LINKING PERFORMANCE METRICS TO FINANCIAL PERFORMANCE FROM PERSPECTIVE OF AGENCY THEORY
-Case Study: Supply organization

Jyväskylä University
School of Business and Economics

Master's Thesis

2024

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Subject: Economics
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ABSTRACT

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Title
Linking performance metrics to financial performance from perspective of agency theory

Subject	Type of work
Economics	Master's Thesis
Date	Number of pages
30.5.2024	71

Abstract

One of the key tasks of performance management is to implement the company's strategy by directing operations towards goals. However, companies may have challenges defining suitable metrics and understanding their overall impact on the company's goals. The aim of this master's thesis was to investigate the relationship between performance metrics and financial metrics in a production organization, and to identify the connections between these metrics.

The research was conducted as a case study in an organization that is part of a larger international production company. The theoretical framework of the research was based on performance management and agency theory. Data was collected in the target organization through observations, interviews, and documents.

The results showed that, based on the literature, the performance metrics used in the target organization were relevant to the management of a production company. The research also identified performance management issues within the target organization, which aligned with the reasons for performance management failures as outlined by agency theory.

The research provides the target organization with basic information to improve the performance measurement system. It highlights some important points about their current measurement system. A clear deficiency was found in monitoring the costs and effects of poor quality based on both the literature and the interviews. In addition, reducing the number of metrics could streamline and simplify management processes.

Key words
performance management, performance measurement agency theory, case study, supply chain, production

Place of storage
Jyväskylä University Library

TIIVISTELMÄ

Tekijä Laura Pirskanen	
Työn nimi Suorituskykymittareiden yhdistäminen taloudelliseen tulokseen agenttiteorian näkökulmasta	
Oppiaine Taloustiede	Työn laji Pro gradu -tutkielma
Päivämäärä 30.5.2024	Sivumäärä 71

Tiivistelmä

Yksi suoritusjohtamisen keskeisistä tehtävistä on toteuttaa yrityksen strategiaa ohjaamalla toimintaa kohti tavoitteita. Yrityksillä voi kuitenkin olla haasteita määritellä sopivia mittareita ja ymmärtää niiden kokonaisvaltainen vaikutus yrityksen tavoitteisiin. Tämän pro gradu -työn tavoitteena oli tutkia suorituskykymittareiden ja taloudellisten mittareiden välistä suhdetta tuotanto-organisaatiossa, ja tunnistaa näiden mittareiden välisiä yhteyksiä.

Tutkimus tehtiin tapaustutkimuksena organisaatiossa, joka on osa suurempaa kansainvälistä tuotantoyhtiötä. Tutkimuksen teoreettinen viitekehys perustui suoritusjohtamiseen ja agenttiteoriaan. Data kerättiin kohdeorganisaatiossa havaintojen, haastattelujen ja asiakirjojen avulla.

Tulokset osoittivat, että kohdeorganisaatiossa käytetyt suorituskykymittarit olivat kirjallisuuden perusteella relevantteja tuotantoyrityksen johtamiseen. Tutkimuksessa tunnistettiin myös kohdeorganisaation suorituksen johtamiseen liittyviä ongelmia, jotka puolestaan ilmensivät hyvin niitä syitä, jotka agenttiteorian perustella johtavat suorituksen johtamisen epäonnistumiseen.

Tutkimus tarjoaa kohdeorganisaatiolle pohjatietoa suorituksen mittauksen kehittämistä varten. Tutkimuksen perusteella voidaan nostaa kohdeorganisaation kannalta kiinnostavia huomioita nykyiseen mittaristoon liittyen. Huonon laadun kustannusten ja vaikutusten seurannassa havaittiin selkeä puute niin kirjallisuuden kuin haastattelujenkin perusteella. Lisäksi mittarien määrän vähentäminen voisi virtaviivaistaa ja yksinkertaistaa hallintaprosesseja.

Asiasanat suorituksen johtaminen, suorituksen mittaaminen agenttiteoria, tapaustutkimus, toimitusketju, tuotanto	
Säilytyspaikka Jyväskylän yliopiston kirjasto	

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1 INTRODUCTION

The primary long-term financial goal of a company is to maximize profit. Practically, companies have three ways to achieve this goal: by reducing costs, raising sales prices, or increasing productivity. In economics, special attention has been paid to the study of productivity. Differences in productivity among companies have traditionally been explained by factors such as research and development activities, information and communication technology, and employee skills (Ohlsbom, 2023). To achieve their goals, companies should translate their long-term objectives into short-term targets that can be measured and monitored.

Understanding the connection between performance metrics and overall financial performance indicators is essential to align supply chain processes with the company's financial strategic goals in which many companies struggle (Elgazzar et al., 2012). The main reason for this challenge is that supply chain performance metrics and financial performance metrics are defined differently, making it difficult to translate operational metrics focused on day-to-day activities into financial objectives (Camerinelli, 2016).

The purpose of this Master's thesis is to explore the connections between performance metrics and an organization's financial results. The study is conducted as a commission for a target organization that needs to clarify the connections between its performance metrics and financial results. The underlying aim is to gather background information for a simulation model that could serve as a tool to facilitate daily management. However, the implementation of the simulation model is not within the scope of this study. The research is guided by the following research question:

RQ1: How do supply chain performance metrics affect an organization's financial performance?

This will be investigated through two sub-questions. The first sub-question aims to identify which performance metrics in the target organization have the most direct and significant impact on the company's financial results. The

motivation for this question is to use the metrics identified later in the simulation model. Simultaneously, potential deficiencies in the organization's performance measurement will be identified.

SQ1: Which metrics have the strongest effect on financial indicators?

The second sub-question aims to broaden the understanding of the impacts of metrics on financial results and their interrelationships.

SQ2: What kind of interrelationships can be detected between performance metrics?

The commissioning organization is engaged in the design and manufacturing of heavy equipment. The target organization is part of a large multinational company. The focus of the target organization's production operations is the assembly of products based on customer orders. It procures most of its components from independent suppliers according to its own product design requirements. The activities of the target organization and the issues within its scope broadly define the context and scope of the study. In other words, this thesis addresses the research topic within the context of the case organization.

The research is limited to the core functions of the target organization: manufacturing, new product manufacturing, and operational purchasing. The procurement organization is not part of the target organization, so this work does not focus on raw material prices from a procurement perspective. Since the ultimate purpose of the research is to provide information that can improve the management of the target organization's operations, the research also delves into the challenges of performance measurement and the issues encountered in managing with performance metrics in the target organization.

In recent years, research has tried to deal with the impact of supply chain management on a company's financial performance. Some studies have focused on the effects of supply chain management on financial performance (Gunasekaran et al., 2004; Shi & Yu, 2013). Other studies have examined the impact of the Lean manufacturing philosophy on the financial result (Fullerton & Wempe, 2009). In the literature, efforts have been made to identify metrics suitable for production operations (Gunasekaran & Kobu, 2007) and performance metrics supporting the Lean philosophy (Sangwa & Sangwan, 2018). The supply chain metrics used in operational management focus on the daily operations of the supply chain. By paying attention to the details of these day-to-day operations, companies can improve the performance of their overall supply chain. This, in turn, is seen as a positive effect on general measures of financial performance (Presutti & Mawhinney, 2007). However, the studies do not give unambiguous answers to which indicators have the greatest impact on the financial result, so there is no ready-made management model. The research emphasizes that every organization must always set performance indicators in

accordance with its own strategy and goals, considering the special features of its business.

The goal of this research is to identify the most relevant performance indicators for the target organization, which have a clear connection to the company's financial performance, considering the operating environment. In addition to applicability, previous studies have discussed topics such as the relationships between metrics and the failure to measure performance effectively. Examining the relationships between metrics highlights the importance of careful metric design. If metrics are not implemented carefully, their interrelationships may not be adequately considered, resulting to an undesired outcome. In addition, a lack of understanding of the relationships between different metrics can lead to critical areas not receiving enough attention. Inadequate understanding of metrics can be seen as a distortion, which is one of the main causes of performance measurement failure (Lazear & Gibbs, 2014).

The research is conducted as an empirical case study in the target company, with empirical data collected through interviews, observations, and documents. The theoretical framework of the study is based on performance management and measurement theory, linked through the principal-agent theory. Since performance measurement and management aim to influence employees' actions and, consequently, the company's results, this theory serves as an excellent framework for the research.

The research paper is structured as follows. The first chapter provides an overview of the entire research, outlining its purpose. The theoretical framework consists of two chapters: the first (chapter 2) examines performance management and measurement in general and from the supply chain perspective. The third chapter explores the drivers of financial performance in a production organization. Following the research framework formed by these chapters, the detailed implementation of the research is presented in chapter 4. Chapter 5 contains the presentation and analysis of the research results. Finally, the conclusion is discussed in Chapter 6.

In this paper, an AI-powered language modeling program, ChatGPT 3.5, has been used for language planning and grammar checking purposes. The original text was written by the author.

2 THEORETICAL FRAMEWORK

This chapter presents the concepts of performance management and measurement. In addition, performance measurement, and the reasons for its failure are examined. Agency theory is used as a theoretical framework, which provides a good framework for performance management research. In addition, the topic is examined from the point of view of supply chain (SC) performance measurement, and the aim is to find the key performance indicators (KPIs) of the target organization's industry.

2.1 Performance measurement and management

According to Brudan (2010), performance management includes all activities to ensure that the company's performance is managed in accordance with the company's strategy and objectives. Performance management gives organizations the opportunity to make their operations more efficient by collecting and refining information with the help of internal and external metrics to support decision-making (Amaratunga & Baldry, 2002). However, good performance management requires more than individual measurement and reporting.

From an individual employee's point of view, performance management is above all performance measurement and management based on measurement results. Brudan (2010) describes performance management as a general process in which the entire operation is oriented towards goal-oriented performance. Performance management therefore consists of several sub-processes, which include strategy definition, planning and goal setting, strategy implementation, training and performance measurement, reporting and evaluation (Brudan, 2010). Performance management also includes defining operating methods, monitoring and feedback, motivating and rewarding personnel, and ensuring customer satisfaction. In performance management, it is still easy to measure things only with the owner's criteria - profitability and efficiency. However, performance

management must be seen as a broader concept. The company's success and thus financial profitability is the result of meeting the expectations of all business stakeholders. In addition to the owners, key stakeholders are employees and customers.

