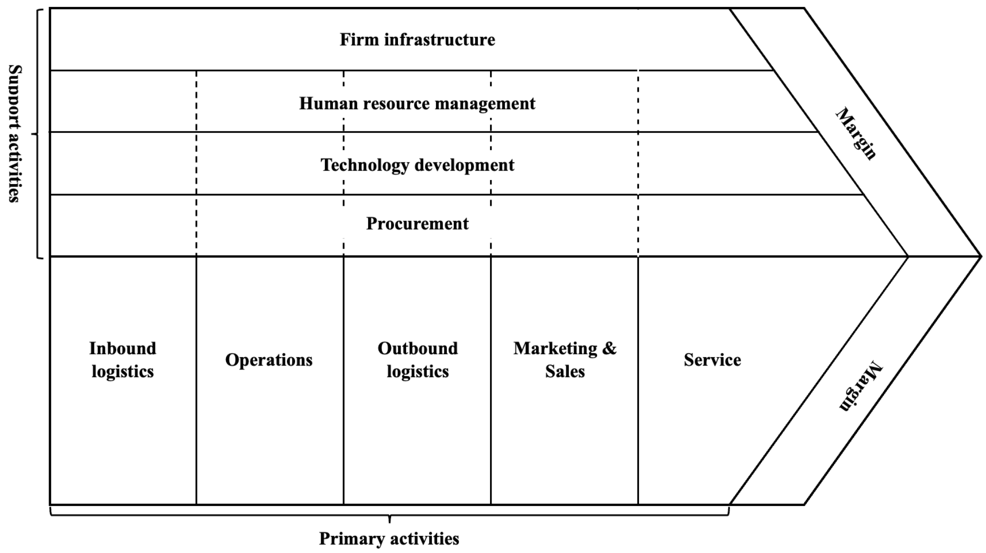


Figure 3.6: Porter's value chain (Porter, 2001).

In the value chain, the total value is displayed, and it consists of value activities and margin. Value activities can be divided into two broad types, primary and support activities. Primary activities are the activities involved in the physical creation of the product together with the delivery and after-sales services. In all firms, primary activities can be divided into five generic areas, as displayed in Figure 3.6. Support activities are activities that support the primary activities. These support activities provide purchased inputs, human resources, technology as well as various firm wide functions. The dotted lines in the Figure represents the fact that human resource management, technology development and procurement can be associated with either specific primary activities or support activities throughout the whole chain (Porter, 2001).

3.3.1.1 Identifying activities

To be able to identify the different value activities, the isolation of each distinct important technology and strategy activity needs to be performed. Furthermore, it is important to notice that the value activities and accounting classifications are rarely the same. Accounting classifications separate costs that are associated with the same activity while grouping activities with disparate technologies (Porter, 2001).

3.3.1.2 Primary activities

As mentioned there are five generic activities for any firm competing in any industry. Each category can be divided into a number of different distinct activities which depend on the particular industry and the firm's strategy. Below these are listed with a concrete description (Porter, 2001).

Inbound logistics

These are activities related to receiving, storing and other inputs to the product as for example material handling, warehousing, inventory control, vehicle scheduling, and returns to suppliers.

Operations

The activities related to operations are associated with the transformation of the various inputs into the final product and includes activities such as machining, packaging, assembly, equipment maintenance, testing, printing, and facility operations.

Outbound logistics

These activities concern the collecting, storing and physical distribution of the product to buyers and include specific activities such as finished goods warehousing, material handling, delivery vehicle operations, order processing and scheduling.

Marketing & sales

These activities are related to providing a means by which a consumer can purchase the product as well as inducing the consumers to do so, such as advertising, promotions, sales force, quoting, channel selection, and pricing.

Service

These activities are related to the providence of services to enhance or maintain the value of the product and include specific activities such as installation, repair, training, parts supply, and product adjustment.

It is important to notice the value of each primary activity heavily depends on the industry and the firm's strategy. For example, the inbound and outbound logistics for a distributor are the most critical, whilst for a service company outbound logistics may be largely nonexistent and operations the most important. However, in any firm each of the primary activities will be present to some degree and therefore play a role in the competitive advantage of the firm (Porter, 2001).

3.3.1.3 Support activities

Support activities are essential functions that help to enhance the efficiency and performance of the primary activities. These support activities, though not directly involved in the production or delivery of the firm's offering, play a crucial role in maintaining the competitive edge of the company. As mentioned, there are four types of support activities (Porter, 2001). These activities will be discussed principally rather than in depth, to provide context for the primary activities yet remaining focused on the operations within the organization.

Firm infrastructure

This includes the company's organizational structure and therefore often stretches throughout the entire chain. It includes a number of different activities such as planning, finance, accounting, legal support and quality management.

Human resource management

These activities include the recruitment, training, development and compensation of employees. Human resource management supports both specific primary activities as well as the entire chain.

Technology development

This area covers the development of technology to support value-creating activities. Technology development takes many different forms, from basic research to media research, process equipment design and servicing procedures.

Procurement

The activity of procurement refers to the function of procurement and not the purchased inputs. Purchased inputs are commonly associated with primary activities, however, purchased inputs are present in every value activity including support activities.

3.3.1.4 Activity types

Within each value activity, both primary and support activities, there are three different types of activities. These are direct-, indirect- and quality assurance activities (Porter, 2001).

Direct activities

These activities are directly involved in the value creation to the customer and include for example assembly, sales force operation, product design and recruiting.

Indirect activities

These activities are those which enable the continuation of direct activities and include for example maintenance, scheduling and sales force administration.

Quality assurance

The activities that ensure the quality of other activities and consists of for example monitoring, inspecting, reworking, reviewing, checking and adjusting.

Quality assurance activities are often found in almost every part of a firm although they are often not recognized as such. Furthermore, quality assurance activities affect the cost as well as the effectiveness in order to cater to the quality standards. It is often preferred to simplify or eliminate quality assurance activities through performing other activities better, since this lowers the cost of quality assurance (Porter, 2001).

3.3.1.5 Defining the value chain

When defining the value chain it is important to remember that the appropriate degree of disaggregation depends on the economics of the activities together with the purpose for which the value chain is analyzed. The basic principle when defining activities is that each activity should be isolated and separated when, having different economics, the potential for impact of differentiation must be high or the activity represents a relatively large or growing part of the cost. When using the value chain, successively more detailed sectioning can be done of some activities as the analysis exposes insights. Other activities can be combined if those prove to be unimportant to the firm's competitive advantage (Porter, 2001).

Furthermore, it is of great importance to notice that although the value activities together form the foundation of a firm's competitive advantage, the value chain is not just a group of independent blocks but rather a system of interdependent activities. The value activities within the value chain are often related by linkages. Linkages are the relationship between the cost or performance of one activity and the performance of another. One example of such a linkage is how enhanced inspection of incoming goods can lead to reduced quality assurance costs later in the process (Porter, 2001).

3.3.1.6 Summary

In summary, Porter's value chain is a framework for analyzing a company's value-adding activities, and can be used to identify and address inefficiencies within a company's manufacturing strategy. It separates primary activities (directly related to product creation, delivery, and service) and support activities, which supports the primary functions through firm infrastructure, human resource management, technology development, and procurement. It is important to isolate each activity to understand its economics, impact on differentiation, and cost implications. In addition, there are different types of activities within the value chain, such as quality assurance, where Porter argues for simplification to enhance efficiency. It is important to notice that the value chain should not be viewed as a collection of independent activities but as an interconnected system, where understanding the linkages between activities can lead to strategic advantages and cost reductions.

3.3.2 Ljungberg & Larsson's process flow

To enable a more in depth mapping of the value chain's activities, Ljungberg & Larsson's process flow theory is used. With the approach of Ljungberg & Larsson on processes, any process in an organization can be mapped and described, which is done through a systematic approach of analyzing which parts go into and out of each activity. Thereafter, these activities are after one another to form a map which describes the process flow and each of the specific activities that occur (Ljungberg & Larsson, 2001). This function is vital for creating an understanding both upstream through the use of Porter's value chain and Hill's framework but also downstream to the individual activity.

In order to achieve the purpose of proposing specific improvements one needs to establish an in-depth understanding of the processes of which the value chain consists of. The entire manufacturing domain is inherently cross-disciplinary, not just in its application but also theoretically. In many manufacturing organizations, the process-oriented approach is often steered by representatives predominantly from a single discipline, such as engineering. The perspective on manufacturing processes emphasizes, among other things, the crucial importance of a holistic view. This underscores the necessity of breaking down silos and fostering collaboration across various disciplines for a comprehensive understanding and efficient execution of manufacturing processes. With this said it is important to map out the different processes, and process choices a company has to do. Furthermore, differentiation and competitiveness is created through many of the processes and in many industries they are not public and thereby difficult to study in order to draw advantage which is why they can create important competitive advantages (Ljungberg & Larsson, 2001).

A traditional organization map often fails to show what is actually being done and the correlation between the process and the customers it aims to serve. Traditional schemes often focus on internal governing and control while lacking the focus on value creating. The focal point of an organization map should rather be external and horizontal. Furtherly, in order to gain an understanding of an organization map it is important to firstly understand the main process. However, there does not exist a concrete uniformal definition of the main process and it can instead be represented in the following forms (Ljungberg & Larsson, 2001):

- The processes whose activities refine goods or services to an external customer.
- Processes that realize the business idea.
- Processes that together form a system that serves as the foundation for the business. If one is removed, the business falls.
- Processes that are of special importance for the business.

A main process map contains main processes which stems from not only the customers expectations but also from how these develop over time (Ljungberg & Larsson, 2001).

3.3.2.1 What is a process

Through the action of describing an organization with the help of process maps, one can easily explain and understand how different parts of an organization are related to each other and how they correlate in order to create value to the customer. However, it is important to know that solely the mapping of an organization's processes does not directly implicate any improvements to the business (Ljungberg & Larsson, 2001).

One characteristic of a process is that it can be done again and again. The factor of repetitiveness makes the processes specifically meaningful to analyze in depth since even small gains can result in major results when being repeated. Furthermore, a process consists of activities, see Figure 3.7. The number of levels between the processes on the highest level and the lowest level depends on the business's size as well as the purpose of the mapping (Ljungberg & Larsson, 2001).

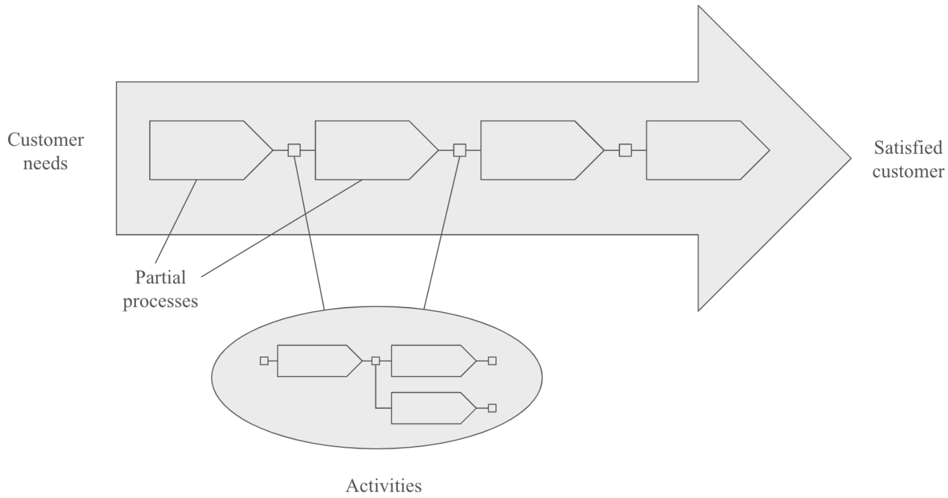
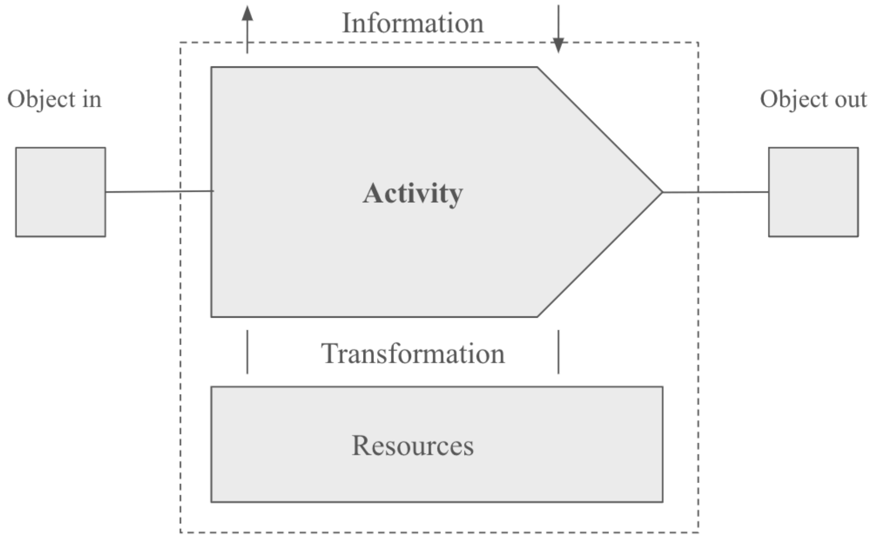


Figure 3.7: Describes the relation between processes, partial processes and activities (Ljungberg & Larsson, 2001).

The recommended definition of a process consists of five key words: object in, activity, resource, information, and object out. The relation between these keywords can be seen in Figure 3.8. These are all related to the process fundamental characteristics together forming the process components (Ljungberg & Larsson, 2001).



Object in - Starts the process
Activity - A sequence of specific actions
Resources - Necessary to perform the action
Object out - The result of the transformation which occurred in the process
Information - Supports and controls the process

Figure 3.8: The components involved in a process (Ljungberg & Larsson, 2001).

3.3.2.2 Mapping processes

A prerequisite to be able to measure and develop the processes of a business is naturally to know what they are. Main processes were previously discussed, and according to Ljungberg and Larsson (2001) with co-author Christian Roos there are three categories of processes: Main processes, support processes and leading processes. Since the purpose relates closer to suggesting an area of improvement rather than the leading of processes, the focus will solely be on main and support processes. Support processes are processes that are needed for the organization to work as a whole but that cannot singularly be recognized as critical for the success of the business. In an organization there should only be a few main processes while the number of support processes can be large. Furthermore, it is important to realize that too big conclusions should not be drawn from how the process has been classified since both of these terms are as descriptive as they are valuative (Ljungberg & Larsson, 2001).

For practical reasons, when mapping, one must balance the amount of information given on the map to usability and benefits for the viewer. A map is clearest when not containing too much detail. A map should therefore be complemented with a number of process specifications and or descriptions. Furthermore, depending on the scope of the mapping as well as the purpose it can be necessary to divide the process into several different maps with different levels of detail. As the map for the main process gives a weak contribution in the form of how a process can be developed or looks it is important when such is looked for, to break down the main processes into more detailed descriptions of the sole process (Ljungberg & Larsson, 2001).

When mapping processes of an organization can sometimes be difficult and therefore a work methodology is suggested by Ljungberg and Larsson (2001).

1. Define the purpose of the process and where it starts/ends.
2. Brainstorm the process of all potential activities and write those down.
3. Arrange the activities in the correct order.
4. Concatenate and add activities.
5. Define in and out objects for each activity.
6. Make sure that all activities are connected through the objects.

7. Control that the activities are all on a common and real detail level and that they all have purposeful names.
8. Correct until a satisfactory level is reached regarding the description of the process.

3.3.2.3 Analyze processes

At the same time as process development has proven to be an efficient way to enhance a business, it is not successful in all organizations, despite major efforts. The art is in choosing the right processes to focus on. The processes to focus on should be chosen based on their relevance and value. If focus is on processes with too small impact there's a risk that the improvements can be major for the specific process but have a very limited impact on the organization as a whole (Ljungberg & Larsson, 2001).

Different kind of analysis require somewhat different data and background information on the the business, however there are some data that is needed regardless of the type of analysis (Ljungberg & Larsson, 2001):

- An overall description of the process's purpose, object in, object out, effects, customers and suppliers.
- Basis for understanding the overall processenvironment.
- Identified and understood requirements and expectations from customers and other stakeholders.
- Detailed description of the process's design.
- Measurable parameters for the achievements of the process and its most important characteristics.

Considering a company in Kenya that produces high-tech products there are some methods that should be described closer in order to understand the value each method can bring and what is most suitable; bottle neck analysis, general analysis with the help of a process map, analysis of the process structure and lead time analysis (Ljungberg & Larsson, 2001).

Bottleneck analysis

Bottleneck analysis stems from the simple principle that the flow does not principally increase just because parts of the flow are more efficient. Moreover, increased efficiency in the wrong part of a process can lead to devastating consequences regarding ques and capital tie-up (Ljungberg & Larsson, 2001).

General analysis

General analysis with the help of a process map is a method where the process map acts as an excellent support in order to walk through the different processes. Enabling categorisation, identification of underlying factors and valuable insights (Ljungberg & Larsson, 2001).

Analysis of the process structure

Analysis of the process structure gives insights regarding the complexity of the process map. Complexity must be on par with the requirements of the process. Therefore the starting point should be either if the complexity of the processes is necessary or if it is enough (Ljungberg & Larsson, 2001).

Lead time analysis

Lead time analysis is an important and useful method to analyze and develop processes. It stems from the 0.05 to 5 percent rule which points to the fact that it is often a very small part of the total time that it takes to produce a good, that is actually adding value. To measure and analyze lead time often requires practical work (Ljungberg & Larsson, 2001).

3.3.2.4 Summary

Ljungberg & Larsson's (2001) process flow theory enables detailed mapping of organizational activities by systematically analyzing inputs and outputs of each subprocess, resulting in a comprehensive process flow map. The approach of mapping each activity in context of the process map is essential for understanding the value adding activities. The theory takes a criticizing standpoint towards traditional organization maps for their internal focus and advocates for a more external, horizontal perspective to better reflect value adding activities. The concept of a process is defined as repetitive activities with one input and another more refined or more finished output. Ljungberg & Larsson (2001) further propose a methodology for process mapping and analysis, including defining the process's purpose, sequencing activities as well as identifying inputs and outputs. The approach extends to analyzing processes in order to identify and understand structural complexities to for example improve lead times. Ljungberg & Larsson (2001) highlights the need of cross-disciplinary collaboration and a shift towards process mapping which also includes external stakeholders such as customers for a competitive advantage and efficient organizational performance.

3.4 Theoretical framework: Application of theory

If a manufacturing company wants to improve its efficiency, it must find the sweet spot between its product, market strategy and manufacturing strategy. At first, the company needs to develop a product which satisfies a need in the market, and serve their customer base better than the competitors. Its core value, product design and features need to be determined. Depending on the product's characteristics, a manufacturing strategy needs to be developed that is suitable. It includes various factors, such as customization options, expected volume and the product's complexity. In addition, a well planned process design is crucial for the manufacturing strategy to be successful. This sweet spot is illustrated in Figure 3.9, which highlights how four different theoretical frameworks (Kotler's Three Levels of Product, Hill's framework on aligning market and manufacturing strategies, Porter's Value Chain and Process Flow analysis by Ljungberg and Larsson) can be used together in order to provide a comprehensive understanding of a Kenyan company producing environmental high-tech products. Furthermore, specific processes can be identified in order to improve them while keeping each process aligned with corporate objectives.

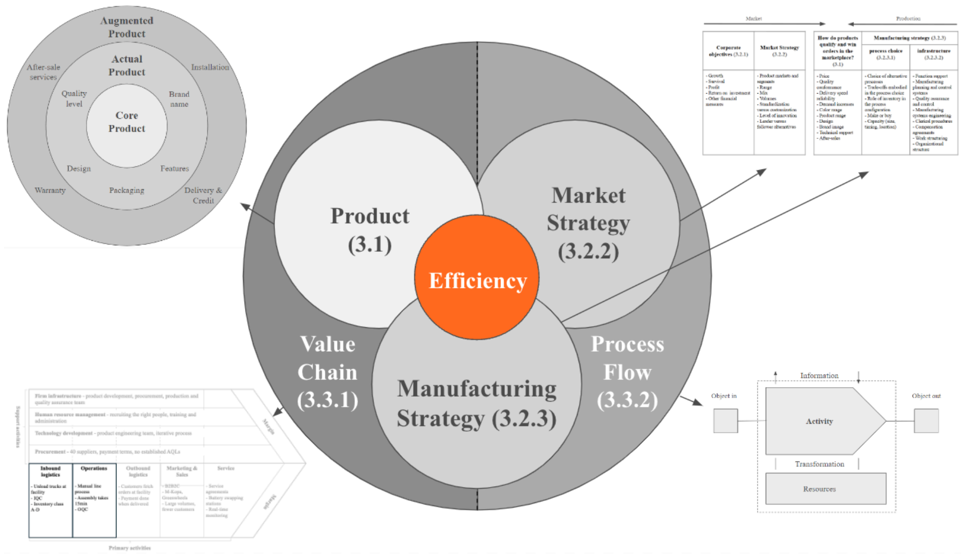


Figure 3.9: Conceptual illustration of how the interplay of the product, market strategy and manufacturing strategy affects the operational efficiency, as well as tools to map the value adding activities and processes.

When synthesizing the theories of Kotler's Three Levels of Product, Hill’s framework on aligning market and manufacturing strategies, Porter’s Value Chain and Process Flow analysis by Ljungberg and Larsson, a comprehensive analysis for a Kenyan company producing environmental high-tech products can be conducted. The analysis focuses on understanding the product comprehensively, aligning the manufacturing strategy with the product and market strategy, and then allows for an optimization of the manufacturing flow.

Firstly, Kotler’s model allows for a deep understanding of the product at three levels: Core (the basic need the product fulfills), Actual (the tangible product and its features), and Augmented (additional services or benefits). This comprehensive view of the product allows a company to understand what requirements the product puts on the manufacturing and market strategy. Furthermore this allows for the company to more easily understand where to direct time and resources in order to enhance the manufacturing without losing any factor of the customer value of the product's different levels. Thereby the business can be able to make a more efficient assembly of the product (actual product) without losing other factors within the augmented product which might involve maintenance and customer support.

Secondly, Hill's framework ties the manufacturing strategy to the market strategy. It starts with defining corporate objectives, which might include, market share targets, sales volume, innovation benchmarks and sustainability goals. Following this, the market strategy needs to be aligned with the manufacturing strategy regarding forecasted sales volume, customers expectation on quality, target segments' unique needs and so forth. These strategic decisions should shape the manufacturing strategy, which includes decisions on process design (for example batch or line processes) and infrastructure (inventory and quality control). For the case company, this might involve choosing a specific process ensuring quality control is stringent to build trust in a market where product reliability is critical.

Thirdly, Porter's Value Chain is a tool to get an overview of a company's strategically value adding activities. By using the Value Chain, a company can get a better understanding of how all company activities affect each other. It helps a firm to identify potential competitive advantages and areas which need to be improved, in order to create more value and achieve higher margins.

Lastly, the Process Flow analysis by Ljungberg and Larsson emphasizes a detailed understanding of the manufacturing flow. This involves mapping out each step in the manufacturing process, identifying bottlenecks, and ensuring efficiency. It is about understanding how each component of the process (input, activity, resource, information and output) interacts and affects the overall efficiency. When this is done in combination with Kotler's model, Hill's framework and Porter's value chain, a detailed analysis of a specific process can be conducted and improved which aligns with overall corporate objectives, such as manufacturing volumes, and market strategy. In practice this could mean analyzing the specifics of the manufacturing in order to identify steps where delays occur most frequently, implementation or fine tuning of quality checks at critical juncture, or rearranging the workflow to minimize downtime. Based on the scope of the thesis, the process flow analysis will be conducted on the primary activities of inbound logistics and operations from Porter's value chain.

In applying these theories, an analysis of the Kenyan company which produces high-tech products should result in:

1. Thoroughly understand their product at all three levels (core, actual, augmented) to ensure they meet and exceed customer expectations.
2. Investigate if their manufacturing strategy is aligned with their market strategy and corporate objectives, ensuring they are producing what the market demands in the most efficient way possible.
3. Map and analyze their manufacturing processes to identify inefficiencies and areas for improvement.

Overall, this synthesized approach ensures that the company not only produces environmentally friendly high-tech products but also remains competitive and responsive to market needs and customer expectations.

3.4.1 Method of applying theory

Applying this integrative approach of the theoretical frameworks Kotler's three levels of products, Hill's manufacturing framework, Porter's value chain and process flow analysis by Ljungberg and Larsson allows for unraveling the alignment between individual processes and broader corporate, market and manufacturing processes. This theoretical interplay is used to dissect and enhance the company's strategic alignment across the operational efficiency, showcasing an intertwining of theories to address specific operational processes challenges.

Kotler's three levels of products are used to, via the core, actual and augmented levels, ensure a holistic understanding of the customer value the product brings. The insights from Kotler's framework are used to uncover specially important parameters which together with the market strategy in Hill's framework will provide an understanding of the product in relation to its competitive landscape.

Hill's framework for aligning market and manufacturing strategies is then used in its full format to understand how the corporate objectives align with the manufacturing capabilities. Hill's framework is used together with mainly the inbound and operational sections of Porter's value chain to form an understanding for process choices, where the value creation takes place and the linkage of different processes.

The insights uncovered are then used together with the closer process and activity mapping which is enabled by Ljungberg & Larsson theoretical approach. To understand how incremental changes, which impact factors such as scale and quality, can be made in specific activities it is essential to understand how the strategic objectives translate into practical execution, which is made possible through this integrative approach.

3.4.2 Gathering of data in relation to theoretical models

When collecting information in relation to the theory, the collection has been done mainly through interviews with people in different levels and departments within the organization. The information collection has also been done through websites.

It is important to note that the collection of data has been done in the same order as described in 3.4.1, which has enabled the questions to be specific and allow for a progressive understanding of the product, organization and lastly the individual processes in relation to the strategic objectives.

4. Case study: the company

In the following chapter, the case company will first be introduced. Later, there will be an empirical study about the company according to the theory in chapter three.

4.1 Introduction of the case company

As stated in 2.2.2 Criterias for selecting the case company, the company was founded in 2017 by a group of Swedish entrepreneurs. From the beginning, the company has always been dedicated to the developing, designing, and manufacturing of electric vehicles, including motorcycles and buses, directly from their headquarters in Kenya (Case Company Website, 2023a).

In 2022, the company changed name and it was more than a rebranding effort; it signified a strategic realignment towards a broader ambition of facilitating sustainable transport across the continent. This change reflected the company's growth and its expanding vision to create a wider array of electric mobility solutions, tailored specifically to meet the challenges and opportunities presented by the African market (Doll, 2022b).

A cornerstone of the company's philosophy is its commitment to local production and engineering. The mantra "Made in Kenya, for Africa" encapsulates the company's belief in leveraging local talent and insights to produce electric vehicles that are suited to the African context. This approach ensures that the vehicles are environmentally friendly, economically viable and culturally resonant with their primary users (Case Company Website, 2023a).

To support the adoption of electric mobility, the company has focused on building an integrated ecosystem that includes not only the vehicles themselves but also the necessary supporting infrastructure. This includes everything from charging stations to fleet management software, demonstrating a comprehensive approach to tackling the traditional barriers to EV adoption in Africa. The company's efforts in this area aim to streamline the transition to electric vehicles, making it as seamless and beneficial as possible for users across the continent (Case Company Website, 2023a) (Doll, 2022a). To enable sales in the markets to which the company aims to sell within, almost all of their sales of the product is through B2B2C. The distributors of the motorcycles are different companies that offer financing solutions for the end-customer. The company's biggest customer is M-Kopa, a Kenyan asset financing company, which stands for 80 percent of the sales. After M-Kopa purchases a product, they lease it to the end customer (Person 1, 2024). The end customer pays 25 000 KES in downpayment, and then 450 KES per day for the motorcycle and 250 KES per day per battery (M-Kopa, 2024)

In a significant move to scale its operations and increase its impact, the company has expanded its production capabilities with the company Park in 2023. The establishment of a new facility capable of delivering up to 50 000 electric motorcycles annually while still remaining a carbon-neutral assembly facility marks a pivotal step in the company's ambition to meet the growing demand for clean transportation options in Africa. This expansion is coupled with strategic partnerships and initiatives aimed at deploying electric motorcycles widely across the continent, underscoring the company’s important role in Africa’s transition towards sustainable mobility (Doll, 2023).

To summarize, the company’s journey from a research project to a cornerstone of electric mobility in Africa highlights the potential for localized design and manufacturing to meet specific regional needs and at the same time contributing to broader environmental sustainability goals. Through the company’s innovative approach and strategic expansions, the company is setting the stage for a future where electric mobility is a cornerstone of transportation across Africa (Doll, 2022a) (Case Company Website, 2023a).

4.2 Kotler’s Three levels of product

The company’s main product is their electric motorcycle product (see Figure 4.1). It is tailored for the African use case, with focus on affordability, functional design and performance (Case Company Website, 2023b). At the moment, the motorcycles are mainly sold to customers in Nairobi, which is where the product is manufactured and the only place where the company has built charging stations (Person 1, 2024).

Figure 4.1: The product (Case Company Website, 2023b).

4.2.1 Core product

The core value of the product is that it offers the user an easy way to move around in a city on a day-to-day basis. For the Kenyan market, an additional core value is that the product works as an income stream. The product is almost only purchased for commercial use, and allows the user to work within taxi-services, deliveries and cargo transportations (Person 1, 2024). Boda Bodas are the most common income stream for young Africans, making up 5 percent of young workforces' occupations (Person 1, 2024).

4.2.2 Actual product

The product is characterized by its functional design, engineered specifically for the African landscape and infrastructure (Case Company Website, 2023b). It has a similar build and feel of the Bajaj Boxer BM150 (the market leader), having similar wheels, tires, suspension, brakes, switches and mirrors (Person 1, 2024). The product's electric motor gives it instant torque and a relatively fast acceleration. The motorcycle has a robust frame suitable for tough terrain and roads with poor quality. In addition, the frame supports a dual battery system, which can be charged with a portable adapter from a standard wall outlet, or the batteries can be changed at the company's charging stations. The product has a significant carrying capacity, making it possible to carry both passenger and cargo (Case Company Website, 2023b). The motorcycle has additional features such as USB charging ports, different drive modes, a digital screen and storage in the tank area. In Table 4.1, the product's technical specifications are described.

Table 4.1: Technical specifications for the product (Case Company Website, 2023b).

Technical specifications	**Description**
Range	75 km per battery pack (maximum 2)
Payload	220 kg
Top speed	90 km/h
Peak torque	58 nm
Acceleration 0-60 kp/h	6.9 sec
Battery capacity	2 x 3.24 kWh
Weight	129 kg (single battery) or 149 kg (dual battery)

4.2.3 Augmented product

The augmented aspects of the product includes values such as after-sales services, warranty, customer support and the infrastructure that supports its use, including charging and maintenance facilities (Case Company Website, 2023b) (Manthey, 2023) (Doll, 2023a). Below, each of the augmented aspects are presented.

After-sales services

The company offers service agreements for the product, which covers maintenance and software upgrades for all electrical components (Case Company Website, 2023b).

Infrastructure for charging and maintenance

The company has developed Africa's first set of electric motorcycle charging stations (located in Nairobi), offering fast charging capabilities and battery swaps. It aims to support the product's utility, providing infrastructure which makes charging and continuous operation easier (Manthey, 2023).

Environmental benefits

The product has no tailpipe emissions. Together with Kenya's green energy, which stands for more than 80 percent of the energy, the motorcycle has a clear environmental position (Case Company Website, 2023b) (International Trade Administration, 2022)..

Cost savings

The product has lower operational cost compared to traditional combustion engine motorcycles. The lower running costs are due to its electric nature, which requires less maintenance and fewer moving parts with the absence of a conventional fuel system. Therefore, owners can expect a reduction in the total cost of ownership. This aspect is particularly appealing in markets where cost efficiency is a critical purchasing factor. However, it is worth noting that the initial price is higher (Doll, 2023a) (Case Company Website, 2023b).

Connectivity

The company has integrated connectivity features into the product. These features enable real-time monitoring of the motorcycle's status, including location, battery health, and current usage status, which creates value for fleet management and individual owners who value security and operational efficiency (Case Company Website, 2023b).

4.2.4 Summary

The company's electric motorcycle is designed for African markets with focus on functionality, performance and affordability. Currently it is sold to the Nairobi market, and serves the needs as a versatile mobility solution. The motorcycle is used for commercial purposes, such as taxi services, deliveries, and cargo transport, providing an income stream to the drivers. The product features a functional design suitable for Africa's landscape, offering a robust build, and a dual battery system with a range of 75 km per battery and capable of carrying a 220 kg payload. In addition to the product itself, it offers the customer after-sales services, battery charging and swapping stations in Nairobi, lower operational costs compared to their combustion engine competitors and connectivity features for fleet management. In Figure 4.2, the product's core product, actual product and augmented product are showcased.

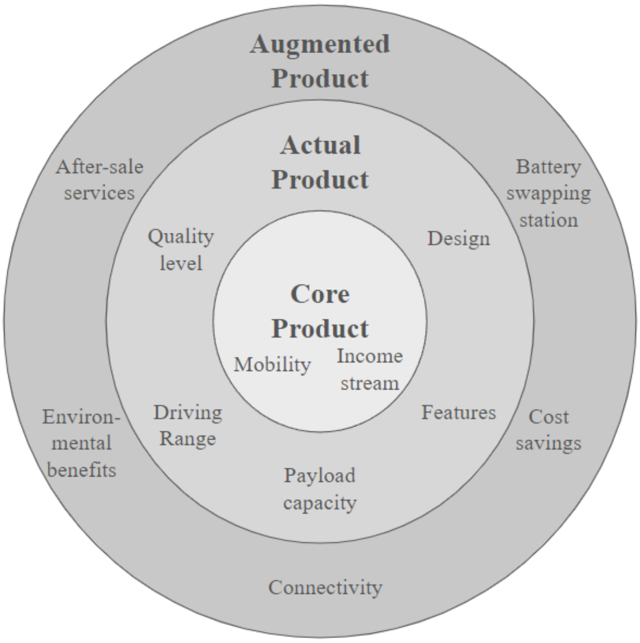


Figure 4.2: The three levels of the product.

4.3 Hill's framework of Manufacturing Strategy

The company's manufacturing strategy integrates its corporate objectives in a distinctive approach where much emphasis has been taken to the African context, both regarding the end-customers characteristics and to the specifics of the product. What makes the product qualify on the Boda Boda market in Kenya is its design and functionality. Since the product is based on the market leading motorcycle Bajaj Boxer BM150, there is a market product fit. Other factors that make the product qualify on the market is its carrying capacity and low maintenance and use costs (Person 1, 2024). Followingly is a closer look, through the lens of Hill's framework, into how the company's corporate objectives, market strategy and manufacturing strategy work together with the goal to create an order winner.

4.3.1 Corporate Objectives

In terms of high-level corporate objectives, the company has two clear goals (Person 1, 2024).

1. Electrifying Africa one vehicle at the time.
2. Become profitable to fulfill the above vision in the long term.

Electrifying Africa one vehicle at the time represents the company's ambition and objective to get as many electric vehicles on the roads in Africa as possible (including a significant amount of the company's products). It is measured by both the total number of electric vehicles in Africa, as well as the number of the company's vehicles delivered to customers. It is an objective that is almost impossible to achieve in practice, but works as a motivator and driving force at the company. The company's profitability objective on the other hand, is clearly defined and measurable. In order to reach profitability, the company needs to produce and sell roughly 2000 products each month (Person 1, 2024).

To achieve their corporate objectives, the company has a clear focus on both absolute and market-share growth. The company aims to continue to grow between 50 to 100 percent yearly, and to become one of the major players on the Boda Boda market in Kenya (Person 1, 2024).

4.3.2 Market Strategy

The company's target market with the product is the Boda Boda market, starting with the one in Nairobi. As mentioned previously, the company's market strategy is to focus on sales through B2B2C, with M-Kopa as the biggest customer. M-Kopa currently stands for about 80 percent of the company's sales, and M-Kopa leases the motorcycle at the price of 450 KES per day for the motorcycle and 250 KES per day per battery, and a downpayment of 25 000 KES (M-Kopa, 2024). This financing model is suitable for both the company and the Kenyan market, since the company wants to focus on product development and many customers do not have enough cash to purchase a product upfront. Besides M-Kopa, the company sells the product to Greenwheel, a leasing company in partnership with Uber, and to other businesses who either lease the motorcycle or use it for other commercial purposes. At the moment, the company is focusing on selling multiple products as fleets to companies. The reason for this is that the product is almost solely used for commercial purposes by the end customer (taxi service, transportation of cargo and personal transportation, for example in security companies) (Person 1, 2024).