Performance measurement is a sub-concept of performance management, and they are closely related. Neely et al. (1995) defines performance measurement as the process of quantifying the efficiency and effectiveness of action. Efficiency tells how economically the company use its resources. Instead, efficiency tells how successfully the company achieves the organization's goal (Pellinen, 2017, p. 45). In the research field, there is no clear line between performance management and measurement, so many authors define the terms in their own way (Brudan, 2010). On the other hand, performance measurement system (PMS) is a group of performance measurement indicators that are used to quantify necessary actions to achieve both the efficiency and effectiveness of actions (Neely et al., 1995). Those indicators are called key performance indicators (KPIs) and they include a set of both financial and non-financial metrics (Gopal & Thakkar, 2012). The core objective of every performance measurement system is to manage organizational operations (Amaratunga & Baldry, 2002).

With the help of performance measurement, companies can optimize the allocation of resources and guide its operation to achieve the organization's goals (Järvenpää et al., 2013, p. 323-332). On the other hand, performance measurement helps to identify success factors, measure customer satisfaction, clarify organizational processes, locate areas for improvement and ensure that decisions are based on facts and not on intuition or assumptions (Gunasekaran & Kobu, 2007). It is important to understand that measurement is not an end in itself but can be used as an aid to more effective management. Although performance measurement results reveal what has happened, they do not necessarily provide insight into why it happened or what actions should be taken as a result. In order to use performance measurement results effectively, it is necessary to move from mere measurement to predictive management (Amaratunga & Baldry, 2002). Companies must understand the central role of key performance indicators in guiding the organization. Ideally, a robust performance measurement system would act as an early warning mechanism that quickly reports incidents, diagnoses root causes, and guides necessary corrective actions (Bhasin, 2008).

2.1.1 Agency theory perspective

When navigating today's dynamic business environments, organizations often rely on control mechanisms (Pellinen, 2017, p. 32). Agency theory provides a structured framework for understanding how organizations select, implement, and process the outcomes of these mechanisms. Agency theory focuses on the scenario where two parties enter a contract and one party (the agent) works for the other (the principal). At the heart of the theory is the examination of the contract between the principal and the agent, the aim of which is to determine the most efficient contract under the prevailing circumstances. These conditions

include human factors such as self-interest, bounded rationality, and risk tolerance.

The agency theory research outlined by Eisenhardt (1989) falls into two separate categories: positivist and principal-agent relationship-oriented. The goal of positivist studies is to locate situations where conflicts of interest arise between the principal and the agent, as well as the strategies by which the principal directs the agent's behavior. In contrast, studies focusing on the principal-agent relationship delve into its practical applications, such as employer-employee dynamics or buyer-supplier interaction. Their primary goal is to determine the optimal basis for the principal-agent contract, given the desired outcome or behavior. These approaches complement each other, as the former explores different contract possibilities and the latter searches for the most efficient contract option under the shaping conditions of outcome uncertainty, agents' risk tolerance, information availability, and other relevant factors.

Agency theory aims to address the challenges inherent in the relationship between two key players: the agent and the principal. The first challenge, known as the agency problem, arises when the interests of the principal and the agent diverge, or when it is difficult or expensive for the principal to ensure that the agent acts in their best interests. This can manifest as moral hazard, where the agent prioritizes their own interests over those of the principal, or as adverse selection, where information disparities lead the agent to make decisions that are unfavorable to the principal (Eisenhardt, 1989).

Agency theory assumes that individuals are rational actors who seek to maximize their expected utility (Bonner & Sprinkle, 2002). When focusing on the employer-employee relationship, one-dimensional agency models generally assume that the agent will not work without incentive compensation. This is because the effort naturally expended by the agent without explicit incentives does not significantly affect the optimal solution (Kalmi & Kauhanen, 2006). However, multitasking models have found that agents can still invest effort even if there is no incentive reward (Holmstrom & Milgrom, 1991). Alternatively, in situations involving multitasking, measurement differences may appear. For example, in a scenario with two tasks, one task may be easily quantifiable, while measuring the other task proves challenging. In such cases, it is possible that the agent prioritizes an easily measurable task, even if the principal wants both tasks to receive equal attention. In these circumstances, it may be better not to use any incentives (Holmström, 2017).

Another challenge, the problem of risk allocation, arises when parties have different perceptions of risk, leading them to choose different solutions to the same situations (Eisenhardt, 1989). Agency theory modeling often assumes that individuals, such as employees, behave in a risk-averse manner (Bonner & Sprinkle, 2002). Thus, when monetary incentives are based on imperfect forms of behavior, such as outcomes affected by both effort and random factors, individuals may demand a risk premium. This brings with it the possibility of inefficient risk sharing, where the motivational benefits of performance pay must outweigh the loss of efficiency. Essentially, agency theory emphasizes the need

to strike a balance between providing sufficient motivating monetary incentives and effectively dividing work between different tasks. Achieving this balance requires careful consideration of how incentives are structured to match individual preferences and promote desired behavioral outcomes.

2.1.2 Common frameworks and models

In today's work environment, different frameworks are used to manage and measure performance. Balanced scorecard (BSC) is a leading framework widely used in strategic management (Neely et al., 2000), so it is a typical performance management tool (Cao et al., 2015). The primary strength of the BSC, which includes four main perspectives - financial, customer, internal processes, and learning and growth - is its ability to seamlessly integrate different dimensions of performance into a unified system, which translates the strategy into effectively functioning phases (Jalali Naini et al., 2011).

The Performance Pyramid developed by Lynch and Cross in 1991, is a hierarchical framework designed to align an organization's strategy with its operations, linking goals from top to bottom. It consists of four operational levels, which concern the organization's external effectiveness (left side) and internal effectiveness (right side) (Kurien & Qureshi, 2011). At the top of the pyramid is the company's vision, which defines its core idea, the products, and services it offers, and its customer base. The vision also defines the scope and efficiency of the operation. Moving down the pyramid, the next level focuses on the marketing and finances of the business units. Bridging the gap between top-level strategy and day-to-day operations, the enterprise operating system integrates metrics such as customer satisfaction, flexibility, and productivity. At the bottom of the pyramid, four key performance indicators (quality, delivery, turnaround time, waste management) are used daily at department and work center level (Järvenpää et al., 2013, p. 311). The main strength of the performance pyramid is the effort to align the company's goals with operational performance indicators.

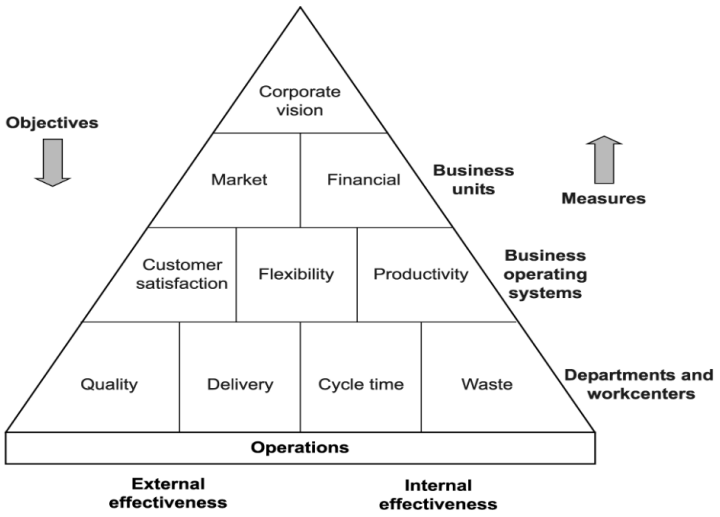

FIGURE 1 Performance pyramid. Source: Adapted from Kurien & Qureshi (2011)

The Performance Prism, developed by Cranfield University, shifts its focus towards stakeholders (Pellinen, 2017, s. 105-115). Neely et al. (2001) assert that it prompts managers to ask critical questions and consider the interconnections between merics in a manner that other frameworks do not intuitively suggest. (Neely et al., 2001). The framework's name encapsulates its functioning; it comprises five interlinked facets:

- Stakeholder Satisfaction: This facet delves into identifying important stakeholders and understanding their wants and needs, offering a broader perspective than the Balanced Scorecard (BSC) by encompassing employees, suppliers, alliance partners, regulators, and others.
- Strategies: Unlike the traditional approach of aligning measures with strategy, the Performance Prism asks what strategies are necessary to ensure stakeholders' needs are satisfied.
- Process: It focuses on the processes required to execute strategies, such as product development, demand generation, and enterprise planning, and emphasizes the identification of specific metrics to address associated questions.
- Capabilities: Recognizing the significance of people, practices, technology, and infrastructure in enabling business processes, this facet emphasizes the fundamental building blocks necessary for an organization's competitiveness.
- Stakeholder Contribution: Acknowledging the reciprocal relationship between organizations and stakeholders, this facet highlights the stakeholders' role in contributing to the organization's success, a critical and distinctive feature of the Performance Prism.

Unlike traditional measurement frameworks, the Performance Prism does not merely provide a perspective; rather, it serves as a tool for management teams to shape their thinking about the key questions relevant to managing their business effectively (Neely et al., 2001).

FIGURE 2 Performance Prism. Source: Adapted from Kurien & Qureshi (2011)

Balanced Scorecard (BSC), Performance Prism and Performance Pyramid represent collection of distinct approach to measuring performance. The primary purpose of the BSC is to identify indicators that are in line with the company's vision, mission, and strategy. It emphasizes the importance of deriving metrics directly from the company's strategic goals, which ensures a clear dependency or influence relationship between the desired goals and the metrics that follow their achievement (Järvenpää et al., 2013, p. 336). By combining a few strategically important metrics into one comprehensive report, the BSC makes cause-and-effect relationships visible, which prevents one metric from being weighted at the expense of others.

In contrast, Performance Prism takes a more holistic view of performance measurement. It expands its focus beyond owners and customers to include personnel, supply chains and other communities. This broader perspective is particularly useful for organizations with multiple stakeholders. Performance Prism aims to facilitate the selection of measurement systems that integrate strategies, processes and capabilities to achieve stakeholder satisfaction (Järvenpää et al., 2013, p. 335). By highlighting and differentiating stakeholder contributions and stakeholder satisfaction, it ensures a holistic approach to performance management.

The third approach, the Performance Pyramid, focuses on extending strategic goals to the entire organization primarily driven by the customer perspective. This framework emphasizes the importance of aligning the entire organization with strategic goals that reflect customer needs and expectations. Setting goals from the top down ensures that all levels of the organization are aligned with the overall strategic direction.

Comparing these references, the BSC stands out for its internal focus on aligning measures with strategic goals and clarifying cause-and-effect relationships. This prevents the improvement of a single measure at the expense of others. BSC has been criticized for being overly simplistic, and it does not sufficiently consider competitors or other important stakeholders. In addition, it was criticized for emphasizing the owners' goals too much. If the organization's goal setting is complex, a balanced set of indicators is considered to offer a too linear approach to setting goals and evaluating them. In contrast, the Performance Prism, with its holistic stakeholder approach, integrates different organizational aspects. It seeks to achieve holistic satisfaction in different groups, emphasizing the balancing and integration of multiple perspectives. The Performance Pyramid, on the other hand, emphasizes the expansion of strategic goals throughout the organization, ensuring that all efforts are aligned with customer-oriented goals.

While the BSC is effective in ensuring balanced improvement through clear visibility of cause-and-effect relationships, the Performance Prism provides a broader and more comprehensive framework that considers the needs and contributions of multiple stakeholders. The Performance Pyramid offers a customer-oriented approach to goal setting and strategic alignment, which ensures that the entire organization is oriented to meet customer expectations.

Each framework brings a unique perspective to performance measurement that reflects different organizational priorities and approaches to achieving strategic goals.

2.1.3 How to manage and measure performance in practice

Performance measurement can have a positive impact on the organization. It not only emphasizes the value of the measured performance, but also motivates employees to work towards goals (Pellinen, 2017, s. 340-342). In addition, it promotes healthy competition and creates conditions for rewarding achievements. However, to take advantage of these positive effects, it is crucial to choose the right metrics and set realistic goals. Even though researchers have presented several frameworks for selecting performance metrics, the main challenge is the lack of a step-by-step method to arrive at the best collection of metrics, most frameworks provide only general guidelines (Neely et al., 2005).

The development of an organization's performance measurement system typically involves three phases: planning, implementation, and utilization (Bourne et al., 2000). When designing a performance measurement system, Beamon (1999) outlines four essential questions to consider: what to measure, how to integrate multiple individual metrics into a coherent system, how often to measure, and how and when metrics should be reevaluated. The principles guiding the design of a performance measurement system are alignment with strategy, acceptance of both financial and non-financial metrics, simplicity of use, providing quick feedback, a balanced approach that covers different perspectives and a short- and long-term perspective (Camerinelli, 2016; Gunasekaran et al., 2004; Kurien & Qureshi, 2011; Neely et al., 2000). In addition, the dashboard should contain a limited number of performance metrics. Kaplan and Norton recommended 20-25 metrics for companies. Pellinen (2017, s. 340-342) states that in Finland the actual number of measures is 4-25 metrics per organization. Striking a balance between fewer and broader metrics versus a wider range of metrics can be challenging, as each approach has its advantages and drawbacks. If using wider quantity of metrics, there is more information about organization's performance. On the other hand, wider quantity of metrics can be hard to manage, and influence of metrics can be dizzy.

Despite extensive research on performance measurement and management, limited attention has been given to the implementation and continuous updating of performance measurement systems. Therefore, it is essential to focus on implementation, usage, and continuous improvement of these systems (Gopal & Thakkar, 2012). While the design, implementation, and use of performance metrics are critical, they are not standalone efforts; continuous review and adaptation processes should be put in place to ensure the system's relevance and effectiveness in changing business environments (Bourne et al., 2000). However, merely setting targets and measuring performance are insufficient to fully leverage their benefits. Therefore, it is usually worthwhile to link them to incentives (Järvenpää et al., 2013, p. 347-349).

Organizations can try to influence the effort levels of employees and the prioritization of different tasks by rewarding good performance. An ideal performance measure covers all aspects that employees can influence to improve the company's performance and nothing else (Lazear & Gibbs, 2014). In practice, however, no single measure can achieve such perfection. It is challenging to manage all the ways in which employees can influence the company's result, and on the other hand, the result is always affected by other factors as well. Incentives are often related to narrow financial rewards, such as bonuses or management stock options. However, these rewards form only a small part of a properly designed incentive system. Such systems must consider all activities in which employees may engage, including many non-financial metrics, and consider the different factors that motivate people in different environments. Well-designed metric systems and underlying employee incentives increase labor productivity (Cecere, 2014, s.49).

The entire performance measurement process remains ineffective if no action is taken based on the performance data produced. Unfortunately, this often fails (Neely & Bourne, 2000). The success and rationality of performance measurement can be evaluated using five criteria:

- Importance and Relevance of the measurement object
- Validity of measurement
- Reliability of measurement
- Understandability of measurement
- The cost-benefit ratio of the measurement

(Pellinen, 2017, s. 102-103)

In an effective performance measurement system, the metrics must be consistent with each other and guide operations in accordance with the organization's goals. However, the design, implementation and utilization of performance metrics are a continuous effort (Gopal & Thakkar, 2012). In a constantly changing business environment, the focus must be on developing dynamic performance measurement systems that quickly adapt to current needs and requirements. Organizations should prioritize performance management over mere measurement (Neely et al., 2005). However, choosing the right metrics is crucial for successful management, which highlights the key role metrics play in organizational success.

2.1.4 Why performance measurement fails?

Many companies face several problems with the performance metrics they use (Lambert & Pohlen, 2001). A key concern guiding organizations is obtaining information about the influences and outcomes of their actions (Pellinen, 2017, p. 37). This information is essential when evaluating the organization's performance and determining how operations should be further developed. The evaluation should be carried out from both a qualitative and quantitative perspective, focusing on the quality of the metrics. To make full use of the measurement

potential, it must be monitored and compared. Identified anomalies should act as a signal for actions that require necessary corrections (Pellinen, 2017, p. 37).

Efficiency issues are often related to simplicity and automation. The challenge is to measure as little as possible while ensuring that the measurements are meaningful. On the other hand, the issue of efficiency is a separate issue, as many organizations have difficulties getting value from performance measurement data, even if they have successfully designed and implemented a good measurement system. This failure to manage performance data is increasingly problematic in modern organizations. Despite robust infrastructures supporting performance reporting systems, the analysis of performance data is often neglected, and there is a lack of knowledge about the tools and techniques available to understand the data's messages. In addition, there is no improvement process related to the measurement data, and no means to evaluate how quickly the improvements have an effect or their direct correlation to the implemented actions (Neely & Bourne, 2000).

As the saying goes, "you get what you measure," metrics used as performance indicators should be carefully evaluated, even if not used with incentives. Human resources economics provides a valuable framework for evaluating performance metrics and identifying the root causes of performance measurement failure. Lazear & Gibbs (2014) present four main characteristics for evaluating incentive systems: risk profile, distortion, possibility of manipulation, and fit with work design. Because incentives are closely related to performance measurement, these same characteristics are also reflected in performance measurement indicators in general.

2.1.4.1 Risk profile

Risk can be divided into two types: uncontrollable risk and controllable risk. Uncontrollable risk is an unexpected variation in performance that cannot be controlled by the employee. Instead, a controllable risk is something that the employee can control. When considering performance metrics, it would be useful to analyze how much risk they contain. It is generally recommended that performance metrics include only what the employee can control, but exclude all uncontrollable risks (Lazear & Gibbs, 2014). If there is a lot of uncontrollable risk in a performance measurement, there are options to influence it in a few ways: for example, by ignoring (e.g. lower connection to incentives) that metric, or it can be replaced by another metric that is not as risky, that is, by using a narrower performance metric (Lazear & Gibbs, 2014). On the other hand, controllable risk can have the opposite effect. If there is a situation where the employee has some information that the company does not have, it is known in economics as asymmetric information. In this case, the employee can be encouraged to use all the knowledge he has for better performance, in which case a greater connection to the pay for performance is needed (Lazear & Gibbs, 2014). It is also worth noting that if the impact of the incentives is large, then the risk premium should also be included.

2.1.4.2 Distortion

When the goal is to reduce uncontrollable risks in performance measurements by choosing narrower metrics, another problem can arise: distortion (Lazear & Gibbs, 2014). Distortions can affect the success of performance measurement in different ways. For example, when a company has a specific goal to achieve, any measure other than this exact measure of that goal can be distorted. Another problem arises when the metrics do not measure what they should. For example, metrics identified as supply chain metrics may focus only on logistical metrics with an internal perspective, instead of covering the entire supply chain (Lambert & Pohlen, 2001). This narrow focus can lead organizations to improve their performance at the expense of other supply chain members, reducing overall supply chain value. Metrics such as inventory turnover can also pose challenges because they may not be able to capture the different forms of inventory, or the risk associated with holding inventory. Because supply chains involve multiple participants, pushing inventory down the supply chain can reduce overall supply chain performance despite improvements in inventory turnover at the supplier level (Lambert & Pohlen, 2001).

Another problem is the tendency of many organizations to focus exclusively on measuring aspects that are easy to measure and ignore important but difficult to measure indicators (Pellinen, 2017, p. 37). This selective focus can lead to unintended consequences, such as quality degradation, if metrics do not take quality aspects into account. In addition, there is often a gap between strategy and measurement. Developing metrics in isolation without connecting them to the organization's strategy or operational goals is a common mistake objectives (Beamon, 1999; Gunasekaran et al., 2004; Lambert & Pohlen, 2001). If critical aspects such as customer satisfaction are left unmeasured even if customer satisfaction is part of the company's strategic goals, it can divert performance away from the organization's original goals. Furthermore, there is an understanding of the importance of financial and non-financial performance metrics, but the link between them fails (Beamon, 1999; Gunasekaran et al., 2001). In addition, different managers may develop performance metrics for different purposes, leading to ambiguity in the organization's performance and potentially steering the organization away from its goals.

The scope of performance measurements can also pose challenges. Adding numerous metrics without understanding which ones are important can make it difficult to manage and identify key performance metrics. Likewise, failure to distinguish between metrics used at strategic, tactical, and operational levels can lead to inefficiencies in the utilization of performance measurement (Gunasekaran et al., 2001). For example, inventory levels may be more relevant when evaluating at an operational level if daily monitoring is possible.