The company's main competitors are Ampersand and Bajaj Auto. Ampersand was the first company to make electric motorcycles in Africa, and is the company's main competitor regarding electric motorcycles (Person 1, 2024). They have a similar set-up and offering as the company, with battery swapping stations in Nairobi and financing solutions through M-Kopa (Ampersand, 2024). The main difference between the product and Ampersand's motorcycle is their designs, which can be seen in Figure 4.3 (Person 1, 2024). On the other hand, Ampersand's motorcycle has a lower acquiring cost, with a downpayment of 20 000 KES and the daily cost of 450 KES. The operating costs for Ampersand's motorcycle is 185 KES per battery swap (M-Kopa, 2024).

Bajaj Auto and the company offer motorcycles with similar characteristics, since the product's design is based on the Bajaj Boxer BM150. Bajaj is the largest player on the motorcycle market in Kenya (MCD Team, 2024). The main difference is that the product is electric and the Bajaj Boxer BM150 has a combustion engine (Person 1, 2024). Therefore, the operating costs for the Bajaj Boxer BM150 (and other combustion engine motorcycles) are higher than for the product (Case Company Website, 2023b). The market price for a Bajaj BM150 from 2019-2023 ranges between 60 000 - 100 000 KES (Jiji, 2024). Figure 4.3 showcases the Bajaj Boxer BM150, Ampersand's electric motorcycle and the product.

Figure 4.3: Bajaj BM150 (top), Ampersand's electric motorcycle (bottom left) and the case company's product (bottom right) (Bajaj, 2024) (Case Company Website, 2023b) (Ampersand, 2024).

All in all, the company's position in the Boda Boda market is to offer an electric motorcycle that is as practical and durable as the Bajaj Boxer

BM150. The company sees themselves as the leader in product innovation in regards to developing and designing an electric motorcycle from scratch, specified for the African market. The other electric motorcycle companies active in Kenya buy all their components straight off the shelf from suppliers in China in complete knockdown kits, with no in-house design and development of the components (Person 1, 2024).

The company has a small market share in Kenya. In 2023, the company manufactured around 800 products, while in total 68 835 new motorcycles were sold in Kenya the same year (Person 1, 2024) (MCD Team, 2024). The company does not currently have any demand constraints for the product in relation to its manufacturing. Even though it may not be an intended strategy, it results in the company producing to order. At the moment, the factor that is putting constraints on the production and sales volume of products is financing. However, M24$ in financing was secured in February 2024, which will allow the company to scale further. In 2024 and the upcoming years, the company expects to increase their sales' volume multifold (Person 1, 2024).

4.3.3 Manufacturing Strategy

The company sees themselves as a product oriented company, which also performs assembly out of necessity. Therefore, in regards to the manufacturing strategy, it is important to understand that the company's goal is not to be seen as a manufacturing company. Consequently, the company wants to upstream as much of sub assemblies and other manufacturing processes as possible to the suppliers (Person 1, 2024).

Furthermore, it is important to recognize that the assembly process only makes up a small fraction of the manufacturing cost per motorcycle (between 2 and 5 percent). For that reason, the cost of the assembly process is not a main concern for the cost of the motorcycle. However, the capacity of the assembly can still be a critical factor (Person 1, 2024).

4.3.3.1 Process choice

The company has chosen to use a manual assembly line process in their manufacturing. There were several reasons for it. Firstly, the company purchases components that are ready for assembly and subassembly straight away. Secondly, the activities that are needed to assemble the components to a finished product are simple, and consist mostly of screwing components together using bolts and wrenches. In addition, the process choice was also affected by the expected volume, the product's characteristics and the market that the company competes in. As stated previously, last year the company manufactured 800 products, and is planning to multifold the volume in the upcoming years. The product is standardized, with few customization options. Lastly, line processes have been used in assembling automotives for the last 100 years, and is the industry standard (Person 1, 2024).

In addition to the assembly line process, there are subassembly stations that feed components into the main assembly line. There are in total 44 subassemblies outside the main line. As mentioned previously, the company's goal is to get rid of the subassemblies. However, they are still necessary to make all the components fit on the product. The reason for this is closely correlated with the company's broader manufacturing strategy. As stated above, the company sees themselves as a product oriented company, and therefore wants minimal in-house resources on activities such as component modifications (Person 1, 2024).

4.3.3.2 Infrastructure

The company is using a classification system for their raw material stock, which depends on each component's cost and importance for the product. The system consists of four classifications, from A to D (Person 1, 2024):

A. Class A consists of the three most expensive components: frame, motor and battery. Together, they stand for 60 percent of the inventory costs and need C-suite approval to purchase. The frame is the most complex component, as it requires special tooling which brings a long lead time. Motors are expensive and consequently not too many are kept in stock. However, the battery is the most expensive item, but it is easier to scale the usage.

B. Class B components are relatively expensive and difficult to source. the company is actively working to reduce this number, and has done so. From 30 to the current number of 18.

C. Class C inventory consists of cheaper components that are easy to buy and less expensive. One example is the seats.

D. Class D inventory are heavily standardized items, such as bolts. Class D items make up in total around 5 to 10 percent of the component cost of a motorcycle.

The classification system helps the company to keep track and control of the most expensive and crucial components of the product. In other words, the company is using Pareto analysis for their operational inventory.

The company has two sets of control of quality. The first one is the incoming quality check (IQC). This process refers to the control of the newly received components, prior to assembly. After the product has been assembled, there is an outgoing quality check (OQC) to make sure that the motorcycle is working as it should. After the product passes the outgoing quality check, the product will be delivered to the customer. However, the products that M-Kopa is purchasing have to go through an additional quality check at M-Kopa's facility. If it fails, the product will be sent back to the company and have to go through a rework process (Person 1, 2024).

At the moment, the company is reactive in their quality control, focusing on detecting issues with the components. The main reason for it is that certain suppliers do not deliver components with sufficient quality. For example, the company inspects 100 percent of batteries, motors and frames, which takes a long time. The company wants to move away from being reactive, to being proactive. To succeed with that, the company wants to improve their relationship with their suppliers, to make sure that the incoming components do not need to be tested to the same extent as they are today. In addition, the scrap from the low quality components make up a significant cost for the company. As a result, the variation of quality for the components requires the company to spend additional resources and time (Person 1, 2024).

It is the head of each department (for the different processes) that carries the responsibility for when the quality level of either components or the product is not met. The company's ambition is to involve everyone, from the floor to the top, in all departments in the quality work, and to share the responsibility (Person 1, 2024). The department with the most impact on the overall quality is the procurement team, since their task is to find the right supplier who can deliver quality components. A low quality component affects the whole assembly process, outgoing quality check and in the end delivery to customer. Finding the ideal supplier is easier said than done and is one of the many things the procurement team is working on (Person 1, 2024).

4.3.4 Summary

The company's manufacturing strategy integrates its corporate objectives through a focused approach to both the market and the processes within the context of the African electric vehicle sector. The overall objectives of the firms, as described by Person 1 (2024), are focused on both the electrification of Africa as well as achieving profitability, with more specific targets for production in order to drive market penetration and financial sustainability.

The company has a manufacturing strategy where a product-oriented approach is taken over a process-centric model. Through this, the company is working on upstreaming subassemblies and minimizing in-house assembly costs to maintain focus of the product and enable financial sustainability.

The market strategy is made to suit the Boda Boda market, which is done through a B2B2C model that enables the end-customer to lease the motorcycle without the company acting as a financier. This approach has been chosen to adapt to the purchasing capabilities of the target demographic, while enabling product accessibility and thereby market expansion. Furthermore the competitive positioning of the product is strategic, highlighting the unique design, tailored to the African context. In Figure 4.4, these specific characteristics are highlighted in Hill's framework.

Market → ← Production

Corporate objectives (4.2.1)	Market Strategy (4.2.2)	How do products qualify and win orders in the marketplace? (4.1.4)	Manufacturing strategy (4.2.3)	
			process choice (4.2.3.1)	infrastructure (4.2.3.2)
- Electrifying Africa one vehicle at the time - Become profitable - Yearly growth between 50-100%	- Boda Boda Market (starting in Nairobi) - Commercial usage - B2B2C (leasing). - 800 Roam Airs produced 2023, increases multifold in 2024 - High standardization - Only electric motorcycle designed for the African use case	- Based on the market leader's design (product market fit) - High carrying capacity - Low maintenance and usage costs	- Line process with subassemblies stations - Aims to only assemble components, no modifications - 44 subassemblies fed into the main line	- Reactive quality control - Incoming quality control for components - Outgoing quality control for Roam Air - Cost and importance classification of inventory - Pareto analysis of inventory

Figure 4.4: Hill's framework applied to the company. The numbers underneath refer to the more detailed descriptions of the chapters in regards to the company. For the theory, see chapter 3.

4.4 Map the value chain

In order to cater for the needs of identifying the functions described in Hill's framework in relation to the structuring of activities in an organization, Porter's Value chain is used. Following, in chapter 4.4.1 are the support activities within the company's organization presented and thereafter in chapter 4.4.2 the primary activities are described to provide an understanding of where value is created within the organization.

4.4.1 Support activities

Firm infrastructure

The company’s organization is divided into different functions, such as product development, procurement, production and quality assurance team. Some of the teams are supporting merely one primary activity, while others support several (Person 1, 2024). For example, the quality assurance team is active in inbound logistics and operations, as well as communicating with M-Kopa about faults of delivered motorcycles (Person 2, 2024).

Human resource management

Human resource team supports the primary activities with recruiting the right people and administration regarding employees (Person 1, 2024).

Technology development

The company’s product engineering team designs the product and sets specifications. It is an iterative process, and the team is continuously re-designing new parts to make the assembly process more efficient. Currently, the product consists of 258 components (Person 1, 2024).

Procurement

The company currently has around 40 suppliers. Minimum order quantities vary a lot between the different suppliers and so does the quality, with some suppliers the quality meets expectations whereas with others it falls short. Generally, there is a bulk discount applied and with local suppliers there is usually a 30 day credit. However, with Chinese suppliers, which are some of the major ones, 20 percent is paid when an order is placed and the remaining 80 percent when the components are shipped (Person 1, 2024). Furthermore, it is worth noting that currently, there are no established accepted quality levels (AQL). There is also limited feedback to the supplier from the quality controls which leaves somewhat of a gap between what quality that is expected and delivered. With two suppliers there have been established a good connection with feedback from the quality department and with those two suppliers the quality of the delivered goods have improved a lot (Person 2, 2024).

4.4.2 Primary activities

Inbound logistics

The company receives the goods to their facility by trucks, which is then unloaded into the workshop. Before the components are loaded into the warehouse, they undergo an IQC. The extent of testing depends on the component. When components have passed the IQC, they are being placed on shelves in the workshop by a forklift. As previously stated, the raw material inventory is classified from A-D, depending on cost and importance for the build (Person 1, 2024).

Operations

As presented in 4.2, the company's operations consist of a manual line process, with subassemblies stations feeding assembled components to the main line. After a subassembly, each subassembly component goes through an IPQC before it is ready for the main assembly line (Person 2, 2024). In the main assembly line, each procedure is standardized and the line consists of eight assembly stations with in total five in process quality controls. When the product is fully assembled, there is a static quality control where the product is tested as an integrated system before it is sent to the OQC. If a motorcycle fails any of the IPQCs it will be passed on to the repair station. In the repair station, the procedures are not standardized and instead the mechanics proceed on freehand to fix the reported problem (Person 2, 2024). Each of the eight stations have a tact time of 15 minutes which ideally results in one assembled product every 15 minutes (Person 4, 2024).

After a product has been completed, it goes into an OQC (outgoing quality check). If the motorcycle does not pass the OQC, it will be sent to rework where the issue will be fixed. The OQC is a highly standardized process which consists of both ocular sections (assures the non existence of scratches and the correct mounting of for example the windscreen), technical sections (for example tests of display functions and battery) and practical sections (driving and capacity tests). If the motorcycle passes the test, it is ready to be shipped to the customer. However, M-Kopa, the company's largest customer, conducts an additional OQC (M-Kopa's IQC) at the company's facility. M-Kopa is not paying for a motorcycle until they have passed their own quality check (Person 1, 2024). The product sometimes fails both because of low quality components and of faulty assembly (Person 5, 2024).

Outbound logistics

When a product has passed the OQC, it is placed in a designated area in the company's workshop until it is being sent off to the customer. M-Kopa comes to the workshop once a week to pick up the motorcycles that are ready to be delivered to the end customer (Person 1, 2024). As stated earlier, M-Kopa only pays for the motorcycles when they have passed their own OQC. This extended lead-time, together with the Chinese suppliers not giving any credit, results in an average of 45 days between the company paying for components and receiving payment from the sales (Person 1, 2024).

Marketing & Sales

Regarding the sales and marketing that the company conducts, the marketing is largely adapted to the sales-model the company has, which is B2B2C. This sales approach is achieved through selling the motorcycles in bulk to financing companies and thereby partnering with entities such as M-Kopa and Greenwheels. This is largely reducing the financial barrier to purchase a product for the end customer, hence making the motorcycles more accessible, as well as enhancing the value proposition. Thereby, the company also allows for marketing to go via these partners, however the company actively works to maintain a relatively strong media presence (Person 1, 2024).

In summary, the marketing and sales activities are intricately adopted to cater the needs of the B2B2C sales-model, making the motorcycles available to a wider audience while considering the commercial use of the end-consumer. This approach strengthens the overall value chain by selling in larger volumes (Person 1, 2024).

Service

The company provides service agreements for their customers which covers maintenance and software updates for the product (Case Company Website, 2023b). Additionally, the company Hubs in Nairobi, the company's motorcycle charging network, provides fast charging and battery swaps for product owners (Manthey, 2023). Furthermore, the product's connectivity system allows owners to monitor their motorcycle's status in real-time, including its location and battery health (Case Company Website, 2023b).

4.4.3 Summary

The company's value chain is illustrated in Figure 4.5. It is an overview of the flow of the value activities at the company. Figure 4.5 illustrates where in the organization many of the critical activities take place. Inbound logistics and operations are the two areas relevant for the purpose, however the activities are all interconnected which is critical to understand.

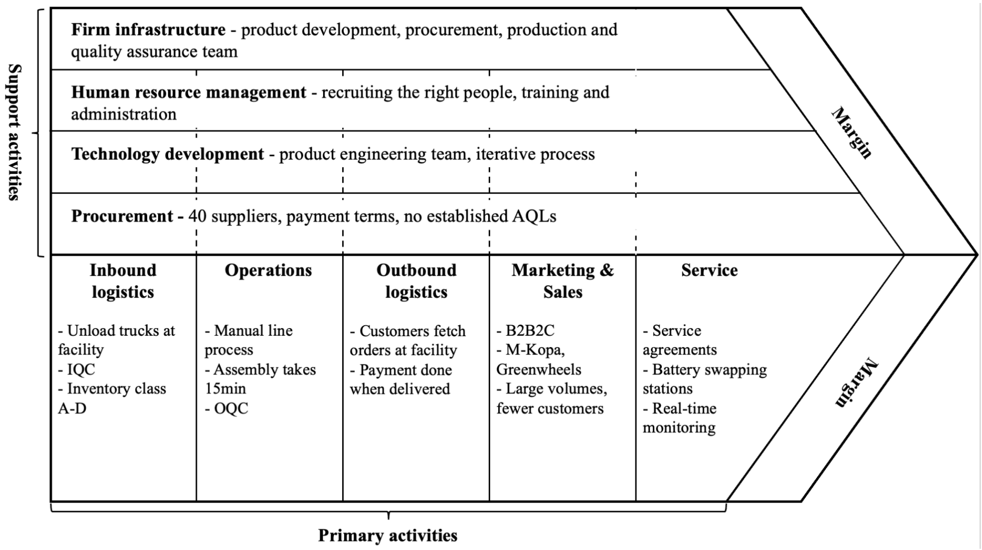


Figure 4.5: Porter's value chain applied to the company.

4.5 Process flow

When an understanding of the activities has been created through the description of support and primary activities in Porter's value chain, a low-level approach where each activity is described and mapped is needed. This approach is done by utilizing the theory of Ljungberg & Larsson which provides a framework for an in-depth mapping of a specific process, which allows for creating an understanding of each process. The main processes in incoming logistics and operations are showcased in Figure 4.6 and are further described followingly.

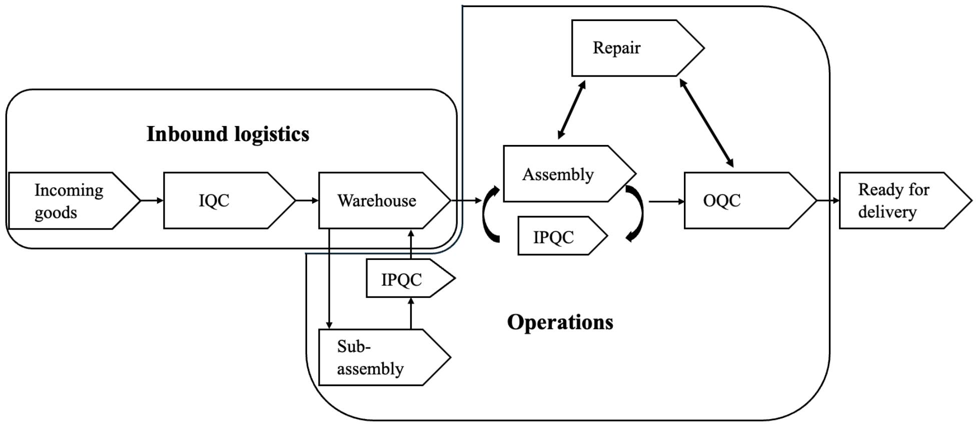


Figure 4.6: Main process map for inbound logistics and operations.