Other common distortion in performance metrics include intangibles, opportunity costs, group size, and time horizon considerations. Intangible assets, such as quality measures in quantity-focused performance measurement, can pose challenges (Lazear & Gibbs, 2014). Opportunity costs can lead to distortions through accounting valuation problems, while decisions to use only internal

services can create monopoly-like conditions between departments, making performance evaluation difficult. Determining the appropriate group size for assessment can also be challenging, as narrow metrics can distort incentives by reducing cooperation between employees, while large-scale metrics can introduce unmanageable risks. Furthermore, the backward-looking nature of most performance metrics can distort incentives for actions with long-term consequences, requiring careful consideration of time horizons in performance measurement (Lazear & Gibbs, 2014).

2.1.4.3 Potential for manipulation

Another common problem with performance metrics is the possibility of manipulation. When a particular measure is emphasized, employees may be tempted to focus solely on improving that measure rather than the actual performance it represents. This tendency is particularly strong when performance metrics are tied to incentives (Lazear & Gibbs, 2014). Companies may believe that a metric correlates significantly with their desired goals, which is why they base bonuses on that metric. However, when incentives are combined with an action, employees may feel compelled to manipulate their performance to achieve the goal. As a result, the correlation between the metric and the company's value decreases, hindering the organization's ability to achieve its goals. In addition, the longer the metric is used, the more likely it is that employees will discover methods of manipulation. Narrower procedures are particularly susceptible to manipulation.

In organizations with a culture of blame, measurement can become challenging because individuals may resist the availability of measurement data (Neely & Bourne, 2000). As a result, people may prioritize a desired metric or number over actual performance. This phenomenon is commonly seen in settings such as call centers, where metrics such as average call handling time are key performance indicators. In such environments, operators may engage in practices such as intentionally booking a line or answering calls without contacting the caller to achieve target metrics rather than focusing on providing quality service (Neely & Bourne, 2000).

2.1.4.4 Match to job design

Since performance measurements are intended to guide employees towards the company's goals, it is important to assess how well these metrics fit into work planning (Lazear & Gibbs, 2014). One thing to consider is the scope of the metrics. A broader measure covers more aspects of performance, including a wider range of employee actions or outputs that are partially under the employee's control. The scope of the metrics can affect their susceptibility to manipulation, but other factors must also be taken into account. Broader metrics have the advantage of focusing on multiple aspects of performance, thereby avoiding narrow task focus, and achieving total performance. However, they also carry a higher risk, while narrower procedures may be more prone to distortion.

The ideal measure should align with the responsibilities of the job (Lazear & Gibbs, 2014). For instance, there are distinct differences between white-collar and blue-collar jobs, such as decision-making authority, task complexity, and requisite specialized knowledge. These differences may warrant the consideration of broader metrics for roles with higher levels of controllable risk, allowing for a more comprehensive assessment of employee performance by accounting for various variables (Lazear & Gibbs, 2015). When determining the scope of performance metrics, it's important to decide the number of tasks to include and the level at which work units should be measured—whether at the individual, team, or division level. Additionally, consideration should be given to the time horizon of the chosen measure, whether it is forward-looking or backward-looking (Lazear & Gibbs, 2014).

2.2 Performance measurement in Supply Chain context

The supply chain includes an integrated manufacturing process where raw materials are transformed into finished products and delivered to customers (Beamon, 1998). It consists of various components including suppliers, manufacturers, distributors, and customers. In addition, the supply chain also consists of many flows, such as information, finance, and products, which are essential components in any supply chain (Galankashi & Rafiei, 2022). Beamon (1998) emphasizes that despite the multifaceted nature of the supply chain, it can be conceptualized and managed as a unified whole. On the other hand, studies often focus on specific segments of the supply chain instead of looking at the entire supply chain.

Performance measurement systems have been analysed and classified in the literature, but only a few of them have focused on supply chain performance metrics (Gunasekaran & Kobu, 2007; Lambert & Pohlen, 2001). The complexity of supply chains poses challenges for decision-makers to choose the most suitable metrics from numerous options. Choosing the right metrics is a complex task that requires careful consideration. To address this challenge, various approaches to classify supply chain performance metrics have been proposed in the literature. Classification can provide valuable information about what metrics should be put in place to achieve a balanced perspective and what they measure. Metrics are typically classified into financial and non-financial or qualitative and quantitative metrics.

2.2.1 Performance metrics

It is generally recommended that organizations carefully select appropriate metrics that are aligned with their strategic goals (Elrod et al., 2013). This subsection first provides an overview of key performance metrics used in supply chain management and then identifies KPIs used in manufacturing processes.

Camerinelli (2016, p. 96) listed the most common combinations of three key performance indicators for supply chain organizations, collected from a survey of several European companies. Factors like inventory level, stock, transportation costs, perfect order fulfillment, flexibility, delivery accuracy, costs of goods sold, , planning accuracy, inventory turnover, supplier performance, on-time delivery and delivery reliability were mentioned among few others. Although several factors were considered, a review of the metrics revealed four primary indicators by which supply chain managers evaluate their performance: efficiency, cost savings, customer service and delivery performance. The study also highlights the lack of a standardized naming pattern for these metrics. On the other hand, despite similar terminology, apparently identical metrics cannot be assumed to produce consistent results.

The metrics mentioned above concerned the organization of the entire supply chain. Looking at the studies of several researchers (Bhasin, 2008; Gunasekaran et al., 2001, 2004; Gunasekaran & Kobu, 2007; Israel et al., 2023; Neely et al., 1995; Sangwa & Sangwan, 2018; Senol et al., 2021), 11 key performance indicators can be observed that have been used in the production organization to measure the performance of the manufacturing process:

- Defect rate
- Cost per operation hour
- Manufacturing lead time
- Manufacturing cycle time
- Stock level
- Work in process (WIP)
- Finished goods inventory
- Inventory turnover
- On-time delivery
- Capacity utilization
- Labor efficiency

Despite the variety of metric names, efficiency, cost savings, inventory levels, customer service, time and delivery performance can be identified as the primary concerns of the supply chain and manufacturing managers. For effective performance measurement and improvement, it is necessary that measurement should be achieved between the financial and non-financial impacts of the reflective organization, which can be linked to the strategic, tactical, and operational levels of decision-making and control (Gunasekaran et al., 2004).

2.2.2 Financial and non-financial metrics

The evaluation of a company's performance consists of both financial and non-financial dimensions. Financial metrics are primarily suited for strategic-level analysis, providing insights into long-term organizational performance and financial health (Gunasekaran & Kobu, 2007). In contrast, non-financial metrics

are often more appropriate at the operational level, offering insights into day-to-day operations and performance drivers. This chapter aims to understanding how financial and non-financial metrics work together to evaluate how well supply chain or manufacturing process are performing.

Both financial and non-financial metrics consist of quantitative and qualitative approaches for assessing supply chain performance. However, the overall goal of all companies in the supply chain is still to achieve financial sustainability by maximizing profits, minimizing costs, and ensuring customer satisfaction. Despite this, many companies often overlook the need for a balanced framework containing both financial and non-financial metrics. Financial metrics often reflect past performance, so focusing heavily on them could cause problems in long term. Yet, for long-term survival, putting customer satisfaction first is crucial. This means looking at things like quality, cycle time, employee skills, and productivity (Gautreau & Kleiner, 2001). This approach offers a more proactive approach to sustaining competitive advantage.

Through examination of existing literature, Israel et al. (2023) analyzed and synthesized seven constructs of non-financial metrics along with their corresponding metrics of supply chain performance. These include customer satisfaction, quality performance, supply chain relationships, competitive advantages, lead time, and delivery performance. These metrics are detailed in Table 1 above. Additionally, the study identified three constructs related to financial supply chain performance metrics and their associated metrics. The financial supply chain costs, inventory turnover and cash flows. Metrics of these are presented later in Table 2. The following sections provide a comprehensive discussion about these.

Measuring and managing customer service success and satisfaction are vital components of supply chain management for gaining competitive advantage in the global market. Thus, customer satisfaction is a key measure of firm and supply chain performance (Lehyani et al., 2021). It's a central objective of supply chain management, measured by how products and services exceed customer expectations and the perceived value they provide. Studies highlight the importance of customer satisfaction in supply chains, emphasizing quick and cost-effective responses to customer needs (Israel et al., 2023). Without satisfied customers, supply chain performance suffers, underscoring the need to measure customer satisfaction in assessing overall supply chain effectiveness.

Quality performance is an important non-financial measure of supply chain success, evaluating products, processes, and services. Organizations use various quality metrics to ensure effective customer interaction and operational management, as well as customer satisfaction at manageable costs. Metrics include adherence to agreed specifications, low defect rates, and efficient processes (Israel et al., 2023). High defect rates may impacting production, cycle time, order fill rate, and customer satisfaction (Senol et al., 2021). Key performance indicators (KPIs) such as defect rate, order fill rate, product return rate and product damage rate monitor the synchronization of operations against quality standards (Senol et al., 2021). Improving quality improve reputation,

competitiveness, and profitability by making operations more efficient and attracting customers (Israel et al., 2023).

TABLE 1 Non-financial metrics of supply chain. Source: Israel et al. (2023)

SC Performance measures	SC Performance metrics (KPIs)
Customer satisfaction	Customer perceived value of products and services
	Customer query time
	Flexibility
	Responsiveness
	Customer's order fill rate
Quality performance	Meeting agreed products and service specifications
	Number of complaints
	Defect rate and rejection rate
Supply chain relationships	Collaboration, strategic partnerships and alliances
	Fewer disputes
	Joint problem solving
	Trustworthy
Competitive advantages	Meeting market requirements: cost, quality, standards, and time, credibility, financial and human resources capability
	Supply chain innovations
Lead time	Order processing time
	Production lead time
Delivery performance	Total cycle time
	Delivery at the right place
	Suppliers' reliability
	On time delivery
	Quality of delivered goods

Supply chain relationships is a non-financial metric that evaluates partnerships, coordination and cooperation between companies (Israel et al., 2023). Prime indicators include long-term partnerships, joint problem-solving, and reduced disputes (Sillanpää, 2015). Such relationships improve supply chain performance by attracting and retaining customers and suppliers, and reducing costs and risks (Israel et al., 2023).

Supply chain competitive advantage reflects the qualitative efficiency of companies and their supply chains, which is measured by their ability to outperform competitors in responding to market demands (Israel et al., 2023). This covers meeting cost, quality, and time requirements, as well as commercializing unique products or services. Organizations that can meet these requirements demonstrate superior supply chain performance, which strengthens sustainability and overall business performance. In addition, such advantages facilitate market entry and promote sustainable growth and development (Israel et al., 2023).

Effective time management is important in the operation of the supply chain, which covers activities from procurement to customer delivery. Time directly impacts strategic processes and is measured using various metrics. Lead

time serves as a non-financial, quantitative measure of supply chain performance, representing the average time required to complete specific tasks or processes within the supply chain (Israel et al., 2023). It's assessed in relation to total cycle time. Key metrics include time for order processing and distribution activities. Shorter lead times increase performance by ensuring timely delivery and customer satisfaction, while longer processing times lead to delays and dissatisfaction (Israel et al., 2023). Timely delivery of outsourced inventory reduces operational costs and increases customer satisfaction. Key performance indicators include supplier lead time, on-time production, and on-time delivery, crucial for maintaining competitiveness (Senol et al., 2021).

Delivery performance, an important non-financial metric, metrics the efficiency of the supply chain in processing procurement requirements and delivering to customers within specified time frames (Israel et al., 2023). It covers on-time delivery, accuracy in delivery location and order completeness, and reliability of suppliers. These metrics align with supply chain management objectives, ensuring the right quality and quantity of goods are delivered to the right place and time. On-time delivery ensures continuous supply availability, preventing stock-outs and maintaining customer satisfaction (Israel et al., 2023).

As mentioned before, financial metrics are also important in addition to the non-financial metrics presented above. The essence of supply chain management lies in executing activities and delivering goods and services to customers at minimal costs. Extensive literature highlights the importance of cost-effectiveness throughout the supply chain, achieved by meticulously quantifying and optimizing various costs incurred in supply chain operations (Israel et al., 2023). These costs include manufacturing costs, raw material costs, acquisition and operational costs, inventory costs, transportation and distribution expenses, service costs, and risk-related costs. The main objective of supply chain management is to operate within predefined budget constraints, ensuring cost-effectiveness and sustainable financial performance. Furthermore, the adoption of sustainable supply chain practices such as Just-In-Time (JIT) can significantly contribute to achieving cost-effectiveness and sustainable financial performance (Galankashi & Rafiei, 2022).

Supply chain organizations aim to enhance operational performance and customer satisfaction by minimizing overall costs. Modern supply chain management emphasizes controlling the flow of processes such as products, information, and cash (Senol et al., 2021). Managing operational costs in the highly complex structure of global supply chain operations is challenging. It is important for companies to identify and measure key performance indicators (KPIs) to effectively manage supply chain operations. Monitoring KPIs such as forecasting accuracy rate and inventory turnover rate directly impacts procurement costs (Senol et al., 2021).

Another important measure of supply chain performance from a financial perspective is the inventory turnover rate (Israel et al., 2023). This metric indicates how efficiently businesses within the supply chain utilize their inventory, reflecting the frequency of inventory purchase, usage, and

replenishment within the organization. Calculated as the ratio between the cost of goods sold and the average annual inventory, a higher inventory turnover ratio signifies robust sales performance, increased revenue, and improved profit margins. Conversely, a lower inventory turnover ratio indicates slow sales or declining demand, which leads to lower revenue and profitability (Israel et al., 2023).

Cash flows serve as a vital measure of the supply chain's financial sustainability, representing a quantitative measure of financial performance (Israel et al., 2023). In the examined literature, authors emphasize key metrics such as sales revenue, return on equity (ROE), profit margin, return on assets (ROA), return on investment (ROI), efficiency in asset management, and operational equipment efficiency as pivotal indicators of sustainable financial cash flows and overall supply chain performance (Israel et al., 2023). Elevated ROA, ROE, and ROI signify financial growth and sustainable supply chain performance. Additionally, the net profit margin emerges as a primary determinant of supply chain financial performance, computed as total revenues minus total incurred expenses (Israel et al., 2023).

TABLE 2 Financial metrics of supply chain. Source: Israel et al. (2023)

SC Performance measures	SC Performance metrics (KPIs)
Supply chain costs	Logistics costs
	Cost for raw materials
	Manufacturing cost
	Transport cost
	Material return costs
	Inventory holding costs
	Risk costs-obsolescence, loss, damages and scraps
Inventory turnover	Inventory turnover ratio
Cash flows	Gross sales/revenue
	Working capital
	ROA
	Assets and operational equipment
	Assets turnover ratio
	ROI
	Gross profit margin
	ROE

In terms of strategic management, it is important that there is a strong connection between the operation of the supply chain and the financial performance of the organization. This link allows companies to relate their operational achievements directly to their overall financial situation. Often, however, the challenge arises when there is a conflict between the way supply chain performance is measured and the financial goals (Elgazzar et al., 2012; Presutti & Mawhinney, 2007). This difference can lead to activities that do not support the organization's goals, which in turn poses significant challenges.

When performance metrics are not aligned with organization's goals, they often encourage counterproductive behaviour, leading to increased supply chain costs and management difficulties (Alexander, 2018, p. 175; Cokins et al., 2021, p.181).

Ensuring a balanced set of metrics is important to prevent unintended consequences. For example, excessive focus on inventory turnover can negatively affect customer deliveries (Alexander, 2018, p. 175). Furthermore, performance metrics should be forward-looking to drive effective process improvement (Cokins et al., 2021, p. 181). However, misalignment may be overlooked by management, resulting in short-term fixes and long-term harm. Narrowly focused performance measurements can also hinder effective cost management throughout the supply chain (Cokins et al., 2021, p. 185). In the next chapter, a closer examination will be conducted to understand the drivers of operational performance and how metrics are interconnected with each other.

3 LINKING PERFORMANCE MEASUREMENT TO OPERATIONAL EFFECTIVENESS

In this chapter, the focus is on understanding the interrelationships between performance metrics and how they drive operational performance. First, in subchapter 3.1, operational effectiveness and its measurement will be discussed. Following that, in subchapter 3.2, the interrelationships between metrics will be examined. Subchapter 3.3 delves into Lean manufacturing practices and its significant influence on company performance. Previous research will be presented in subchapter 3.4. Finally, the chapter will conclude with a summary of the theoretical insights.

3.1 Operational effectiveness

The company's financial decisions are guided by accounting data, typically focusing on the profit and key ratios (Pellinen, 2017, p. 58-59). The goal is to maximize profitability and minimize costs. However, solely relying on profit and loss statements may overlook capital costs, potentially leading to investment-focused strategies rather than operational effectiveness. This subchapter aims to view how operational effectiveness can be measured and what drives it. Main focus is on how operational effectiveness can be increased in manufacturing environment.

Operational effectiveness can be measured by factors such as business process efficiency, execution, and cost management, with industry-specific considerations influencing priorities (Alexander, 2018, p. 362-363). On the other hand, profitability is often considered as a key indicator of operational effectiveness. It's important to note that a highly inefficient organization can still achieve high profit margins if it possesses a strong competitive advantage that allows it to maintain high prices (Alexander, 2018, p. 361). However, this scenario may not be sustainable in the long run, as competitors are likely to enter the market attracted by the high margins. Moreover, profitability alone does not

account for the asset levels required to sustain a business. Return on capital employed (ROCE) and return on equity (ROE) offer more comprehensive metrics of management effectiveness, as they consider both profitability and asset utilization (Alexander, 2018, p. 361).

The dynamics of each industry also strive significant influence; for instance, mature sectors such as automotive prioritize cost reductions, while others like aerospace place a premium on quality (Alexander, 2018, p. 368). Effective forecasting of future demand is essential to avoid increased costs and ensure customer satisfaction. In many businesses, fixed costs such as factories and personnel are significant. For instance, factory utilization is typically measured through metrics like labor hours, material or process throughput, or production output, depending on the nature of the business. Likewise, understanding operations such as refineries' capacity, break-even point, and utilization is critical to monitoring operational performance (Alexander, 2018, p. 368).

Efficient business processes are the primary factor affecting operational efficiency and profit margin. The efficiency of operations has a significant impact on costs and thus on value creation. Key processes such as supply chain management, revenue process management, and new product development (NPD) affect financial factors (Alexander, 2018, p. 362). Evaluating the performance of these processes holistically, rather than through isolated income statement classifications or functions, is typically more effective (Alexander, 2018, p. 362). Although specific functional areas may be responsible for certain outcomes, such as manufacturing for inventory levels and finance for receivables, it's essential to recognize that most outcomes result from processes that cover multiple functional areas. Thus, the essential step of breaking down drivers and aligning them with their corresponding processes is important for achieving effective management (Alexander, 2018, p. 391). Subchapters 3.3.2 and 3.3.3 will review KPIs for key processes influencing operational effectiveness focusing on areas that case organization can influence. But first, in next subchapter, Interrelationships between metrics are discussed. After that, in subchapter 3.3 Lean manufacturing will be presented because it’s significant role driving operational effectiveness in manufacturing industry.

3.2 Interrelationships between metrics

Understanding the complex relationship between performance metrics and financial performance is important for effective organizational management. Cause-effect relationships between performance metrics are important to understand. If improving one measure leads to increase in another, there exists a cause-effect relationship between them. Conversely, a negative change in one measure is likely to adversely affect the other. On the other hand, problems may also arise because the metrics conflict with each other. Thus, understanding and thoroughly evaluating these complex relationships is essential.

For example, in a manufacturing environment, increasing production output can be achieved through various strategies, such as reducing cycle times or eliminating unproductive time (Neely et al., 1997). However, focusing solely on improving one metric may lead to unintended consequences. For instance, consider the decision to increase batch sizes to minimize setup time without considering its broader impact on inventory levels and overall operational efficiency (Neely et al., 1997). These actions may lead to hidden costs and operational inefficiencies, highlighting the importance of implementing comprehensive performance measurement strategies. Similarly, existing accounting systems can misguide management focus, leading to suboptimal decisions and resource allocation. Hence, ensuring that performance metrics align with organizational objectives and recognizing their broader impacts are important for effective performance management and informed decision-making. By cultivating a deeper understanding of the complex interrelationships between performance metrics and organizational outcomes, companies can navigate challenges more adeptly and drive sustainable success (Neely et al., 1997).

3.2.1 DuPont model visualizes relationships

Traditionally, supply chain management processes seek to synchronize supply and demand using advanced forecasting techniques. However, in today's globalized networks, a new challenge arises: balancing cost reduction and efficient asset utilization. While efforts are made to minimize costs by eliminating waste, it is equally important to optimize the use of company assets (such as equipment, capital, and inventory) to maintain overall supply chain efficiency and profitability (Camerinelli, 2016, p. 154).