The components are delivered by the supplier to the company's workshop. At arrival, it is unloaded into the facility (Person 3, 2024). Then the components go through the IQC. The sample size and extent of testing depends on the different components. Components that pass the IQC are moved to the warehouse, while the ones that fail the IQC are either placed in a special area of the warehouse, or are transported to the basement for modifications (Person 2, 2024). From the warehouse, some components are retrieved to the subassembly stations (Person 3, 2024). After they have been assembled, they go through an IPQC. If the newly assembled component passes the IPQC, it is sent back to the warehouse. Then, components are taken from the warehouse and moved to the assembly process, where the product is completed. The main assembly line has eight assembly stations and five IPQCs (Person 4, 2024). After the motorcycle has been fully assembled, it is moved to the static test. The static test involves quality checking the integration of all components and if they work properly together. If a product fails the static test, it is sent to repair where the issue will be fixed. When a motorcycle has passed the static test, it continues to the OQC. The OQC consists of driving, capacity and strength tests. When a product passes the OQC, it is ready for delivery. However, when the customer is M-Kopa, they do their own static test and OQC that each motorcycle has to pass before being delivered to the end customer (Person 2, 2024).

4.5.1 Inbound Logistics

4.5.1.1 Incoming goods

The first step of the inbound logistics is the subprocess of incoming goods, which is illustrated in Figure 4.7. A closer look at the activities that together form the subprocess of incoming goods are showcased in 4.8. Firstly, the goods are unloaded from trucks at the company's workshop. After it has been unloaded, the goods need to be identified. They always have a corresponding purchase order in the ERP system, which must be identified with a reference number. After the order is identified, the goods are confirmed in the ERP system as received. Worth noting is that the company is using their own reference number for an order and not the part number from the supplier. Therefore, the process of reordering the same components becomes more difficult. Furthermore, the purchase order is conducted by the procurement team who get the component specifications from the product development team (Person 3, 2024).

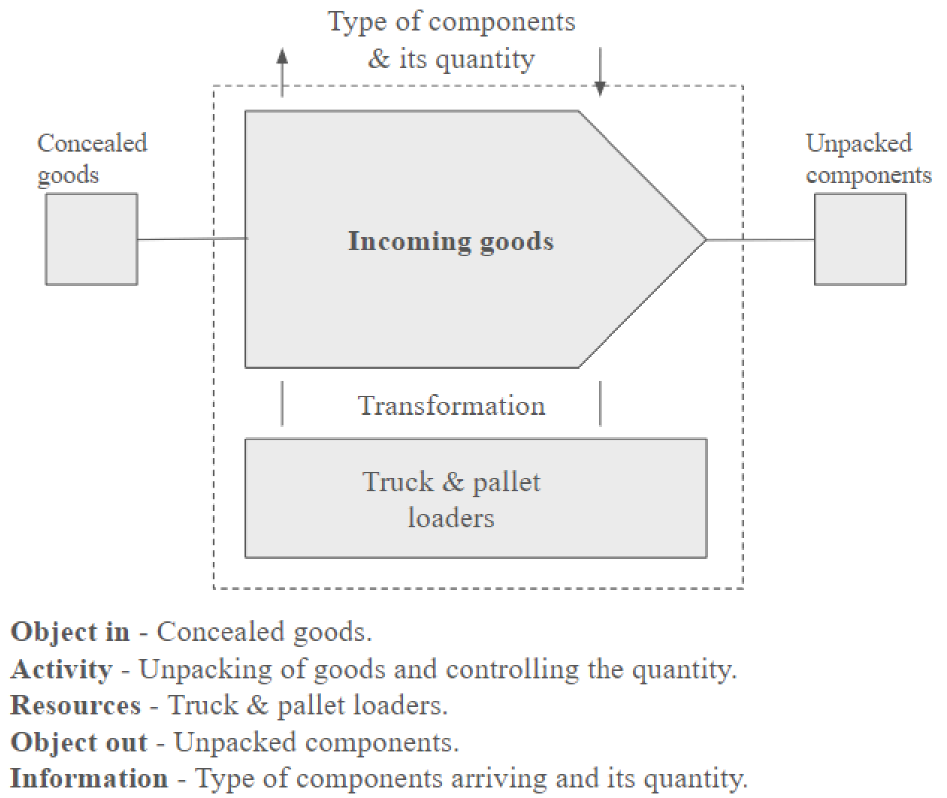


Figure 4.7: A description of the subprocess: incoming goods (Person 2, 2024).

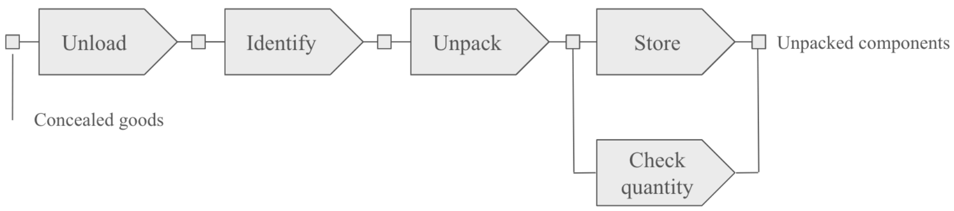
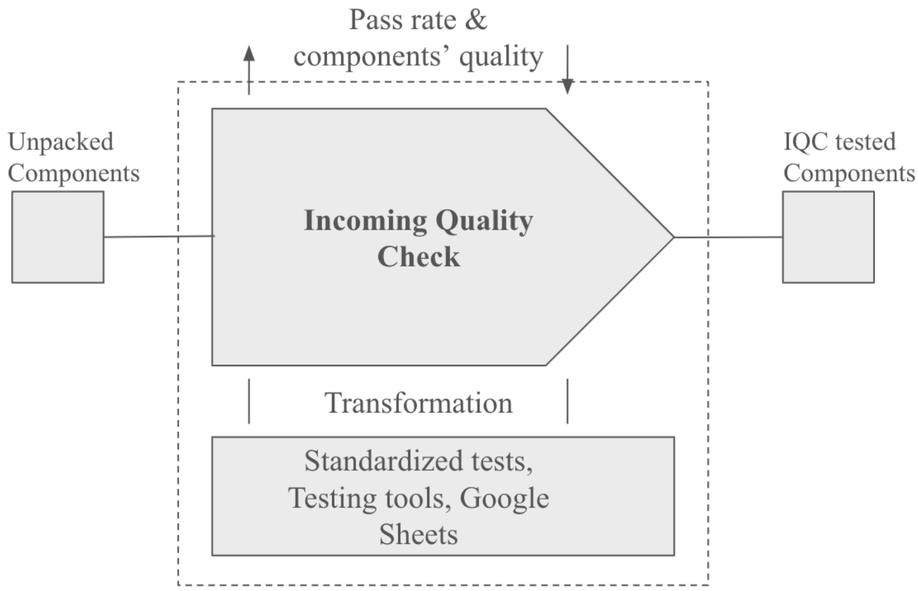


Figure 4.8: The activities that form the subprocess: incoming goods (Person 3, 2024).

4.5.1.2 IQC

The IQC is a vital process which aims to ensure that all the parts that proceed to the warehouse are up to standard. Depending on which component that is concerned the process can vary a lot. Both the material planning team and the main line is heavily dependent on the IQC. Hence it is specifically important to notice the information flows (Person 6, 2024). In Figure 4.9 an introduction is given to the IQC with a description of the subprocess. In Figure 4.10 the subprocess is divided into each of the activities that occur in the IQC. Each of the separate activities are then described in detail.



Object in - Unpacked components.
Activity - Incoming quality check. Varying tests depending on component.
Resources - Standardized tests, Testing Tools and Google Sheets.
Object out - Tested components. Goes either to warehouse or quarantine.
Information - Components' pass rate and level of quality.

Figure 4.9: A description of the subprocess: Incoming Quality Check (Person 6, 2024).

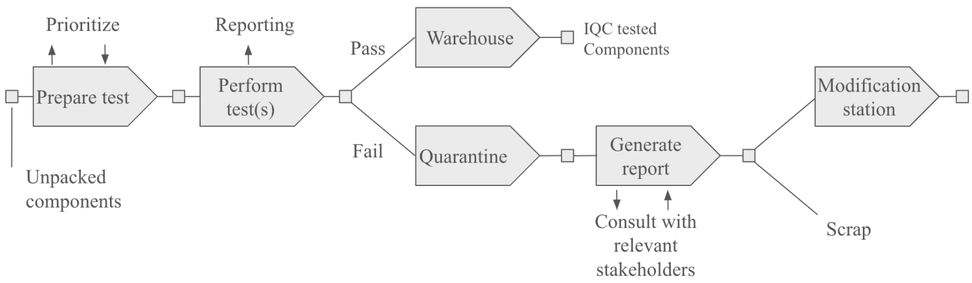


Figure 4.10: Activities involved in the IQC (Person 6, 2024).

Prepare for testing

The first activity in the IQC is to prepare testing of newly arrived components. When the company receives a shipment, it is not always certain which components that are arriving and usually shipments contain several different components. A reason for this uncertainty is that sometimes the company does not have a purchase order number or a packing list for the arrived shipment. For IQC to know which components they should start testing, they need to know the components' priority. Therefore, the goods need to be unpacked and identified before the IQC can be done. The priority of the components depends on stock level and the demand from the production. IQC gets the prioritization list from the material planning team, and it is communicated to them either by face to face or on Slack. As a result, the IQC needs to wait for the material planning team to inform them with a prioritization list of what to prioritize before they can start testing, which causes an extended lead time for the IQC process (Person 6, 2024).

When the IQC knows which components they will be testing and the order of them, they can start preparing for the tests. This includes fetching the right tools, preparing for documentation and staffing the right technician for certain components (since the staffs' expertise differs). However, sometimes insufficient time is left for the preparation because of lack of planning. This as well can lead to extended lead time in the IQC process (Person 6, 2024).

Perform test

The IQC tests all of the different components, but the extent of the tests differ. The share that is tested is currently totally dependent on previous test results, for some components that are of special importance to the build such as the battery, the frame and the swingarm, IQC tests all of them. The methodology for these tests are presented in table 4.2. For others, the IQC tests a certain percentage depending on its nature and supplier. If for example 10 percent of a batch are tested and two are found faulty then 30 percent in the same batch needs to be tested and if another faulty item is found, then the whole batch is tested. The tests are standardized for all components. During the testing of a component, each parameter that is being measured is documented in Google Sheets. If a component passes all the tests, it is sent directly to the warehouse, and noted in Google Sheets that it passed the tests. If a component fails on one or more parameters, they are sent to quarantine (a temporary storage). The failure is also noted in Google sheets. (Person 6, 2024).

Table 4.2: The testing methodology for three of the most difficult yet important components to test (Person 6, 2024).

Battery	First there is a visual inspection. Then there is an initial charge of the battery to 100 percent which takes 2h15min. The battery is then discharged to 0 percent which takes 2h. The battery is then left to cool, and then charged to 50% for storage which takes 1h15m. When this is done the testing machine which reads the data from the battery, transmits data to the cloud. Sometimes trackers do not succeed in sending the data to the cloud (stops and starts again) which is most often due to lost network connection. For those batteries, they need to redo the whole process of battery testing again. This phenomenon affects about 70-80 of 500 batteries.
Frame	The frame is a demanding and time consuming item to test. To be able to test some alignments and mounting points, components such as the motor and swingarm need to be mounted. Thereafter the measurements are taken. Then those parts need to be removed before the component is moved to the warehouse. Despite this demanding testing procedure some alignments are still not possible to test in accordance with the current methodology.
Swingarm	The swingarm is first tested with a jig thereafter measurements are taken to ensure the fit. However this jig and the measurements still cannot ensure all alignments.

Reporting

If a component fails the IQC the responsible technician will start writing an initial report on what was wrong with components from a certain shipment. At this stage of the report, an overview of pass rate and the nature of the faults will be presented. Then it will be sent to the procurement and technical team on Slack, to inform them what the IQC have found (Person 6, 2024).

Decision pass or fail

Components which pass the test proceed to the warehouse and components which fail continue to quarantine while awaiting a decision. The pass rate depends on the different components, however it is for many components problematic and frequently bad quality batches of components arrive at the company (Person 6, 2024).

Quarantine

The quarantine section is located in a locked area in the basement, while waiting for the decision to either be scraped or modified. However, parts from the quarantine sometimes make it into the assembly line before a decision has been made about what to do with the component. One reason for it is due to miscommunication. The information that a component has failed the IQC is, as mentioned, only in the google sheet but not in the ERP system. Hence in the ERP system that the material planning team and procurement look in, the component does not seem to have any defects. Then, material planning goes down to the quarantine and picks those components, even though the components should not be in the assembly (Person 6, 2024).

Generate full report

For all the failing parts a full test report is generated. At this stage the report is expanded in order to investigate the defect further, and contains among other information, supplier, batch number, who conducted the test, what characteristic of the component that has failed and photos which include detailed information with the dimensions of all the faults (Person 6, 2024).

Consultant with stakeholders

When the test report has been generated, relevant stakeholders need to be informed. The report is discussed to understand what has gone wrong and how to proceed with the component. The meetings typically include the procurement team, IQC and the material planning team. Then there will be a decision whether they go to the modification station or in quarantine forever. The procurement team is also responsible for the contact with the supplier in order to solve the defect for future deliveries (Person 6, 2024)

4.5.1.3 Warehouse

When components have passed the IQC, they are moved with a forklift to the warehouse. In the warehouse, components are loaded to specific positions which are designated for them. At the same time, the components are registered in the ERP to be in stock. The component is stored until the ERP system is triggered by a production order, which informs the warehouse workers that a certain component needs to be retrieved from the warehouse. The component is either moved to the subassembly or the main assembly line, depending on its nature. If a component goes to the subassembly line, the sub-assembled components will then be moved back to the warehouse and stored there, until the ERP system informs that the sub-assembled component is needed in the main assembly. The ERP system informs the warehouse workers to which station in assembly and subassembly the components should be moved to. In addition, it keeps track of the quantity of components in the stock (Person 3, 2024). However, components that did not pass the IQC are occasionally stored in the warehouse (and are available to the ERP system since faulty components are noted in Google Sheets). As a result, low quality components are fed into the assembly line, which makes a product to fail IPQC, static test or OQC (Person 4, 2024). In Figure 4.11, the subprocess description of the warehouse is showcased and in Figure 4.12, all the activities in the warehouse are highlighted.

The picking process in the warehouse is not following the first in first out principle, which can cause issues in the assembly line. For example, if the motor’s bolt holes change from 35mm to 37mm, bolts will be ordered with the new dimension as well (from 35mm to 37mm). However, both the new motor and the new bolts will be stored in the same section of the warehouse as their predecessor. In addition, when there are dimensional changes, sometimes the part number will be the same. When the ERP system then informs the warehouse personnel to pick the motor and the bolts, they do not follow the first in first out principle. As a result, a motor with the old hole dimensions of 35mm can be picked, and the new bolts with the 37mm dimension. A consequence of this is that the assembly personnel will not be able to mount the motor since the bolts do not fit. Then the partly assembled product will be sent to the rework station and the components will be flagged as faulty (Person 6, 2024).

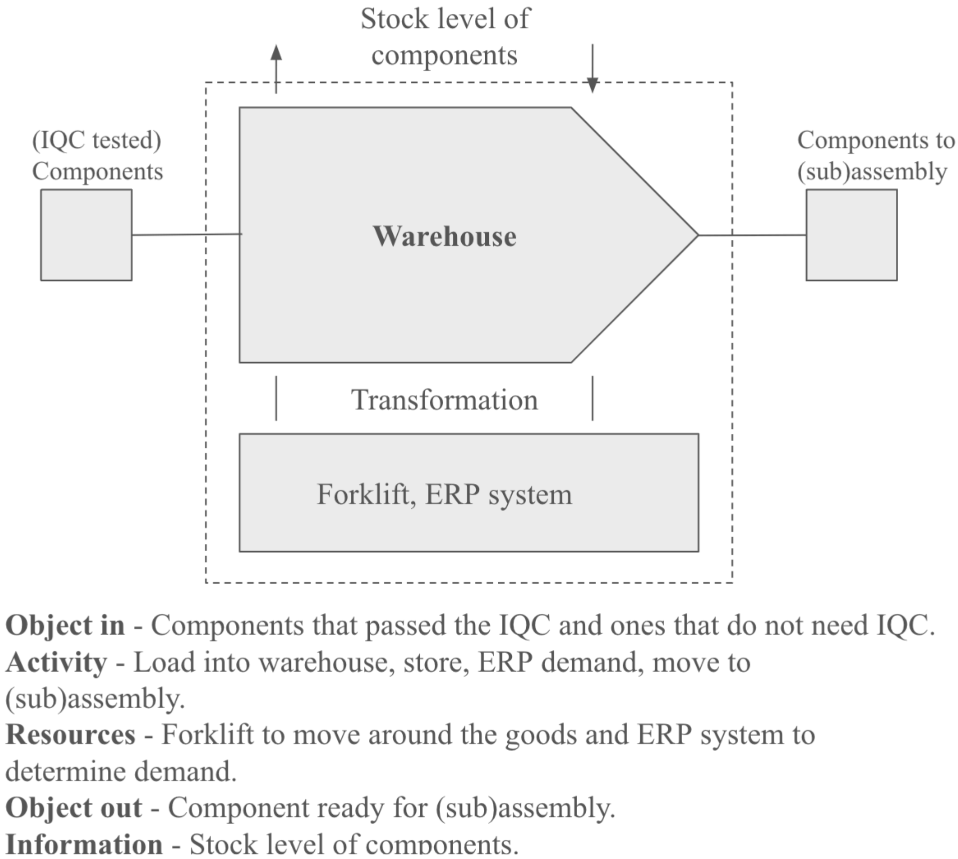


Figure 4.11: A description of the subprocess: warehouse (Person 3, 2024).

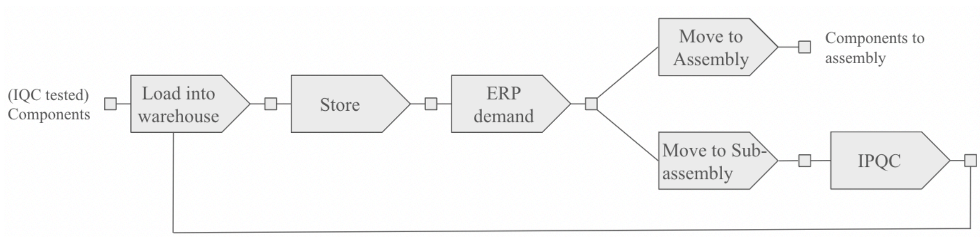


Figure 4.12: Activities involved in the warehouse (Person 3, 2024).

4.5.2 Operations

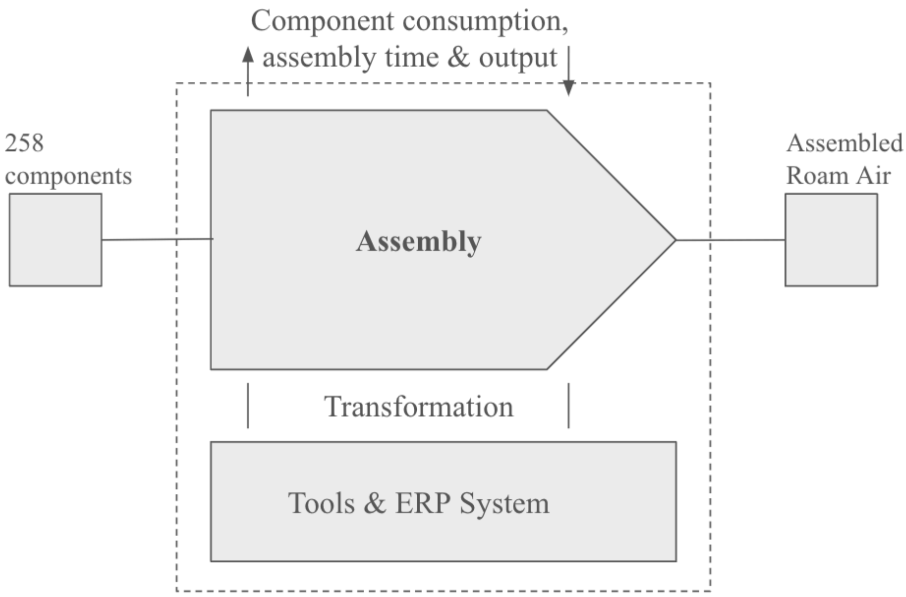
4.5.2.1 Assembly & subassembly

The assembly is the core of all the processes and the subprocess description of the assembly is showcased in Figure 4.13. Figure 4.14 resembles a description of the assembly activities. The assembly process consists of eight stations where in total 42 actions are conducted (Person 4, 2024). Each station has a set time frame of 15 minutes to complete the designated tasks. The assembly consists mainly of screwing together components with bolts (Person 1, 2024). After assembly station 4-8, there are IPQCs (in process quality checks) which consist of standardized testing of the product while it is being assembled. Production orders are created in the company's ERP system for the assembly of the products. It helps the company to plan the assembly with things such as component scheduling and time frame per station.

In addition to the eight stations in the assembly line, there are eight subassembly stations where 44 subassemblies are made (Person 1, 2024) (Person 4, 2024). As for the main assembly line, the production orders are made in the ERP system to manage the flow of production. For the moment, the subassemblies are made to stock, but the company's goal is to have them fed into the main assembly line. After each subassembly, there is an IPQC to determine if the newly assembled component has the right quality (Person 4, 2024). Figure 4.15 showcases the subassembly activities.

Currently the assembly of a product is sometimes started when the stock levels of the bill of material (BOM) is not enough. This is mainly due to two different reasons. One reason is the startup nature of the company. The startup nature can show in many different ways, one example is not having rigid supply chains which can leave gaps for when goods are delivered. The missing component is then mounted afterwards instead of waiting for a full BOM. Another reason is because of miscommunication. This includes when the ERP system informs the production of a certain stock level, when in reality, some components are not available since they did not pass the IQC (which is not available in the ERP system). When this occurs, the product with incomplete BOM eventually is going to reach the repair station due to missing parts (Person 4, 2024).

Currently, a way to report faults during the assembly directly in the ERP system is under implementation, however these faults are still reported in what way they occur and their frequency, but this reporting function is outside of the ERP system. Furthermore, when a product leaves the assembly line to the repair station, this is noted in the ERP but it is only in iAuditor that the actual faults are reported (Person 4, 2024). iAuditor is an audit and analytics platform which structures and categorizes data which enables the company to keep track of specific builds (Person 2, 2024).



Object in - 258 quality tested components.
Activity - 8 assembly stations.
Resources - Tools and ERP System that schedule production and component demand.
Object out - A newly assembled Roam Air.
Information - Component consumption, assembly time and output of Roam Airs.

Figure 4.13:A description of the subprocess: assembly (Person 4, 2024).

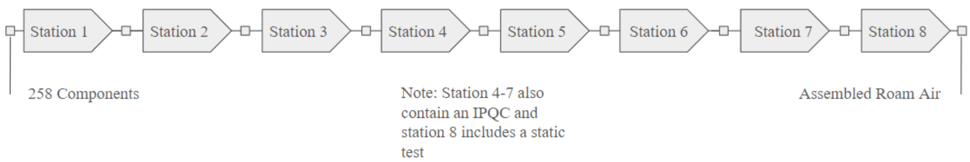


Figure 4.14: An activity description of the assembly (Person 4, 2024).

Figure 4.15: An activity description of the subassembly (Person 4, 2024).

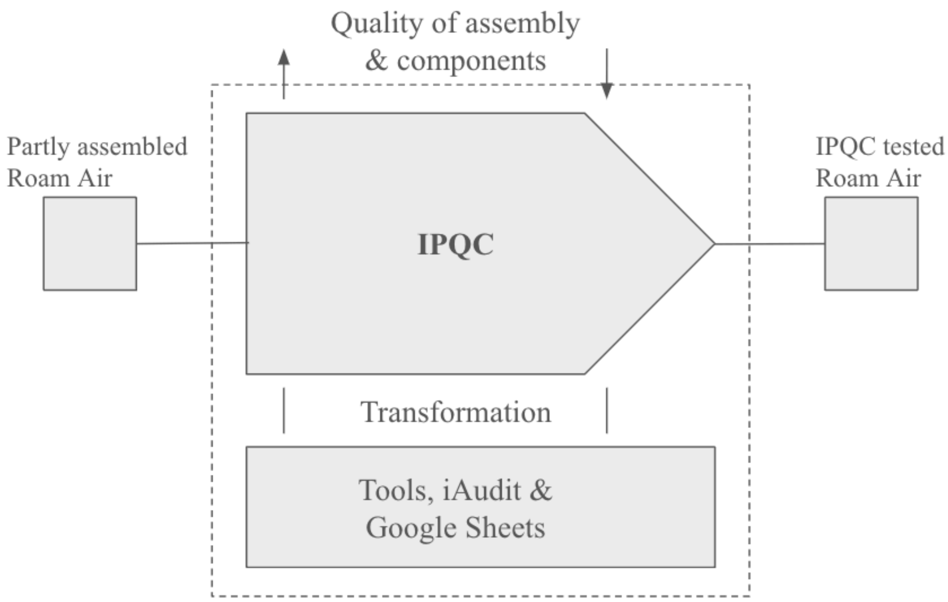
4.5.2.2 IPQC

The IPQC's purpose is to make sure that the quality of the assembly and components are consistent throughout the subassembly and assembly process. Currently, there are IPQCs station after assembly station 4-8, and IPQC after each subassembly (Person 7, 2024). Station eight is a static test, where the integration of all the components are tested. In Figure 4.16, IPQC's subprocess description is illustrated. Figure 4.17 showcases the description of IPQC activities in the assembly line, and Figure 4.18 represents the description of the IPQC activities in the subassembly.

For the IPQCs in the assembly process, there are standardized tests of the product while it is being assembled. It includes measuring parameters such as the handlebar is mounted with the correct angle, right pressure in the tires or if parts are missing. The average time for an IPQC in stations 4-7 is 7 minutes (Person 7, 2024). The static test after station 8 is more thorough and takes 15 minutes. The test itself is similar to the static test in the OQC, which is further described under 4.4.2.2. (Person 2, 2024). If a fault is detected during the IPQCs, there are three options for the line manager which depend on the nature of the fault. If it does not hinder the continuation of the assembly, the product will be moved to the next assembly station. For example, it could be that the angle of the foot rest is incorrect. After the product has completed the assembly line, it will be moved to the repair station and the issue will be fixed. If the fault causes problems in further assembly and can be fixed within 15 minutes, the motorcycle will be moved to a floating station. At the floating station, there is a technician who will try to fix the fault, and then get the motorcycle back into the assembly line. The third option is to remove the product out of the assembly line completely and move it to the repair station. This will be done if the fault can not be solved within the 15 minutes time frame (Person 7, 2024).

For each product that does not pass the tests in IPQC, its faults are noted in a Google Sheets. After a day of production, the data will be analyzed. The company is using Pareto analysis to identify the most common faults of the day. If the fault is regarding the assembly, the IPQC team will inform the production manager. Then, the production manager will take the necessary actions to make sure the fault does not happen again. If the fault is regarding the quality of the components, the IQC team will be informed. IQC will then flag the faulty components and put them in quarantine. Those components will then go through the quarantine process (see Figure 4.10 in 4.5.1.2 IQC) (Person 7, 2024).

The processes of the IPQC after the subassemblies are similar to the ones in the assembly line, but without reporting the results to the production team. Currently the IPQC team sample tests the subassembled component, with an average of 23 percent per batch. However, there are no floating stations. Instead, the components that do not pass the IPQC will be put in a quarantine bin in the warehouse, and then they will go through the quarantine processes again (Person 7, 2024).



Object in - Partly assembled Roam Air.
Activity - In process quality check of components and assembly.
Resources - Tools needed for testing and measuring. Faults are noted in Google Sheets.
Object out - IPQC rested Roam Air.
Information - The quality of the assembly and the components.

Figure 4.16: A description of the subprocess: IPQC. Object in and Object out in the Figure is for the IPQC in the Assembly. For Subassembly, the Object in is Untested subassembled component and Object out is IPQC tested subassembled. The other parameters are the same for both Assembly and Subassembly (Person 7, 2024).

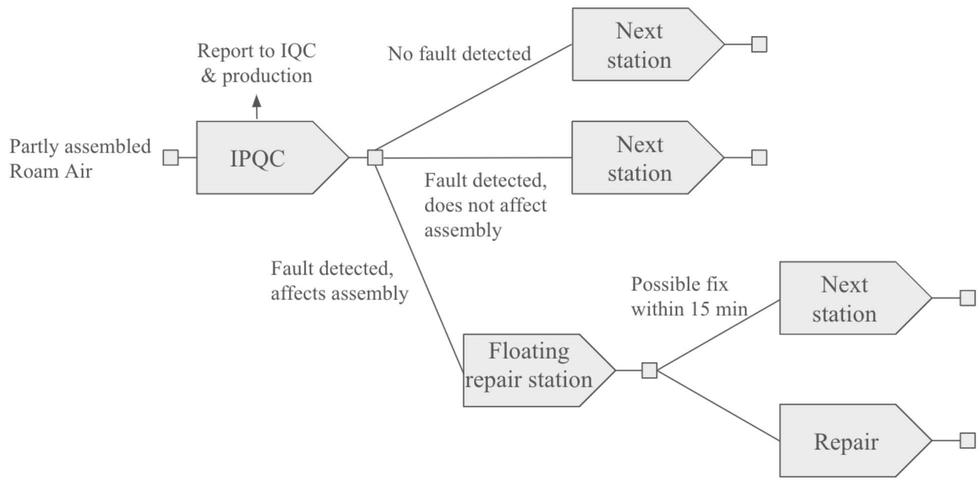


Figure 4.17: An activity description of the IPQC after station 4-8 in the assembly (Person 7, 2024).

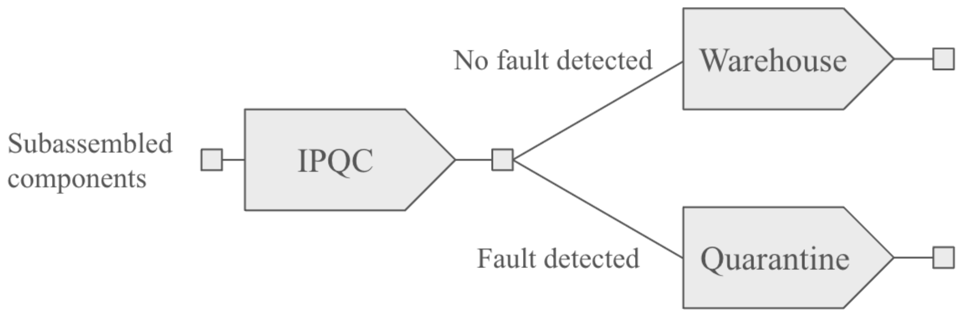


Figure 4.18: An activity description of the IPQC after the subassembly, note that the quarantine location for the subassembled parts often differ from the quarantine for the regular components. (Person 7, 2024).

4.5.2.3 Repair

The description of the repair subprocess can be seen in Figure 4.19, with a more detailed description in Figure 4.20 which highlights the individual activities that are conducted. Although this process flow may seem straight forward, it is far from standardized, which is due to the nature of the faults which are typically not the same. The process of repairment is thereby a dynamic process which changes swiftly and according to the problem. There are no IPQCs in the repair process but once the repair has been resolved it will be inspected and then moved on to the static test or back to the main assembly line (Person 4, 2024).

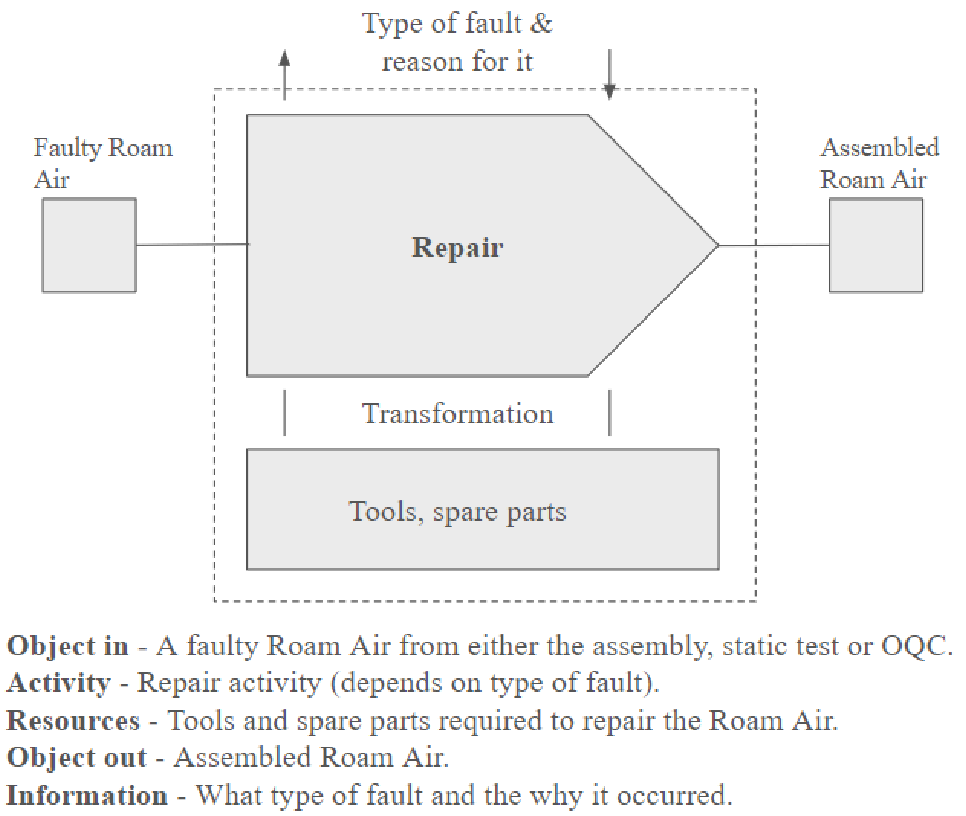


Figure 4.19: A subprocess description of the: repair (Person 4, 2024).

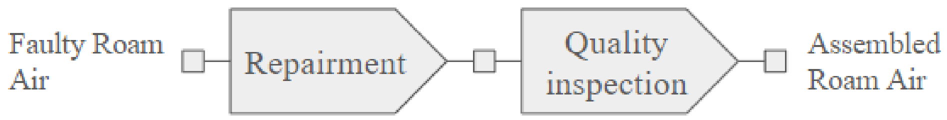
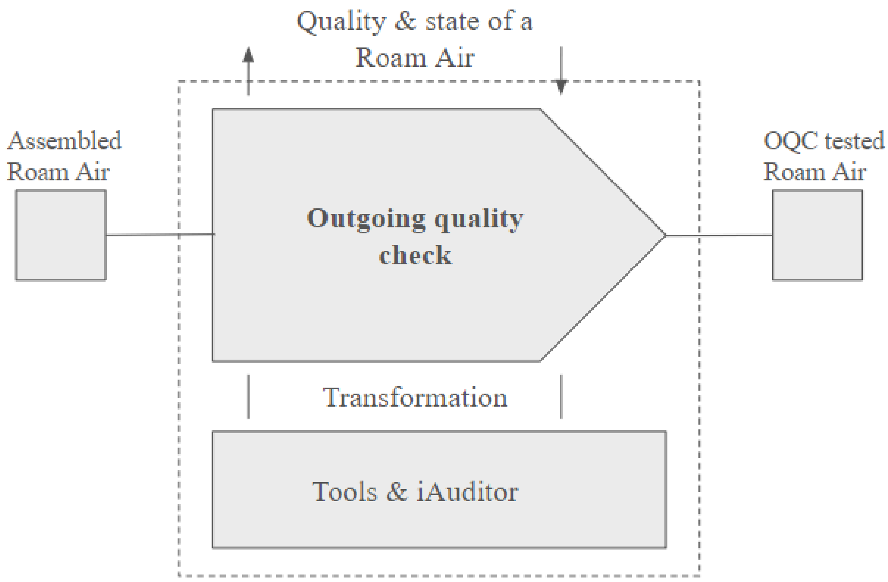


Figure 4.20: Activities involved in the repair (Person 4, 2024).

4.5.2.4 OQC

The OQC is a critical part of the process with three main objectives; Customer satisfaction, brand reputation and product reliability. The OQC is the last process which takes place at the company Park and thereby also the last guard to ensure the mentioned objectives. Figure 4.21 represents a description of the OQC as a subprocess. As can be seen in Figure 4.22 the OQC consists of 4 main activities which are further described below. It is important to note that currently M-Kopa (who buy around 80 percent of the products), as mentioned, do their own IQC at the company's facility. Therefore when a motorcycle has gone through the internal OQC it still has to pass M-Kopa's IQC before it is sold (Person 8, 2024).