The DuPont model, developed by the DuPont Corporation in the 1920s, offers a detailed analytical framework for assessing a company's profitability and visualizing the connections between financial measures. Unlike the simple return on equity (ROE) formula, the DuPont model provides a more comprehensive metric by breaking down the various components contributing to a company's ROE. This breakdown allows managers to identify the underlying factors driving performance and address them systematically (Camerinelli, 2016, p. 155). Additionally, the DuPont model helps uncover the key drivers of profitability and turnover trends over time, serving as a valuable tool for identifying both strengths and weaknesses in financial statements (Aikor, 2022).

In addition, the return on invested capital (ROCE) reflects the company's profitability and capital efficiency. It can be used to assess how efficiently a company is using its working capital to generate profit and provides valuable insights into its ability to create value through operational activities rather than financial movements. Thus, analyzing ROCE proves to be useful in gaining a deeper insight into the factors affecting efficiency and profitability. ROCE is determined by multiplying the profit margin by the capital turnover. The DuPont formula can also effectively illustrate the components of ROCE.

$$\text{ROCE} = \frac{\text{ROCE}}{\text{SALES}} \text{ X } \frac{\text{SALES}}{\text{CAPITAL EMPLOYED}}$$

Profitability measurement (EBIT / sales) describes the operational performance of a business, often quantified as return on sales. It reflects the efficiency of operations within the profit and loss account, excluding finance costs. Instead, capital turnover ratio (sales / capital employed) indicates the efficiency of the use of resources according to the balance sheet and gives insight into how efficiently the organization uses its resources.

The DuPont model's significant contribution becomes more obvious when represented graphically, as shown in Figure X. The visualization helps to clarify the financial connections between operational challenges and financial performance. The key indicators of financial performance— profit margin and capital turnover—are broken down into components tightly linked to activities fostering operational excellence (Camerinelli, 2016, p. 155).

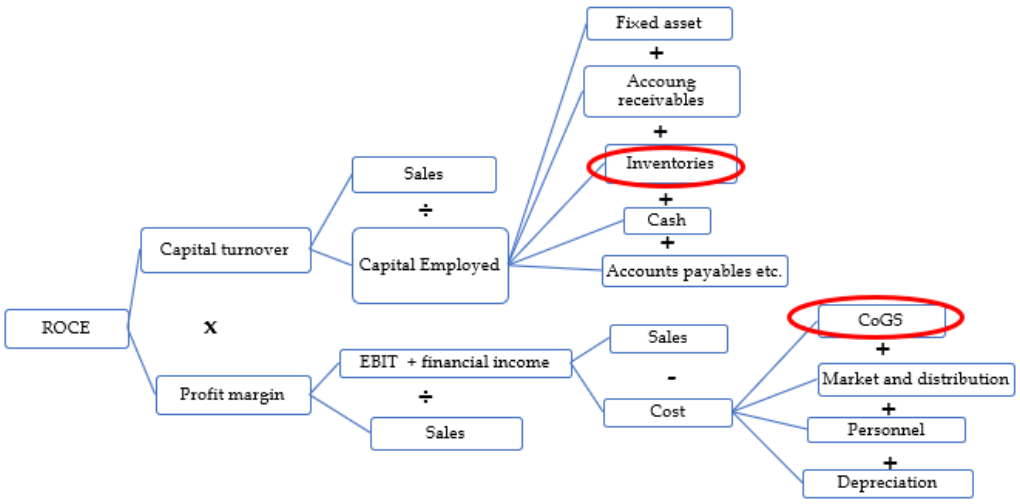

FIGURE 3 DuPont model of supply chain impact to business

Overall, the DuPont model offers a straightforward and practical operational metric by addressing both profit and capital considerations. This enables it to effectively capture the numerous trade-offs between income statement and balance sheet elements in value creation (Camerinelli, 2016, p. 157). The DuPont analysis is typically used to compare past results and identify reasons for improvements or declines in performance.

The focus of this thesis is on the components under the influence of the target organization, which are inventories and cost of goods sold (COGS). Inventories affect the company's result through capital employed, and it is strongly connected to cost of goods sold, so in next chapter cost drivers of

inventories will be discussed. After that, the costs drivers related to the COGS are presented.

3.2.2 Drivers of inventory costs

Inventory requirements vary across businesses and industries. Retailers need inventories for resale, manufacturers require materials for production, while service firms like consulting companies have minimal inventory needs. The core principle of Lean Manufacturing is waste reduction, with inventory being among the most critical forms of waste (Sangwa & Sangwan, 2018).

Within a supply chain, inventory costs consist of various components (Pohlen, 2003). These include opportunity cost, which includes inventory costs, capital tied up in inventory, and storage costs. In addition, there are costs associated with the inventory itself, such as incoming inventory levels and work in progress (WIP), as well as service costs related to inventory management and insurance (Pohlen, 2003). Adopting a just-in-time (JIT) inventory model minimizes holding costs by synchronizing deliveries with production or demand. In addition, optimizing the safety stock level based on historical data and lead times helps companies find a balance between customer service and inventory costs. In addition, there are costs associated with scrap and rework due to defective inventory, and inventory shortage costs due to lost sales or production (Pohlen, 2003). Part and material size should also be considered, as lower-cost parts may require significant storage space due to their large size. Moreover, it's essential to carefully assess trade-offs when managing inventory across different levels of the supply chain (Pohlen, 2003).

In manufacturing company, improving purchasing and manufacturing efficiency can reduce inventory levels and costs (Alexander, 2018, p. 410-411). Companies with a broad product selection generally maintain higher inventory levels. Conversely, firms with limited product options usually have lower inventory. Vertical integration versus outsourcing also affects inventory levels, with integrated firms typically carrying more inventory (Alexander, 2018, p. 410-411).

Forecast accuracy is crucial for managing inventory levels (Pohlen, 2003). By making accurate forecast about demand and ensuring that inventory levels are optimal, businesses can avoid both overstocking and understocking scenarios. This helps reduce the risk of inventory obsolescence and reduces the need for markdowns or discounts to clear excess inventory. Thus, improving forecasting processes and increasing flexibility can help mitigate inventory challenges (Alexander, 2018, p. 410-411).

Reducing lead times is proven to be an efficient way to implement contradictory objectives of production control (Haverila et al., 2009, p. 404). Lower lead times can reduce employed capital and enhance a good performance (Alexander, 2018, p. 410-411). Enhancing supplier quality and delivery performance can cut lead times and inventory levels. Consideration must also be given to longer lead times due to increased distances, as this can increase inventory volatility, leading to either excessive or insufficient inventory levels

(Pohlen, 2003). Such fluctuations can escalate administrative costs and lead to lost sales.

Poorly managed new product introductions can lead to high inventory levels and potential obsolescence, while ineffective end-of-life planning may result in unsalable inventory (Alexander, 2018, p. 410-411). Designing products for manufacturability can reduce costs and inventory requirements by simplifying assembly processes and using common components. Product quality also influences inventory levels; companies producing high-quality products typically require lower inventory levels due to reduced material input, testing, repair, and rework (Alexander, 2018, p. 410-411). In addition, product life cycle significantly impacts inventory levels, particularly during new product introduction and end-of-life phases (Alexander, 2018, p. 410-411).

Leveraging inventory management software and advanced analytics tools improves visibility, automates processes, and provides real-time information on inventory levels, demand patterns, and order fulfillment. This enables companies to make data-driven decisions and optimize inventory management strategies to improve profitability. Effective inventory management, coordinated with company and supply chain strategies, achieves a balance between flexibility and efficiency. While higher inventory levels increase flexibility, they also increase costs and affect metrics such as cost of goods sold (COGS), cash-to-cash flow, and supply chain assets (Alexander, 2018, pp. 411–414). Optimum inventory management minimizes transport costs and improves overall operational efficiency.

In summary, effective inventory management is essential to reduce costs and maximize profitability. It requires a combination of accurate forecasting, JIT inventory practices, safety stock optimization, supplier management, and technology adoption. Continuous monitoring, analysis and adjustment are necessary to adapt to changing market dynamics and customer needs.

3.2.3 Drivers of cost of goods sold (COGS)

It's essential to integrate supply chain costing with the performance measurement system. This connection ensures that supply chain costing isn't isolated but considers factors like quality and throughput cycle time (Cokins et al., 2021, p. 182). This linkage increases a deeper understanding of costs and their drivers, fostering a culture of cost-consciousness within organizations. Combining costs and performance metrics is a step towards effective cost management and strategic decision-making. Additionally, when cost and performance drivers are identified, targeted actions can be taken to achieve the desired results (Cokins et al., 2021, p. 186).

Cost of goods sold (COGS) plays a key role in businesses dealing with physical goods. It indicates the costs associated with producing a product or service to be sold on the market. It represents the total costs incurred from purchasing raw materials and converting them into finished products. COGS typically includes three main components: direct labor, direct materials, and manufacturing costs (Camerinelli, 2016, p. 153).

Understanding COGS is important to accurate cost management and strategic planning, given its impact on profitability (FasterCapital, 2024). Regular cost analyses are essential for proactive COGS management, which allows companies to identify inefficiencies and cost savings opportunities. By understanding drivers of cost of goods sold, such as volume, complexity and variety, companies can identify areas for cost optimization and improve profitability in a competitive market. Understanding COGS enables companies to make informed decisions about pricing, production volumes, and cost-cutting metrics, ultimately creating sustainable cost structures that support sustainable profitability and competitive advantage.

The volume of production or sales directly affects COGS. While higher volume can increase costs, it also brings economies of scale, leading to lower average unit costs. Finding the balance between volume and profit requires identifying the optimal production or sales level that maximizes efficiency and profitability. Complex products or services often leads to higher costs due to increased resource allocation and longer development and lead times. Simplifying processes and products is important to reduce costs and maintain value. In addition, offering a wide range of products or services can increase costs related to inventory management. Achieving a balance between variety and profitability requires strategic market segmentation and customized product offerings that meet specific needs of customers. By comprehensively understanding and analyzing these factors, companies can target cost optimization areas and improve profitability in competitive markets.