Object in - An untested Roam Air, from either the assembly line or the repair station
Activity - Outgoing quality check including static & dynamic tests.
Resources - Tools and iAuditor.
Object out - OQC tested Roam Air.
Information - Quality of components as an integrated system. Determine if it is ready to be delivered to customers.

Figure 4.21: A description of the subprocess: outgoing quality check (Person 8, 2024)

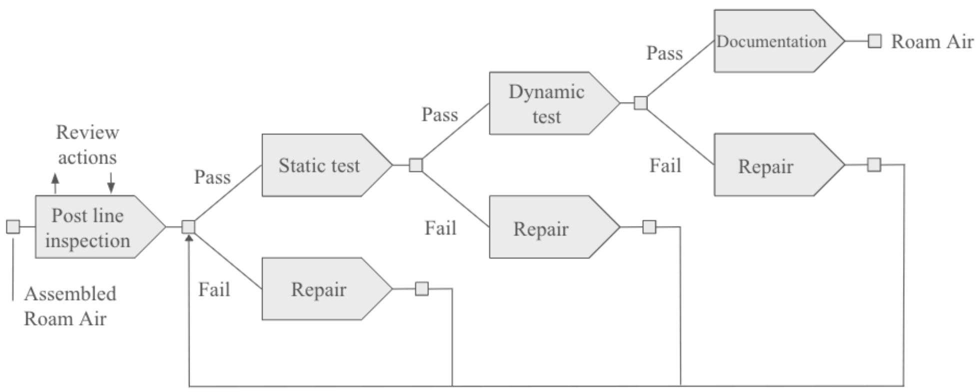


Figure 4.22: The activities involved in the OQC (Person 8, 2024)

Post line inspection

The post line inspection consists of checking that there are not any unsolved matters in the iAuditor. As described in chapter 4.4.2.2. IPQC, a product can move on in the assembly line even though there is either a defect in one part or if a part is missing. This post line inspection exists to ensure that all matters of this nature are resolved and that a product is in fact fully assembled and ready for the OQC (Person 8, 2024).

Static test

The static test's purpose is to check that the product has been assembled correctly and that the integration of all components of the works as it should. It checks the interplay of the mechanical and electrical components as well as the software, to make sure they are calibrated and works properly. Elements like this are not tested in the IQC or the IPQC since the components can only be tested separately before this stage. It includes tests of the controller, tracker, display and GPS. The static test is standardized and follows a checklist, which is done through the use of iAuditor and aims to test everything that can be tested without actually driving the product. If a product fails the static test at any parameters, it will be sent to the repair station. If it passes the static test, it will continue in the OQC process and be moved to the dynamic test (Person 8, 2024).

Dynamic test

The dynamic test consists of a driving test, where the product is driven 10 kilometers (Person 2, 2024). These tests are standardized and the results are noted in iAuditor. The purpose is to test that the motorcycle works smoothly on the roads. It includes checking parameters such as vibrations. In addition, there is a test to check if the product manages to carry a payload of 220 kilograms. The payload test is conducted on one out of every ten products that is produced. As for the static test, if a product fails on any parameters, it is sent to the repair station. If it passes the test, it will be ready for delivery (Person 8, 2024).

Documentation

After the test a batch of products, all defects that were found during the different tests will be documented. Then the OQC team will inform the relevant departments about the fault. For example, if there is an assembly fault, OQC will inform the relevant persons in the production. Then it is their responsibility to investigate why it happens, and prevent the same faults from happening again (Person 8, 2024).

A vast amount of the produced products fail their first OQC. The most common reason why a product fails the OQC is due to workmanship, which corresponds to about 50 percent of the faults. In addition, products that have been to the repair station are usually in better condition than those arriving directly from the assembly line. However, just because they come from the repair station does not guarantee that they are free from faults (Person 8, 2024).

After the OQC has been conducted the product is ready for delivery, which means that it is ready for M-Kopa's IQC. This process is very closely related to the OQC and consists of a summary of the checklist that is used in the OQC. OQC has access to M-Kopa's checklist and access to their iAuditor (where the faults are reported). After M-Kopa have inspected a batch of product, the quality team and M-Kopa have a meeting where they go through all the faults that were found, which is done in order to understand the problem and why it occurred (Person 8, 2024).

If a product passes the OQC, and then fails M-Kopa's tests, it has simply passed the company's OQC with defects which can happen due to many different reasons. It is a time consuming and difficult task to test each and every aspect of the 258 components as an integrated system. So if M-Kopa finds faults, the fault is either not on their or the company's checklist, the fault has not been tested due to sampling or it has been missed. When a new fault is discovered, it is added to M-Kopa's and OQC's test (Person 8, 2024).

4.5.3 Summary

There are seven main processes from incoming goods to the OQC (final quality check before delivery). Figure 4.23 showcases the processes and the involved activities. For a more in depth description of each process, see the relevant chapter.

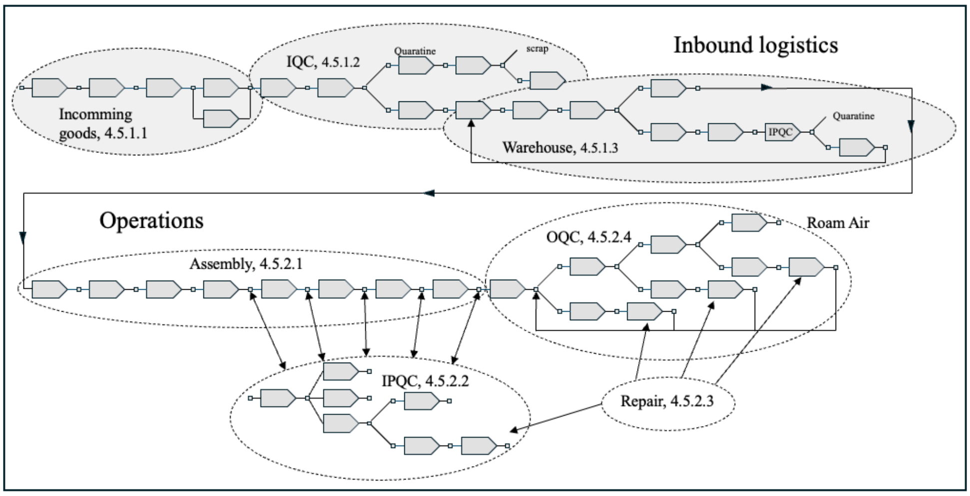


Figure 4.23: Overview of the main processes in inbound logistics and operations.

5. Analysis

In the following analysis, the interplay between product, market and manufacturing strategies are explored within the context of the company's operations, focusing on the product. The analysis is framed against the theoretical framework outlined in chapter 3.4, and shown in Figure 5.1, which is guiding the examination of empirical evidence to assess the company's efficiency in the manufacturing processes. An examination of the linkages of these strategies is done in order to understand how operational efficiency is created and in order to provide a comprehensive overview of activities that impact manufacturing's core aspects.

When addressing the theoretical frameworks of Kotler, Hill, Porter and Ljungberg & Larsson, the discussion considers these perspectives to analyze the alignment across corporate objectives, marketing strategies, and manufacturing operations. Figure 5.1 showcases how the product, market strategy and manufacturing strategy need to be synchronized to achieve efficiency in manufacturing processes. The Value chain offers an overview of all activities in a company which affects the inner circles. The process flow theory can then help map and analyze specific activities in a company that is most relevant to gain efficiency.

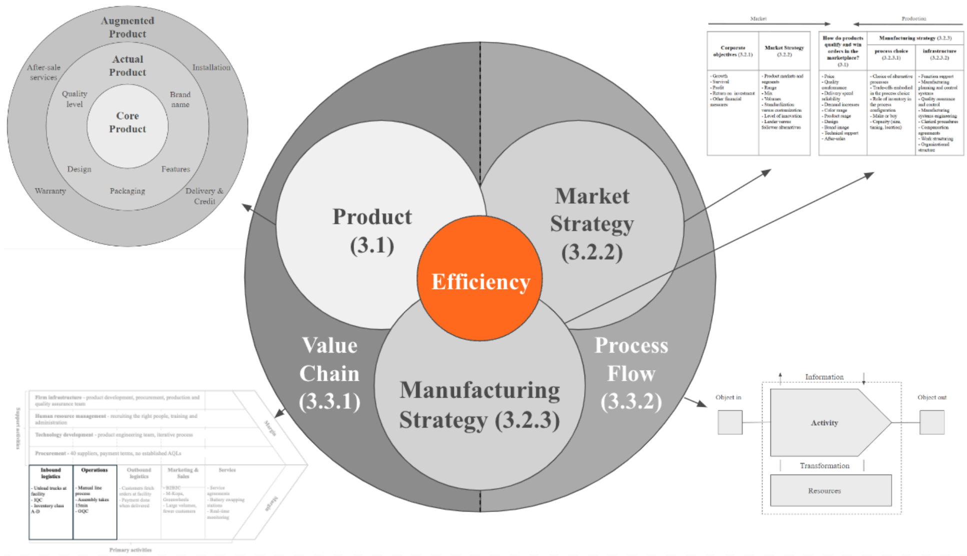


Figure 5.1: Same figure as is in 3.4 Theoretical approach and is used to analyze the empirical evidence.

5.1 Product & Market Strategy

For a comprehensive analysis of the product offering of the product, an intertwining of Kotler’s three levels of product and Hill’s market strategy is used to showcase the company’s competitive advantages and disadvantages on both product and market strategy level. In Figure 5.2, the chosen theoretical frameworks are highlighted.

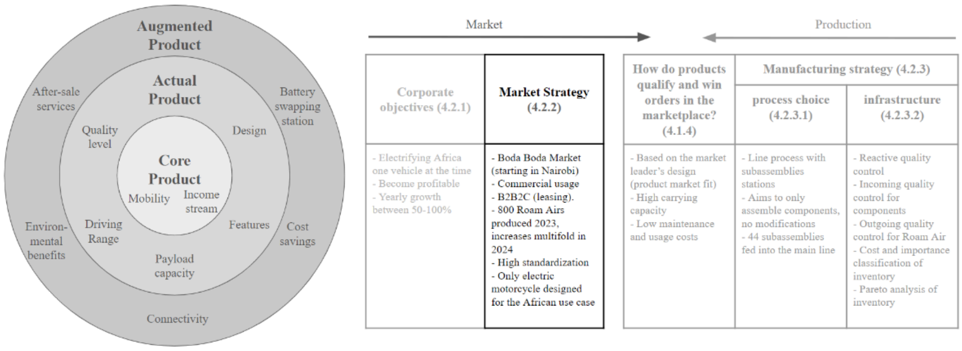


Figure 5.2: Kotler's three levels of product to the left and Market Strategy from Hill's framework to the left.

The company has a strong offering, which is shown through Kotler's three levels of product. There are synergies between features of different levels, which make the product viable. The core product of income stream, in combination with cost savings in the augmented product is an example of that. The same goes for mobility in the core product, with the relatively long driving range and 220 kg payload capacity in the actual product, and at the same time having access to battery swapping stations in Nairobi and after-sales services. This allows a customer to conduct his or her business daily, and if the motorcycle breaks down, they can get it repaired quickly at the company's expense. With the features that the product has, the company has a strong offering to the Boda Boda market in Nairobi. However, the analysis becomes more complex when comparing the company's offer to the main competitors Ampersand and Bajaj within the market strategy in Hill's framework.

Bajaj is the market leader within the Boda Boda market, and the product has a similar design, feeling and functionality as Bajaj's BM150. It will lower the switching barrier for customers that are already using the Bajaj BM150, to purchase a product. The main competitive advantage the product has over the Bajaj BM150 is the lower operational costs, which is a result of expensive petrol and cheaper electricity. The company's five charging and battery swap facilities across Nairobi aim to fulfill the same purpose as petrol stations. However, one drawback is that petrol stations in Nairobi greatly outnumbers the five charging and battery swap facilities. If a Boda Boda driver does not live or work in the proximity of such a facility, it could hinder them from purchasing one. Another disadvantage is that the product is more expensive than the average Bajaj BM150. Even though it has a lower operational cost, the higher price could also be a barrier for customers to switch to the company's product. Thereby some key benefits within the augmented product such as cost savings and environmental benefits are shown compared to the Bajaj. Driving range is one of the major drawbacks for the product when compared to the petrol driven Bajaj, which is evident within the actual product.

The product and Ampersand's electric motorcycle have a similar setup, specially within the augmented and core product levels. Both can be purchased with M-Kopa's financing solution and Ampersand also offers charging stations in Nairobi. The main difference between the two is the design, within the actual product. As stated above, the product's similarity to the Bajaj BM150 is one of their key advantages when acquiring new customers. Ampersand's motorcycle, on the other hand, offers another design. Depending on the characteristics of customers it could both be a disadvantage or advantage for Ampersand. If a customer enjoys the Bajaj BM150 and wants something similar, the product is a clear winner when it comes to design and functionality. If not, the Ampersand's motorcycle would have an advantage. However, since Boda Bodas are used for commercial purposes, functionality should be a top priority for the customer. Bajaj's BM150 has succeeded with this, which is why product have a design that should be a competitive advantage over Ampersand's motorcycle.

The price difference between the product, Ampersand's motorcycle and Bajaj BM150 is clear. Bajaj has the far cheaper motorcycle, ranging from 60 000 - 100 000 KES. As stated above, both the company and Ampersand use M-Kopa as a financing solution. The down payment for the product is 25 000 KES, while Ampersand is 20 000 KES. The daily payment for the motorcycles to M-Kopa is the same (450 KES per day). An owner of a product also has to pay M-Kopa 250 KES per day for one battery, while an owner of an Ampersand is paying 185 KES per battery swap. All in all, the product is the most expensive motorcycle to acquire. However, its low operation cost is what sets the product apart. Since the customer is paying for the battery per day, and not for charging the motorcycle, the product will have the lowest operational cost for owners that drive a lot.

From the standpoint of Kotler's three levels of product and Hill's market strategy, it is clear that the company has a strong offering with their product. It has the same design, functionality and feeling (the actual product) as the market leading Bajaj BM150, which Ampersand does not have. At the same time, its electric nature with lower operational cost and financing solution (augmented product) makes it attractive in comparison to the Bajaj BM150. However, the product is more expensive than their main competitors. Therefore, it is important that the company lives up to the expectations, and offers a high quality product. To be more competitive, the company needs to find ways to lower their price which is uncovered in the market strategy of

Hill’s framework. It is important to take the startup nature of the company in mind, which is why economies of scale is a solid solution. Increasing the output of products from the production is a crucial step to decrease the price of a product which the company is already working on.

5.2 Corporate and manufacturing strategy

The intersection from the product and the company’s market strategy to its corporate and manufacturing strategies, highlights a multifaceted approach to business operations. By intertwining Hill’s manufacturing framework and Porter’s value chain, it offers a detailed perspective on how operational processes are linked to the company’s position in the competitive landscape. The analysis transitions from examining the company’s market position and functionality, to understanding the strategies that support these factors. By the incorporation of Hill’s manufacturing framework alongside Porter’s value chain, with the focus on inbound logistics and operations, the narrative shifts to the operational efficiencies, quality control mechanisms as well as the strategic alignment necessary for scaling. Figure 5.3, frame these two models in order to understand the integrative approach.

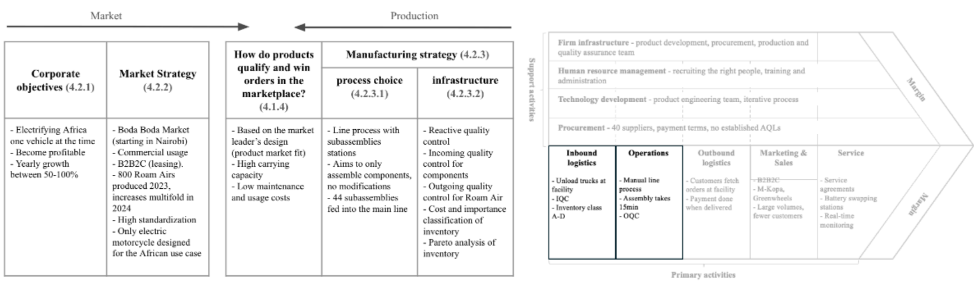


Figure 5.3: Hill’s manufacturing framework together with Porter’s value chain’s inbound logistics and operations.

The interplay between the corporate objectives, market strategy and manufacturing strategy of the company, being a product oriented company with a clear vision to scale multifold are all factors to keep in mind when analyzing the company. To achieve their current corporate objectives, the company needs to offer an order winning product to the market. A prerequisite to that is having a manufacturing strategy that fits the characteristics of the product and the market strategy. Through Hill's framework insights are brought forward regarding the company's sound process choices, however it leaves more to discuss within the infrastructure, for example a reactive quality control apparatus. It becomes clear that the correct processes are in place, however the processes sometimes lack precision to enable a seamless function. The lack of precision in the process becomes especially evident with M-Kopa's lack of trust regarding quality of the products since they introduced their own quality control. Furthermore, in Hill's framework the unbalance between the market strategy and the manufacturing's output is clear, which underscores the criticality of improved efficiency.

The value chain highlights how the primary activities interplay and impact the process in manufacturing. It is clear that the primary activities need to function seamlessly for the company to have a multifold manufacturing growth for the product. The value chain furthermore highlights the primary activities and which functions that are critical. Thereby it becomes clear that quality makes up a linkage throughout the value chain, from inbound logistics to outbound logistics.

5.3 Processes & integrated insights

Kotler’s three levels of product together with the market strategy side of Hill’s framework highlights the importance of maintaining design advantages with a high quality product as well as lowering the cost of manufacturing through economy of scale. Hill’s manufacturing framework together with the operations and inbound logistics sections in Porter’s value chain furthermore showcases the same need for improved efficiency. The process analysis then allows for the revealing of improvements within specific activities.

The progression from strategy analysis to an in-depth examination of the operational processes, highlights a shift towards the individual activities which together form the organization. This transition underscores the linkages between the overarching strategies discussed previously, incorporating product, market, corporate, and manufacturing strategies, to the operational activities that ensure the implementation of these strategies. A mapping of these operational processes is essential for understanding how the company’s strategic objectives translate into practical execution, directly impacting factors such as scalability and quality. Furthermore it is necessary to enable the identification of potential improvements that can be made to the operational processes.

A detailed examination of the company’s operation processes, enabled by the theory of Ljungberg & Larsson, highlights the critical role of information flows. From the arrival of components at the company’s facility to their final assembly and quality control checks. Efficient management of information and clear, purposeful, communication is essential for maintaining quality standards and operational efficiency. The IQC process exemplifies this, with its reliance on accurate, timely information regarding which components have arrived, its priority and testing requirements. Furthermore the linkage here is clear, aiming to prevent downstream issues and meet the company's stringent standards of components before they meet the assembly phase.

In operations, the importance of quality is further underscored with multiple quality control checkpoints throughout the manual assembly line process and subassembly stages. In outbound logistics, the products undergo an OQC by the company and an additional QC by M-Kopa. The extent of quality controls within the company's value chain underscores its critical role in impacting all primary activities from technology development to outbound logistics.

The assembly and subassembly processes further highlight the importance of information flows. Production orders created within the company's ERP system manages the assembly, which thereby relies on accurate data to schedule components and manage production timelines. Furthermore a high quality has a strong linkage to the information flows to be able to manage quality data in a useful manner where actions are done from what is observed in the quality checkpoints. Miscommunications or inaccuracies in component availability, as evidenced by discrepancies between actual stock levels and those reported in the ERP system, can lead to assembly delays and/or need for rework. This not only impacts the production efficiency but also underscores the interconnectedness of quality with information flows and operational effectiveness.

In summarizing the company's processes, the criticality of examining quality activities and information flows becomes apparent. Quality not only directly affects the efficiency of each primary activity but also acts as a crucial link, initiating with inbound logistics and heavily influencing downstream activities. Enhancing quality control mechanisms and information flows across the value chain could lead to significant improvements in reducing rework, shortening lead times, fostering better supplier relationships, and ultimately, securing a stronger market position. Given these observations, a deeper analysis of the company's quality control process is given, with a specific focus on optimizing information flows to enhance the overall integration and efficiency of the value chain.

5.3.1 Quality

Throughout empirical evidence, there is a common denominator that hinders efficiency in the production for the company, the impact of low quality across the processes. The mapping of the company's inbound logistics and operations reveals a complex network of activities with quality-related challenges. These challenges not only threaten the efficiency and output of the company's manufacturing process but could also pose risks to customer satisfaction, brand reputation, and product reliability.

The quality of both components and assembly is a central theme, intricately linked to each step of the company's manufacturing strategy. The initial stages of the process, such as the IQC and the handling of components in the warehouse, set the stage for the quality level at later stages. Despite rigid testing protocols, the failure of components to meet quality standards and the decision-making process regarding their fate highlights systemic inefficiencies and the potential for improvement.

It is evident that these initial quality issues have far-reaching implications. They affect the assembly and subassembly processes, where the integration of faulty or untested components can lead to significant delays and reworks. The repair process, intended as a corrective measure, further underscores the variability and unpredictability of quality issues, adding layers of complexity to the manufacturing strategy. The OQC, including both the static and dynamic tests, is the last line of defense against the quality issues before it is delivered to M-Kopa. However, the fact that a vast amount of motorcycles require rework after their first OQC assessment highlights the quality challenges within the company's manufacturing process.

In analyzing the company's manufacturing strategy, it is crucial to understand that the quality issues are not merely the components themselves, but also the assembly and subassembly processes. The quality of components and the assembly together impact the success of the company's manufacturing operations, and in the end the output of products. To achieve their corporate objectives and beyond, the company needs to increase efficiency and effectiveness throughout their manufacturing processes. Therefore, the next part of the analysis will exemplify the processes, with the aim of identifying quality challenges which can be improved in order to enhance quality, streamline processes, and ensure that the company can increase their output of products and maintain high quality.

5.3.1.1 Identified quality issues

The empirical evidence within the company's inbound logistic and operational processes consistently points to quality as a main factor affecting efficiency and output. Despite stringent quality control measures in place, the persistence of quality issues from the initial stages of component handling through to the final product delivery underscores systematic challenges that need addressing to enhance overall performance and reliability.

Inefficiencies in IQC

A notable inefficiency in the IQC process is the preparation of testing. The preparation of tests can not begin until all received goods have been identified since the IQC team needs to know which components have arrived. Then there is an additional waiting period for the material planning team to provide the IQC team with a prioritization list. This sequence of actions creates unnecessary delays, extending lead times from receiving to testing. Streamlining this process, perhaps by improving the communication of incoming shipments and enabling direct access to shipment contents and priorities, could significantly reduce the waiting period and increase the efficiency of the IQC process.

Another area for improvement is within the IQC testing procedures themselves. The current approach is characterized by extensive testing of components. Even though it is necessary to a certain extent due to unreliable suppliers, it is time-consuming and may not always be the most efficient use of resources. To tackle this inefficiency, the company could integrate a statistical sampling program that calculates the optimal sample size for each component and supplier, based on historical quality data. Such a program would allow the company to dynamically adjust testing protocols based on the risk profile of each supplier and component, and allocate resources where they are most needed and potentially reduce the overall testing time without compromising on quality assurance. This could enhance the efficiency and effectiveness of the IQC process.

Redundant Static Tests

One of the critical issues observed is the redundancy between the static tests conducted during the IPQC and the OQC. Despite similar testing protocols, motorcycles often pass the initial static test at IPQC but fail during the OQC. This phenomenon suggests that there are potential gaps in the testing methodology or execution. It also raises questions about the efficiency and scope of these quality tests. Are the right aspects being tested to the required extent? The redundancy not only wastes valuable time and resources but also delays the production timeline, since a product will be sent back to the repair station and back to the OQC for a new round of tests.

Part number confusion

The confusion surrounding part numbers for redesigned parts further complicates the quality and assembly process. Misalignment or inaccuracies in the part numbers can lead to incorrect parts (older and newer versions with different dimensions) being used in assembly, contributing to quality issues and reworks. This situation highlights challenges in the operations and it affects the warehouse. Since the first in first out principle is not always followed in the warehouse, wrong components get picked. Whether it is due to not changing part number after a redesign or warehouse personnel picking a "motor" without taking the new part number in account, it will cause inefficiencies in the assembly process.

Addressing Root Causes of Quality Issues

Identifying the root causes behind the quality problems is crucial for implementing effective solutions. Notably, 50% of the issues identified during OQC are attributed to workmanship. This statistic suggests a gap in the skills or attention to detail among the assembly team. Addressing this might require a two-pronged approach: firstly, enhancing training programs to improve the craftsmanship of current employees, and secondly, possibly hiring additional staff with higher skill levels to meet the quality standards.

The company faces several quality challenges affecting its efficiency and output. Delays in IQC due to waiting for component identification and prioritization lists extend lead times unnecessarily. Adopting more efficient communication and a statistical sampling program for testing could enhance this process. Additionally, redundant static tests between IPQC and OQC, confusion around part numbers for redesigned components, and a significant portion of quality issues attributed to workmanship highlight areas for improvement. By tackling these issues, the company can streamline its production processes, reduce the need for reworks, and ultimately increase the output of high-quality products. The subsequent analysis will delve deeper into information flows, aiming to identify strategic improvements that can increase quality, efficiency, and output, and thereby supporting the company's corporate objectives.

5.3.2 Information flows

The empirical evidence illustrates insufficient information flow between the company's various departments. This lack of synergy between departments, from incoming logistics through quality control to assembly and OQC is a critical factor contributing to operational inefficiencies, variation of quality, and delayed production timelines. By examining the processes, it becomes clear how fragmented communication is an underlying factor in many of the issues observed within the processes. This fragmentation not only leads to direct operational inefficiencies and quality problems but also represents a barrier to the company's ability to scale effectively and meet market demands. Therefore, addressing these communication gaps is not only about improving internal processes, but also about laying the groundwork for sustainable growth, operational excellence, and creating an order-winning product.

5.3.2.1 Identified information flow issues

Regarding the information flows, the empirical evidence points towards a shortfall in the information flows across the company's various departments which is affecting the entire production, from incoming logistics to the OQC. The deficiency in communication not only leads to operational inefficiencies and inconsistent quality but also hinder scalability. A closer analysis of specific examples unravel the extent of these issues and their implications on the information flows, following are some examples.

Supplier communication and packaging issues

One recurring problem is the lack of clear communication from the supplier and procurement team to the department of incoming goods regarding the packaging and labeling of components. For instance, the absence of purchase order numbers on the outside of packages and missing packings lists lead to confusion and delays upon the receiving of goods. This requires additional steps to identify components correctly, which leads to inefficiencies right at the outset of the production process.

Quarantine miscommunication

The process surrounding the handling of components failing the IQC and their placement into quarantine exemplifies communication breakdowns between IQC, material planning and procurement. Misinformation or lack of information leads to components being collected incorrectly from the quarantine for production based on incomplete BOM, as the ERP system's information conflicts with procurement's assurances, resulting in faulty components reaching the assembly.

Static test discrepancies

Another critical issue arises after the assembly line, where the product passes through the IPQC's static test to then potentially fail the subsequent OQC. The apparent lack of communication and trust between these departments suggest a breakdown in sharing critical quality-related data, undermining the reliability of the testing processes and the quality.

ERP system and Google sheets dichotomy

The disjointed use of an ERP system alongside Google Sheets for tracking quality and stock levels contributes to information silos within the organization. This separation of critical data prevents a unified view of critical operational data, which makes it challenging for departments to access up-to-date information and respond effectively to the information recorded.

Workmanship issues unaddressed

Perhaps one of the most critical yet telling indicators of the information gaps is the lack of awareness within the production regarding the extent of workmanship errors identified during the OQC. Discovering that 50 percent of the OQC failures are attributed to workmanship should spur immediate action and feedback loops between departments. However, the absence of proactive communication and ownership of data prevents the production team from addressing and rectifying these issues.

Addressing these information gaps requires a holistic approach with the focus on the integration of information systems and establishing clear communication protocols to foster a culture of proactive engagement and responsibility. Furthermore, feedback mechanisms between departments need to be formalized to promote a culture of accountability where each department actively seeks out and addresses issues identified in any stage of the production process.

5.4 Summary

Kotler's marketing theories provide insights into product's product structure, highlighting its strengths such as product design and operational cost-efficiency. However, it also points out challenges, such as higher pricing compared to Bajaj and Ampersand, which could deter potential customers.

Hill's strategic framework reveals an alignment between the company's market strategy and its manufacturing operations/capacity. This alignment supports the product's competitive advantage, such as product design and functionality which is crucial for market success. However, discrepancies between market strategy and manufacturing output are identified, which signals a need for improved efficiency in production processes. The need for improvement appears most significantly within the areas of quality and information flow. Furthermore specific areas of improvement can be identified as for example; inefficiencies within the IQC, root cause analysis and information management. As explored in depth in chapter 5.3 the insights hints of both specific incremental improvements, but also redundant processes with the need of streamlining.

Operational challenges and inefficiencies include significant delays in the IQC process due to slow communication and information handling, redundant testing between IPQC and OQC, and discrepancies in inventory data management. These issues are linked back to communication and quality assurance processes that, if addressed, could significantly enhance manufacturing efficiency and in the end, increase the outputs of products.

6. Conclusion

In order to give a meaningful answer to the purpose it is important to revisit the frameworks and empirical evidence that has guided the exploration of the company's processes, when approaching the conclusion. Following, the purpose is presented once more to ensure a clear understanding of the conclusions reached:

Describe and analyze the manufacturing strategy for a company in Kenya that produces environmental high-tech product(s), taking into account the demands set by its product(s) and market strategies, and propose strategic and operational improvements for more efficient processes.

The analysis foundation was set by analyzing the company's strategies, with the focus on the alignment between product, market and manufacturing strategies. This is supported by the theoretical frameworks by Kotler, Hill, Porter and Ljungberg & Larsson. The synergy among these strategies and their operational execution forms the difficulties of the company's efforts to solidify its standing in the competitive Boda Boda market.

Throughout this investigation, the analysis delved into the nuances of the company's product offering, comparing and contrasting with major competitors such as Ampersand and Bajaj, in order to understand the strategic advantages and challenges that the company faces with the product. The analysis underscored the importance of not only the understanding of the different levels of the product, showcased by Kotler's framework, but also the broader operational and market dynamics that influences the company's position. Through the analysis conducted with

Kotler's and Hill's frameworks it can be concluded that more efficient operations are needed in order to maintain the strong offering and aligned market and operational operations. The value chain extends the analysis to showcase how many of the processes are strongly linked and have downstream effects, where quality and information flows are underscored as specially critical which is strongly connected to the linkage throughout the value chain. The process mapping enabled by the theory of Ljungberg & Larsson uncovered a detailed mapping and understanding of the processes. The process understanding in combination with the value chain provides the foundation necessary in order to, at the lowest level, understand which processes and activities are critical for the organization's efficiency.

6.1 Strategic improvements

Based on the findings in the analysis, it is clear that the insufficient quality and information flows throughout the processes is due to lack of supporting activities. It is primarily the firm infrastructure that causes the challenges for the company. The different departments with responsibility over the selected processes are working in silos, which affects the overall performance of the inbound logistics and operational processes. Each department has a clear purpose in the company, and they do what they are supposed to do. However, this causes inefficiencies since the departments fail to see the linkages between each other. There are several examples of this. One is the static test that is conducted twice, once by IPQC and once by OQC. It is understandable from a department perspective why it happens. IPQC wants to make sure that a producthas been assembled correctly, since it is their responsibility. OQC's responsibility is to make sure that the motorcycle is ready for delivery, which is why they also conduct a static test. Both departments have fulfilled their duty individually, but it creates unnecessary processes and increased lead time due to lack of communication between each other.

Another example of processes that showcases departments working in silos, with a lack of a holistic view, is the unaddressed workmanship issues. Approximately half of faults discovered in the OQC are due to workmanship. The production department's responsibility is assembling the products and meeting production targets. OQC's responsibility is to quality check the motorcycles before delivery, and note why they did not pass the quality tests. However, the production department did not know that around half of the issues discovered in the OQC were due to workmanship. The lack of communication, which is causing quality issues, is both departments' faults. As in the previous example, both departments have done what they are supposed to do, but they have failed to see that their departments are cogs in the whole operational process. The production team should have noticed why there are motorcycles in the repair stations, and ask why that is the case. The OQC team should continuously send feedback to the production team. The reason for this inefficiency is due to the lack of a holistic view from each department, which causes insufficient information flows and in the end quality issues.

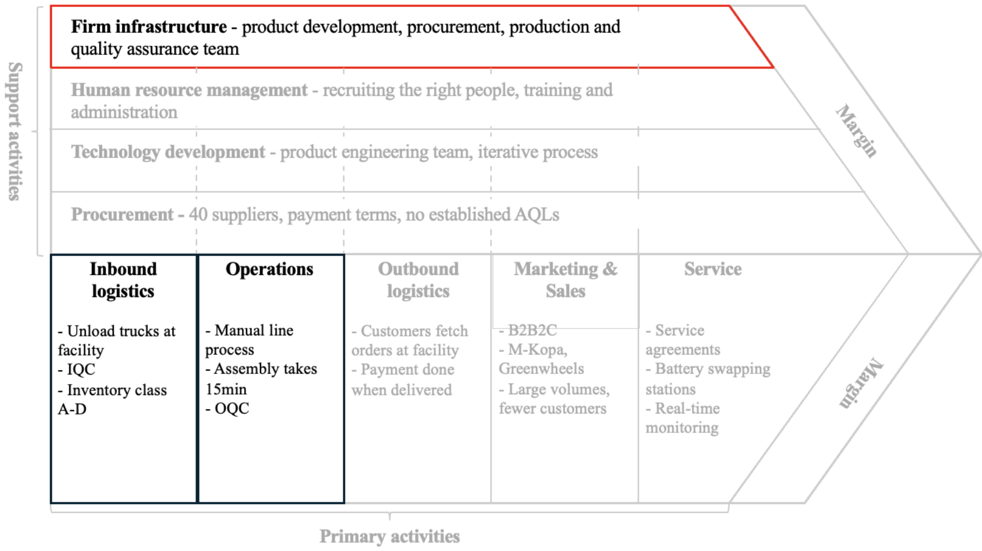


Figure 6.1: Highlights the support activity of firm infrastructure in relation to Porter's value chain.

To solve the issues of the department's lack of holistic view, the company needs to focus on developing their support activities, and primarily within their firm infrastructure, which is highlighted in Figure 6.1. The departments need to be more integrated and understand other departments' roles in the overarching processes of inbound logistics and operations. Closer cooperation between the departments is needed, and a clearer understanding of each department's responsibility.

6.2 Operational improvements

To conclude the analysis and offer strategic recommendations for the company, the focus is towards uncovering concrete steps to address the areas of quality and information flows, which are crucial for enhancing operation efficiency as well as scaling production capabilities. The following section sets the stage for presenting concrete suggestions aimed at refining the company's approach to manufacturing.

It is crucial to emphasize that the forthcoming suggestions are not endpoints but rather part of a continual process of strategic and operational refinement. These recommendations seek to address the critical areas of quality management and information flow, foundational elements that, if optimized, can increase the manufacturing efficiency.

6.2.1 Quality Improvements

Streamline the IQC Process

The IQC is currently very time consuming where for some parts, all the components are tested with thorough tests. Introduce a statistical sampling method for quality testing, leveraging historical data to optimize testing efforts without compromising quality standards. This will allow for reducing the number to items that need to undergo an inspection, in a manner that corresponds to the incoming quality.

Eliminate redundant testing

The last step in the IPQC and the static test in the OQC have many similarities in the tests. Reevaluate the static test in IPQC and OQC to identify and remove redundancies. Currently there the testing is done twice, which creates double the workload but also creates a sense of lacking trust between the different testing instances. Focus on refining test protocols to ensure that they are comprehensive and eliminate false positives that lead to unnecessary work.

Enhance workmanship quality

50% of the faults detected in the OQC are due to workmanship. Develop targeted training programs aimed at improving the skill levels of assembly line workers. This point strongly connects to the accountability aspect which is brought up more in depth under 6.2.2. When the workmanship knowledge improves and the accountability improves, so should the quality of the workmanship.