Raw materials and components are primary drivers of COGS. Direct material refers to raw materials that are used directly in the manufacture of goods (Camerinelli, 2016, p. 153). Their costs can vary due to market conditions, supply chain issues, and geopolitical factors. For instance, an increase in the price of steel can directly raise cost of raw material and thus cost of goods sold. Production supplies such as lubricants, cleaning supplies, and packaging materials also contribute to COGS. Although these items may seem minor individually, they accumulate over time and affect total costs. Efficient management of these supplies is necessary to keep costs down. Manufacturers must establish strong relationships with suppliers and negotiate favorable terms to reduce cost variations. Additionally, minimizing material waste through efficient production processes is essential, as wasted materials increase costs.

Direct labor costs covers the cost of all labor directly involved in the manufacturing process, such as assembly line workers, excluding support activities such as maintenance (Camerinelli, 2016, p. 153). These costs another significant component of cost of goods sold. Worker productivity and efficiency are critical; well-trained employees can produce more units in less time, reducing labor costs per unit. High overtime rates and inefficient labor schedules can inflate these costs. Investing in workforce training and optimizing schedules are effective strategies for controlling labor expenses. Quality control is vital for managing costs of quality (Alexander, 2018, p. 377). Costs related to control, testing, and handling defective products must be managed carefully. Robust

quality metrics reduce the costs associated with rework and waste, ensuring products meet standards and minimizing production costs.

Manufacturing overhead includes utilities, equipment depreciation, and maintenance. Manufacturing overhead includes all costs associated with production that are not tied to specific products, such as indirect labor, indirect materials, property taxes, insurance, heating, and lighting (Camerinelli, 2016, p. 153). The costs of electricity, gas, and water used in production, along with the depreciation of machinery and regular maintenance, significantly impact cost of goods sold. Efficient management of these overheads involves balancing optimal equipment performance with controlling utility consumption. Outsourcing and subcontracting production can help control costs, but on the other hand, they can also present challenges, as the costs of third-party services and contract terms directly affect COGS (FasterCapital, 2024). Manufacturers must carefully evaluate the benefits and costs of outsourcing to ensure it leads to overall savings without compromising quality. Finally, process efficiency, including cycle time and yield rates, significantly impacts COGS. Shorter cycle times and higher yield rates reduce costs by spreading fixed costs over more units. Continuous improvement initiatives like Lean manufacturing and Six Sigma increase efficiency and yield.

Companies can use several strategic approaches to control costs. First, effective inventory management is the key to effective COGS management. It includes tracking raw materials, work in progress and finished products. Leveraging inventory management systems streamlines this process and provides real-time information on COGS components. Supply chain management also struggles with its own challenges, with one notable pitfall being the inaccurate assessment of inventory costs. Two commonly overlooked inventory costs are obsolescence and rework due to engineering changes. Logistics and transportation costs, including inbound freight and internal movement of materials, also influence COGS. Efficient logistics planning, route optimization, and shipment consolidation can reduce these costs.

Implementing Lean manufacturing practices is another effective strategy, aiming to eliminate waste and streamline processes (Sangwa & Sangwan, 2018). This includes initiatives like Just-in-time (JIT) inventory management and continuous improvement efforts, which can result in notable cost reductions within a relatively short timeframe. Third, like mentioned before, building strong relationships with suppliers, and negotiating favorable terms is important for controlling costs (Sangwa & Sangwan, 2018). By utilizing purchasing power and long-term contracts, companies can ensure the stability of pricing and availability of materials, which ultimately leads to significant savings. The fourth strategy involves leveraging technology and automation to increase cost control efforts (FasterCapital, 2024). By automating repetitive tasks, implementing sophisticated inventory management systems, and upgrading machinery, businesses can significantly improve operational efficiency and productivity, resulting in reduced direct costs.

Existing supply chain models predominantly rely on traditional cost metrics and have yet to fully leverage the benefits of strategic cost management within the supply chain. Aligning strategic goals with supply chain performance metrics is essential for manufacturing organizations. This alignment ensures that performance metrics reflect the chosen manufacturing strategy, enabling companies to assess whether their performance aligns with strategic objectives (Beamon, 1999). Moreover, by measuring specific performance indicators, organizations can direct their focus toward areas deemed critical to achieving strategic goals. In addition, traditional management accounting faces numerous shortcomings, including irrelevant cost categories, cost distortions (especially in overheads), and inflexible reporting that often arrives too late to be actionable.

In summary, effective cost control is vital for companies to maintain profitability and increase sustainable growth. Through accurate cost analysis, implementation of Lean practices, strategic supplier negotiations, technology investments, and ongoing review and improvements, companies can adeptly manage direct costs and optimize costs of goods sold (FasterCapital, 2024).

3.3 Lean Manufacturing

Lean Manufacturing (LM), often referred to simply as "Lean", embodies a manufacturing philosophy that prioritizes the creation of value for the end customer, but considers all resources used for other purposes as wasteful and therefore to be eliminated (Lavette, 2014, p. 4). This approach, originating from the Toyota Production System (TPS), emphasizes the optimization of flow and the reduction of inefficiencies to increase overall customer value (Cardenas-Cristancho et al., 2021). Over time, Lean has evolved as a refined strategy building upon earlier efficiency endeavors, drawing insights from methodologies such as Taylorism and Fordism (Lavette, 2014, p. 4). One perspective sees Lean as a toolkit for identifying and eliminating waste (muda), leading to improved quality, reduced production time, and lower costs. Tools like Value Stream Mapping, Five S, Kanban, and poka-yoke aid in waste reduction. Alternatively, Toyota's approach emphasizes improving the flow of work in order to remove unevenness (mura) throughout the system, which indirectly reduces waste.

Both Lean and TPS comprise a set of interconnected principles aimed at cost reduction through waste elimination. These principles encompass pull processing, perfect first-time quality, waste minimization, continuous improvement, flexibility, supplier relationships, autonomation, load leveling, production flow, and visual control. Furthermore, Lean Six Sigma, a combination of Lean and Six Sigma methodologies, leverages a structured approach encapsulated in the DMAIC process (define-measure-analyze-improve-control) (Lamine, 2020, p. 127-130). This methodology focuses on reducing process variability, aligning projects with customer requirements, engaging employees

in continuous improvement, and enhancing overall organizational effectiveness and efficiency.

Lean production can bring many significant improvements to companies. By using Lean management tools, companies can significantly shorten the total manufacturing cycle time and lead time, facilitating quicker responses to market fluctuations and increases the company's flexibility (El-Khalil, 2022). Moreover, these tools enable organizations to minimize inventory levels, like work in progress (WIP), thereby eliminating excess waste (Bhasin, 2008). The implementation of lean practices further contributes to a reduction in defects, leading to fewer defective products and a consequent decrease in both employee and customer injury risk. In addition, Lean methodologies reduce machine downtime, which is connected to better workplace safety (El-Khalil, 2022). Furthermore, these tools improve product quality, boost company productivity, and shorten product delivery times, ultimately increasing customer satisfaction (El-Khalil, 2022). In addition, lean methods can lower costs, cause higher revenues and throughputs, and increased profitability (Bhasin, 2008).

Measuring resource utilization, particularly costs, is a vital component of effective supply chain management (Beamon, 1999). While strategic goals of organizations emphasize the importance of minimizing resources, they also highlight the overall significance of the system's output. Moreover, metrics should be tailored to address both long-term strategic goals and short-term operational objectives effectively. Effective performance metrics should enable organizations to measure progress against targets and checkpoints (Bhasin, 2008). It's critical for lean enterprises to deploy early warning systems, which can either affirm progress or signal the need for problem-solving. A valid assessment requires a diverse portfolio of metrics, including those depicting the product portfolio and its lifecycle, as well as measures of value to the organization both internally and externally. Performance measurement within Lean Six Sigma covers six dimensions: productivity, delivery, inventory, quality, cost, and lead time (Lamine, 2020, p. 127-130).

Variability in time and quantity pose significant challenges to Lean practices, requiring efforts to reduce their impact (Bhasin, 2008). Organizations often address variability in production systems through inventory, capacity, or time management strategies. Total product cycle time emerges as a pivotal metric for tracking lean progress (Bhasin, 2008). Long cycle time leads higher production costs. On the other hand, short cycle time means lower production costs, and it’s related also to shorter lead time and lower inventory. Lead time serves as a fundamental non-financial metric within supply chain performance evaluation, offering a quantitative measure of the average duration necessary to execute a specific task or process within the supply chain (Israel et al., 2023). It includes various stages such as order processing, production, and distribution. Shorter lead time improves performance, which enables on-time delivery and improves customer satisfaction (Israel et al., 2023). Conversely, longer lead times can result in delivery delays and customer dissatisfaction. Measuring lead time is critical because it has a significant impact on customer satisfaction and supply

chain costs. This metric not only reflects the efficiency of supply chain activities but also influences other performance indicators (Israel et al., 2023). In addition, lead time serves as a highly effective method for addressing conflicting objectives within production management (Haverila et al., 2009, p. 404). It enables the simultaneous reduction of the stock level and the increase of the delivery capacity.

3.3.1 KPIs for manufacturing process

In Lean Manufacturing, continuous improvement, productivity, and cost reduction are fundamental principles. Within manufacturing category, there are six key performance dimensions: quality, delivery, process flow, time, cost and inventory. A thorough analysis of 36 research publications Sangwa & Sangwan (2018) identified a total of 33 key performance indicators (KPIs) through frequency analysis.

Quality: In today's rapidly changing economic landscape, the importance of quality cannot be overstated. Quality in manufacturing organizations is often measured by defect, rework, and scrap rates. In the modern business environment, organizations cannot afford defects and rework. Key performance indicators (KPIs) for this dimension include defect rate, Poka-yoke implementation, scrap ratio, and first pass yield (FPY).

Delivery: With customers becoming the focal point of business strategy for manufacturing organizations, meeting delivery commitments has become paramount. Ensuring timely delivery of goods requires accurate estimation of delivery times. Improved on-time delivery is considered a critical factor for success in the market. KPIs for this performance dimension include on-time delivery, transportation or motion efficiency, and flexibility.

Process Flow: Continuous improvement, productivity, and cost reduction are foundational principles of Lean Manufacturing (LM) systems. The pull system, a core component of Just-in-Time (JIT) manufacturing, is crucial for LM implementation. KPIs for this dimension include utilization efficiency, worker efficiency, space productivity, overall equipment effectiveness (OEE) index, lot size reduction, allocation efficiency, pull process efficiency, number of non-value added activities, and process capability index (Sangwa & Sangwan, 2018).