Root cause analysis

When a fault has been detected it is noted and depending on its character and where it is found some action is taken. Employ a systematic approach to identify and address the root causes of quality issues. Focus on continuous improvement processes that engage all relevant departments in solving quality challenges. When doing such an analysis it can be useful to engage in for example the 5 why methodology. A systematic and easy approach to lift faults to where they arise is the key to ensure that the same error occurs twice.

6.2.2 Information Flow Optimization Strategies

Supplier and procurement communication

Many parcels that arrive at the company miss proper labeling and many components are of bad quality. Improve communication protocols with suppliers, ensuring that all shipments are properly labeled and accompanied by a comprehensive packing lists to facilitate efficient inbound logistics. This supplier communication is also critical to communicate the quality defects which is done swiftly through the inclusion of the IQC team in this communication protocol. The IQC team can then inform why the components fail the tests which enable the supplier to act on the information. Through these standardized protocols the communication with the suppliers can be eased, strengthening the relationship and enabling proper labeling together with better quality.

Inform the IQC Process

The IQC team often has to await orders in order to be able to start the preparation for the IQC testing. Implement an information system for incoming shipments to enable the IQC team in advance, reducing waiting times and speeding up the testing phase. This information should go from the procurement team to the IQC team and should be simple and direct. Furthermore it can not be informal as mouth to mouth communication often is forgotten. Thereby the waiting time for the IQC team can be reduced as well as making sure that the right order is done for the testing of the components.

Unified information systems

Disjointed data often results in difficulties when analyzing the data, leading to inefficient priorities and difficulties to manage for example stock levels. Transition from the disjointed use of google sheets to a centralized data management platform such as the ERP system, which is currently used. This integration will offer a holistic view of operations, improve accessibility to real-time data, and facilitate better decision-making. Furthermore it will enhance the communication greatly since the different departments will see and take decisions based on the same data. One concrete example of this is the testing process, where this will allow for transparency between instances that will hinder that the same tests are conducted twice. It has been noted that the company is currently working on this implementation of a unified ERP system, however the importance of the matter brings urgency to the implementation. Even though some parts are developed in order to enable the change, current parallel data management platforms are still developed as well which is why this matter is lifted once more.

Feedback mechanisms and accountability

Lack of feedback mechanisms and accountability tends to disrupt the company's operational efficiency, leading to persistent quality issues and hindered communication that compromise the overall manufacturing process. Introduce formal feedback loops and communication protocols that ensure swift action on workmanship errors and other identified issues. Promote a culture of accountability where departments are responsible for addressing rectifying quality concerns. One clear example of this is the quarantine process, where it is important for the greater good of the company to understand why a component that has been placed in quarantine should not be moved without being fixed. Furthermore, improved feedback mechanisms and accountability for work should improve the quality of the output as well as following up on faults.

6.3 Summary

In summary, the key identified issues include a lack of interdepartmental communication and quality assurance processes, which contribute to inefficiencies and insufficient quality. To tackle these challenges, the company needs to focus on strategic and operational improvements, such as streamline their quality control procedures, improving training programs for the assembly line workers, enhancing supplier and procurement communications, and implementing a more unified information systems in their current ERP. Acknowledging these strategies, the company can address its quality and information flow challenges, leading to improved operational efficiency, reduced rework, and an increase in the output of high-quality products. These improvements will not only support the company's current corporate objectives but also pave the way for future growth and market positioning.

7. Knowledge contribution & reflection

The following chapter delves into the broader implications of the case study. The discussion synthesizes the insights gained from addressing the operational inefficiencies, departmental silos, and quality control challenges, in emerging countries, reflecting on how these issues are mirrored globally. Within the first part of knowledge contribution, the findings are contextualized in a broad perspective within a global framework whilst for the later reflection, a diverse range of valuable lessons for businesses aiming to enhance their operational efficiencies and quality standards, are presented.

7.1 Knowledge contribution

The knowledge contribution from the thesis can be divided into insights most valuable for the industry respectively for the academia. These are presented in chapter 7.1.1 and 7.1.2. At some instances the insights are relevant under both the topics, the insight is then placed under the topic where the relevance is judged to be the most.

7.1.1 Industry

The analysis of the company's manufacturing strategy not only provides a specific roadmap for improvements within the company, but can also provide valuable insights to the broader industry. The challenges identified at the company, such as departmental silos, inefficient quality control processes, and inadequate information flows, are not unique to this single entity but are indicative of issues companies face globally. Following is how the findings from the case study can contribute to the industry knowledge.

Breaking down silos for enhanced integration

The challenge of operational silos is widespread in the manufacturing industry. This case study demonstrates that silos can severely impact operational efficiency and quality of the output. By illustrating the specific processes that lead to lack of integration, the study provides a clear example of how other companies can assess and address similar issues within their organizational structures. Furthermore, the importance of fostering a cross-departmental collaboration and to develop a holistic view of the operations is underscored in order to foster process efficiency and product quality.

Quality control and information flows

The detailed analysis of the quality in relation to the information flows highlight the importance of integrating ERP systems for unified information management. This enables feedback mechanisms to work as a part of an integrated organization. Disjointed information systems lead to preservation of organizational silos.

Adaptability to local and global contexts

The case study's setting in Nairobi, with its unique market and operational challenges, provides a background for understanding how global strategies need to be adapted to the local context. The company's adjustment to market and operational strategies based on local needs, such as the B2B2C business model and the unique situation with green energy, illustrate the necessity of contextual adaptability in global business strategies. Furthermore to strengthen the adaptability the case company has learned much from market standards and aims to employ locally which further illustrate the adaptability of the company.

By discussing these insights in relation to the broader industry, the analysis contributes to the broader discourse on manufacturing efficiency, quality control, and strategic integration. It provides an outline to be compared with a generalizable blueprint for effective operational management, relevant to diverse industries all around the world.

7.1.2 Academia

The analysis of the case companies operational challenges within the broader academic context showcases how the theoretical frameworks employed, can serve as a general blueprint for addressing inefficiencies in manufacturing companies. The frameworks of Kotler, Hill, Porter, and Ljungberg & Larsson provide a structured approach to diagnosing and addressing operational inefficiencies, offering a method to comprehensively and systematically uncover root causes across both broad and detailed dimensions.

Versatile theoretical model

The academic contribution highlights the versatility of these theoretical models in formulating research questions that are general yet accurate to a wide array of manufacturing environments. By applying these frameworks to the specific context of the company, the study illustrates the practical relevance and robustness of uncovering root factors of the theory. Furthermore, it demonstrates the framework's capacity to dissect complex operational structures into manageable segments for analysis, which thereby facilitates interventions.

Modifiable frameworks for specific issues

Moreover, the application of these models in the company's context enriches the academic direction of their scalability and adaptability. Thereby ongoing refinement on these frameworks is encouraged, suggesting that they are not only theoretical constructs but are dynamic tools capable of evolving in response to the diverse challenges presented by global manufacturing landscapes. This opens up new research pathways for academics to explore modifications or expansions of existing frameworks to better address the specific inefficiencies of different industrial sectors of cultural settings.

Thus, this chapter not only reflects the theoretical contributions to academia but also encourages a proactive engagement with theoretical frameworks as living entities that must be continually tested and refined in varied real-world applications. It advocates for an iterative academic process where synergy can be created between theory and practice in order to reach more effective strategies for managing and improving manufacturing efficiency worldwide.

7.2 Reflection and further studies

The concept of reflection within an organizational context serves as an important mechanism for revealing factors that are outside of the focal point for the paper, but yet important for the company's operations and cultural dynamics. This reflection aims to highlight areas within the company where strategic adjustments could lead to substantial improvements in performance and organizational coherence. Additionally, it is important to emphasize the purpose of reflection, which is to identify and discuss potential areas of interest for both the company and other startups in Africa. These areas are intriguing in light of the empirical evidence presented, but are not derived from theoretical advancements.

7.2.1 Work culture differences

During the course of gathering empirical data and information at the company's facility in Nairobi, a difference in work and organizational culture between employees was noticed. The main differences were between people who have an educational or a working experience from outside of Kenya, and the ones that had not.

The management team at the company, characterized by its Swedish origins, operates under a relatively flat organizational structure. Also, other individuals in C-Suite and senior positions have experiences from companies and start ups in the West, which usually have a culture of individual responsibility that requires employees to speak up and address issues directly with supervisors. In contrast, the Kenyan organizational culture is observed to be highly hierarchical. In addition, the work opportunities at companies like the company for graduates in Kenya are sparse. As a result, workers fear job loss, which influences their behavior in the workplace. This fear manifests by workers strictly following instructions and focusing on executing tasks to exact specifications without deviation. For example, if workers encounter issues that may have originated from another department, the workers could feel that addressing these would overstep their responsibilities. Such adherence to defined roles and tasks without considering the broader implications hinder holistic thinking and operational efficiency. It creates an organizational gap when senior employees and management have a work cultural background characterized by more flat organizations where employees are encouraged to engage in disagreements and new ideas.

This cultural disparity can lead to inefficiencies, as seen in the reluctance to challenge the status quo or to undertake proactive measures that may lie outside one's immediate job description. Instead of building silos within the company's organization, there is a critical need for a shift towards a more integrated approach where communication and responsibility are not confined strictly within departmental lines but are spread across the organization to enhance overall performance and operational efficiency. With increasing global investments in startups in Kenya and Africa, further studies on the cultural differences in the workplace between cultures should be conducted. It is an area of interest both for academia and for foreign entrepreneurs active in Kenya and Africa as a whole. Its relevance for companies with clear hierarchies, such as manufacturing, is especially interesting.

7.2.2 Capital binding

One significant area of concern, which is out of the scope of this paper, is the negative impact of capital binding in the assembly, on the company's financial and operational efficiency. This issue arises mainly from motorcycles that are assembled but not fully completed or fully tested.

Motorcycles that proceed through assembly and later fail quality checks require rework to be complete. This not only delays the delivery and requires additional labor and part costs, but also ties up capital in non-saleable inventory. The end of line where these motorcycles end up is where they tie the most capital, which means that this quickly becomes very capital intensive. It is therefore concerning that the products continue to be produced, tested, and sold while there are previously assembled motorcycles that remain incomplete. Furthermore this inefficient use of resources increases operational costs and ties up capital that could be employed more effectively elsewhere.

7.2.3 Suppliers' impact on scaling

One key aspect for the company to increase their operational efficiency and output of products, which were outside the scope of the thesis, is finding the right suppliers. The phenomenon of faulty or incorrect components arriving at the company's facility could be a mix of unreliable suppliers and the conditions for the procurement department to find the right suppliers for each component.

It is challenging for a company with limited resources, who also designs some of their own components, to find a supplier who is able to manufacture unique, high quality components in smaller batches for a lower price. Additionally, the geographical location of suppliers can further complicate the supply chain dynamics. With the company operating in Kenya, and having suppliers in India and China, the distance can lead to increased transportation costs and extended lead times, which in turn can affect the overall production schedule and cost-efficiency. Another significant challenge is ensuring consistent quality and reliability from suppliers, especially when dealing with complex and unique components. the comThe absence of established relationships and trust with suppliers can pose a risk to maintaining high standards of product quality. The company is currently working closely with certain suppliers, and the quality of those components have increased. By collaborating more closely with more suppliers, some of the quality issues can be solved which is crucial for the company's operational efficiency. The challenge here is to find the right supplier who can deliver the current relatively small volumes and that is capable of improving their operations and able to scale up their production at the same speed as the company is scaling their operations.

To find the right suppliers, it is crucial for a company to have a procurement department that possesses a deep understanding of the components they are procuring. This knowledge includes several factors, such as the technical specifications, functionality, and integration of the components within the product. By understanding the precise dimensions, material properties, and the performance requirements of each component, the procurement team can ensure that the parts procured will function seamlessly within the broader system of the product. This technical acumen is essential not only for assessing the quality of what suppliers offer but also for facilitating clear and effective communication with engineering and production departments to confirm compatibility and meet design specifications. Thereby it is essential that the procurement team continually learn and understand the components to avoid any shortcomings in the orders.

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8.2 Interviews

Person 1. C-Suite employee at the company, Kenya (2024). (Interview 2024-02-07)

Person 2. Employee within quality at the company, Kenya (2024). (Interview 2024-02-13)

Person 3. Employee within intralogistics at the company, Online (2024). (Interview 2024-02-22)

Person 4. Employee within production at the company, Kenya (2024). (Interview 2024-02-23)

Person 5. Employee within quality at M-Kopa, Kenya (2024). (Interview 2024-02-14

Person 6. Employee within quality at the company, Kenya (2024). (Interview 2024-03-06)

Person 7. Employee within quality at the company, Kenya (2024). (Interview 2024-03-06)

Person 8. Employee within quality at the company, Kenya (2024). (Interview 2024-03-08)

Appendix

Appendix A: Interviews questions

Interview Person 1

Corporate objectives

- Are there any defined corporate objectives short/long term?
- How do you measure your corporate objectives?
- Do you see any direct impact on the market strategy and/or manufacturing strategy from the corporate objectives?
- What specific goals does the company have regarding absolute growth and market-share growth?
- When do you plan that/set the goal that the company will be profitable?
- Do you have any environmental targets that you include in high-level corporate objectives?
- Are there any other specific actions that are relevant for you to achieve your corporate objectives that you think we should know?

Market Strategy

- How would you describe the typical end-customer?
- How are the payment terms for M-kopa?
- Would you say that you have any other main competitors, more than ampersand and the fossil fueled bajaj bm150?
- What is your target segment within the Boda boda market?

- Do you have any numbers for last year's sales and how do you expect the sales volume to change?
- Is it correct to say that you are rather trying to lead and innovate with product development than follow?
- Do you have any specific actions/initiatives in order to drive the sales of the product?

Manufacturing strategy

- We have just briefly talked with Fabian about this, what kind of manufacturing process is used in the workshop? Line assembly?
- How was this determined?
- How has the product's characteristics and sales volume formed the manufacturing strategy?
- How do you or have you evaluated the fit of manufacturing processes and infrastructure with the product?
- Do you modify any of the components that you purchase, or are they ready for assembly right away?
- If yes, how do you make the decision of whether to buy it ready or modify it yourself?
- How have you determined which technologies/tools and manufacturing options to assemble the product?

Manufacturing Infrastructure

- How do you approach quality control? Is it more focused on detection or prevention?
- Who carries the responsibility for motorcycles that do not pass the OQC? (people on the production/manager)

- As of now, how is inventory impacting manufacturing? Any Classifications?

Interview Person 2

Quality

- Is it possible to get data on numbers of components per shipment that have too low quality (Preferably for components that have the biggest impact for the company's operations)?
- Do you have data on % of productss that fail the company's OQC and the M-Kopa quality check?
- Which component and its low quality has the biggest negative impact for the company? (Increased lead time, costs etc)
- What do you do when you detect a component with too low quality?
    - Do you have a standard procedure?
- How do M-Kopa do their quality test?
- Which is the most common reason the product does not complete the M-Kopa quality check?

Interview Person 3

Incoming goods

- Our perception is that the following activities are being done when receiving goods: Unload, unpack & then store the components before going to IQC? Any more activities?
- Do you know if they put the number of received goods in the ERP when receiving, or are they already in the system from the procurement (even though quantity has not been confirmed at the company)?
- Is there a quantity count?

Warehouse

- Does the process in the warehouse consist of anything more than storing the goods at the dedicated spot which is registered in the ERP and then followingly picking the goods from there to the assembly?

Interview Person 4

Assembly & IPQC

- How many assembly stations are there in the main line?
- How many subassembly stations do you have?
- How long does it take to assemble a motorcycle?
- Can you describe how the ERP is used in the line?
- Do you use standardized testing for each IPQC?
- What actions are taken when an IPQC fails?
- Do you report it in ERP? Excel sheets?
- How does the quality of the components affect the assembly?
- Is there a standard procedure to report low quality components that are discovered in assembly or rework?
- How would you say the cooperation between the assembly team, quality team, procurement and product development works?

Repair

- There is a certain area for repair, either requiring new parts or something else is faulty with the motorcycle?
- Could you briefly describe the rework process?
- Are there standard procedures in rework for certain types of quality problems?
- Are there any quality checks at the rework stations, as it is in the main line?
- Do you have data on how many products that end up in the repair?

Interview Person 5

M-Kopa

- What do you think about the overall quality of newly produced products?
- What is your opinion of the quality of the assembly?
- What is your opinion of the quality of components?
- Could you describe M-Kopa's quality check process?
- How does it differ from the company's?

Interview Person 6

Incoming quality control

- What are the step by step activities from when IQC receives a batch of components?
- If a component fails the test, is it sent to repair or scrapped?
  - Where are the components that did not pass the IQC stored?
  - Is there any physical marking done to it?
- Are you testing all of the components from every supplier?
- If not for some suppliers, how have you decided how many to test?
- Are there certain suppliers that keep delivering low quality components, or is it a general issue with all suppliers?
- If a low quality component has made it to the assembly line, what are the main reasons for it? (Testing too small % of a batch, assembly team accessing scrapped material, insufficient repair, insufficient testing)
- Do you have standardized tests for all components?

- Do you test component classifications differently? (e.g. test 100% of A-components and none of D-component)
    - For some of the most crucial components, how long does the testing take?
- Do you know the time it takes to control all the 258 components needed for a motorcycle?
- Is there any collaboration with the product development team and procurement regarding agreement of quality of a component?
- In your opinion, what is the main reason for low quality components?

Interview Person 7

IPQC

- What are the step by step activities in the IPQC?
- How long does an IPQC take?
- Do you mainly test the quality of the part or rather that the parts are assembled correctly?
- Is it common that low quality components make it to the assembly line?
- What are the differences between static test and the OQC?
- How long does a static test take?

Interview Person 8

Outgoing quality check

- What are the step by step activities from when you receive a motorcycle until it is done with the OQC?
- What is the specific process when a fault is detected? (which program, who gets the report and what actions are taken?)

- Do you experience a higher fail rate for the motorcycles that have been in repair?
- Is it the quality of components or the assembly that causes the most faults?
- How long does an OQC take?
- Is it the same test that M-Kopa does?
- Do you have the data on the faults that are detected?
- Does this data differ from the faults that M-Kopa detect?
- In your opinion, what is the main reason for low quality?