Time: In today's highly competitive global business landscape, the efficient use of time is paramount for organizational success. Lead time reduction serves as a critical catalyst for implementing lean methodologies within manufacturing organizations. Key performance indicators (KPIs) for measuring time effectiveness include manufacturing lead time, manufacturing cycle time, throughput rate, machine downtime, setup rate, and changeover time (Sangwa & Sangwan, 2018). Decreasing cycle times results in lower manufacturing costs, reduced inventory levels, and enhanced flexibility. Close monitoring of material flow throughout the production process aids in identifying opportunities for cycle time reduction (Alexander, 2018, p. 375)

Cost: Lean methodologies aim to drive cost reduction by eliminating non-value-added activities. This reduction in waste leads to decreased variable production costs, encompassing labor, raw materials, inventory, quality control,

material handling, maintenance, and energy consumption. Moreover, Lean practices are continuously directed toward optimizing costs, enhancing quality, and improving customer service. Performance in this dimension is measured through metrics such as processing cost per unit, percentage of cost attributed to poor quality, raw material cost, maintenance cost, labor cost, inventory cost, and in-house material movement cost (Sangwa & Sangwan, 2018).

Inventory: The fundamental principle of Lean Manufacturing (LM) is waste reduction, with inventory management being paramount due to its significant impact. Manufacturing organizations mitigate the effects of variability within production systems by strategically arranging inventory, adjusting capacity, or optimizing time allocation (Bhasin, 2008). Key Performance Indicators (KPIs) for this dimension include metrics such as the raw material inventory, work in process inventory (WIP), finished goods inventory, and inventory turnover (Sangwa & Sangwan, 2018; Senol et al., 2021). In addition, days sales of inventory (DSI), obsolete and slow-moving inventory (OSMI), number of unique inventory parts, past-due customer orders, supplier performance, forecast accuracy and cycle time has been defined as KPIs for inventories (Alexander, 2018, p. 411-414; Senol et al., 2021).

3.3.2 KPIs for new product development (NPD) process

New product development category encompasses six performance dimensions: quality, research and development (R&D), time, market, cost, and rate of return (Sangwa & Sangwan, 2018). Across these six performance dimensions, a comprehensive total of 37 key performance indicators (KPIs) have been pinpointed through frequency analysis of 22 research publications.

Quality: In product development, a defect is characterized by test failures, inaccurate data, and warranty costs. Achieving a certain level of quality often requires numerous iterations during the product design phase. Key performance indicators (KPIs) for evaluating quality in this context are rework or change requests, compliance with quality requirements, standardization of parts and benchmarking (Sangwa & Sangwan, 2018).

Research and development (R&D): R&D accountability can be evaluated by its efficiency, effectiveness, customer focus (both internal and external), and alignment with business strategy. Relevant KPIs for evaluating R&D performance include the number of non-value-added activities, resource utilization, innovation, development costs, time-to-market, and the impact of design on downstream processes such as manufacturing (Alexander, 2018, p. 373). Other important KPIs according to Sangwa & Sangwan (2018) are the frequency of design changes to specifications, life cycle design and assessment, and the identification of bottlenecks. Additionally, product customization, knowledge management, quality function deployment (QFD), and the reduction of processing losses play significant roles in assessing R&D effectiveness. While measuring R&D effectiveness presents challenges, insights from past projects

and benchmarking against industry standards can inform future project management (Alexander, 2018, p. 373).

Market: Product development is important for entering new markets and increasing market share, especially in segments where product life cycles are continually shortening. Efficiency and effectiveness are primary goals, with customer satisfaction and acceptance serving as vital market performance indicators (Alexander, 2018, p. 373). Seven key performance indicators (KPIs) identified for assessing product development in this context include new market development or growth, expected market share, customer satisfaction, the number of new products launched in the last five years, strategic competence, the effectiveness of the risk management process, and product performance (Sangwa & Sangwan, 2018).

Cost: Monitoring actual product costs versus target costs and production yields on new products are important for project success and identifying potential design or manufacturing issues (Alexander, 2018, p. 374). While encountering challenges during the initial production runs of a new product is expected, the learning curve and process efficiencies usually improve over time. However, significant cost overruns, rework, or excessive production variances on new products may indicate underlying design issues or a failure to adequately design the product for manufacturability. In this performance dimension, key performance indicators (KPIs) include the development costs, marketing costs, life cycle costing, and the actual project cost compared to the budgeted cost (Sangwa & Sangwan, 2018).

Rate of return: New product development (NPD) performance at the company level can be measured using common financial metrics such as growth, profitability, and return on investment (ROI) (Sangwa & Sangwan, 2018).

3.4 Previous research

Generally, excellent supply chain performance is associated with low costs, high revenues, and efficient asset management. When measuring financial performance, shareholders typically value profitable growth (Töyli et al., 2008). Although numerous studies have examined supply chain performance and its impact on organizational finances, there is limited empirical research on the relationship between them. According to Shi and Yu (2013), there is a clear connection between excellent supply chain management practices and financial performance. For example, Deloitte Consulting studied 600 companies in 22 countries and found that effective supply chain management significantly impacts a company's financial performance (Elgazzar et al., 2012; Presutti & Mawhinney, 2007).

Another study examining the impact of adopting supply chain management practices on improving return on investment found that 76% of respondents reported financial benefits from effective supply chain management (Gunasekaran et al., 2004). Similarly, Shang and Marlow (2015) studied large

manufacturing firms in Taiwan and found a positive correlation between logistics and financial performance (Töyli et al., 2008). However, Töyli et al. (2008) found in their study of Finnish SMEs that excellent supply chain performance did not result in statistically significant differences in profitability or growth. This suggests that while organizations with the best logistics may grow faster, profitability remains stable (Töyli et al., 2008).

Some studies focused on identifying and defining the most suitable metrics for managing supply chains. Gunasekaran and Kobu (2007) identified 27 key performance indicators (KPIs) for supply chain performance in their literature review. They found that 50% of these KPIs related to internal business processes, and the remaining 50% were customer-centric. Financial performance was the most common metric, while innovation and process improvement were often overlooked. Time and productivity were significant, but resource utilization and flexibility were less frequently measured. Customer satisfaction received less attention despite its importance. There was less focus on financial metrics compared to non-financial metrics. According to their review, quantitative metrics predominated (85%). Additionally, most performance metrics were function-based rather than value-based (Gunasekaran & Kobu, 2007).

Cardenas-Cristancho et al. (2021) propose a new approach to selecting and prioritizing performance indicators in Lean Manufacturing, emphasizing the impact of these indicators on overall performance. Their findings highlight the importance of human factors and the need to reassess classic indicators for effective improvement strategies. On the other hand, Agus and Hajinoor (2012), focus on the Malaysian manufacturing industry, identifying key lean production practices that positively affect product quality performance and, consequently, overall business performance. They found that reduced setup time, pull production systems, shorter lead times, continuous improvement programs, and small lot sizes positively and directly affect product quality performance. Additionally, lean production has a positive but significant indirect effect on financial performance through product quality performance. Swarnakar et al. (2021) examine the impact of Lean Six Sigma (LSS) implementation on firm performance in the Indian automotive component manufacturing sector. The research results highlighted improvements in financial performance, customer satisfaction, learning and growth, and business process efficiency.

Several studies illustrate the operational benefits of Lean Manufacturing, including reduced inventory and costs, and improved quality, delivery service, and productivity (Fullerton & Wempe, 2009; Shah & Ward, 2003). Fullerton and Wempe (2009) studied the relationship between non-financial production performance metrics and financial performance from a Lean Manufacturing perspective. The research emphasizes the significance of employee involvement and the direct impact of these metrics on profitability. It reveals that non-financial manufacturing performance metrics mediate between financial performance and Lean Manufacturing practices, with varied and direct effects on profitability. Additionally, Shah and Ward (2003) examine the impact of lean practices and contextual factors on operational performance. They find that Just-in-Time (JIT),

Total Quality Management (TQM), Total Productive Maintenance (TPM), and Human Resource Management (HRM) are positively associated with operational performance, yet these factors only account for 23% of the overall effect.

Eroglu and Hofer (2011) examine the impact of inventory leanness on firm performance using data from U.S. manufacturing firms over six years. Their findings show significant variation across industries, with one-third of the 54 industries showing no significant effect. This suggests that lean inventory strategies are not universally beneficial and depend on specific industry characteristics. Pooling data from diverse industries can weaken results (Eroglu & Hofer, 2011). They also find that the relationship between low inventory and performance is generally positive but non-linear. Hence, if the inventory level falls below the optimal level, it will negatively affect financial performance.

Based on the literature, effective supply chain management is crucial for an organization's success. It correlates with low costs, high revenue, and effective asset management. Although empirical evidence supports the link between effective supply chain management and financial performance, there is still limited standardization of metrics. Lean manufacturing practices and the implementation of Lean Six Sigma have shown positive effects on product quality, operational performance, and financial results. However, the relationship between low inventory levels and firm performance varies by industry. Overall, optimizing supply chain practices can significantly improve both financial performance and operational efficiency.

3.5 Summary

This chapter concludes the theoretical part of the thesis by bringing together the contents of chapters 2 and 3. This summary lays a solid foundation for empirical research and facilitates the answering of research questions.

The core concept of the theoretical framework of this thesis is performance management and its sub-concept performance measurement, and how they relate to the company's financial performance. Agent theory provides a theoretical framework for evaluating the actions of two parties from the point of view that one party (the principal) tries to influence the actions of the other party (the agent). The thesis examines performance measurement from the perspective of the supply chain and which factors are related to the operational performance of the supply chain. The focus is on the manufacturing processes, and production of new product development, because they are the key processes of the target organization. Figure 4 describes the framework in the thesis.

Understanding which metrics really affect performance and effectively drive the company's goals is a significant challenge. Given the diverse nature and goals of companies, a one-size-fits-all model is insufficient. Therefore, it is important to find out which metrics are suitable for certain fields, such as the production management of manufacturing, which is the case in this thesis. Like mentioned in subchapters 2.1.3 and 2.2.2 financial and non-financial metrics play

a key role in this process and provide different perspectives for evaluation. Financial metrics such as return on capital employed (ROCE) and profit margin provide insight into long-term organizational performance, while non-financial metrics such as customer satisfaction and delivery performance provide detailed information about day-to-day operations.

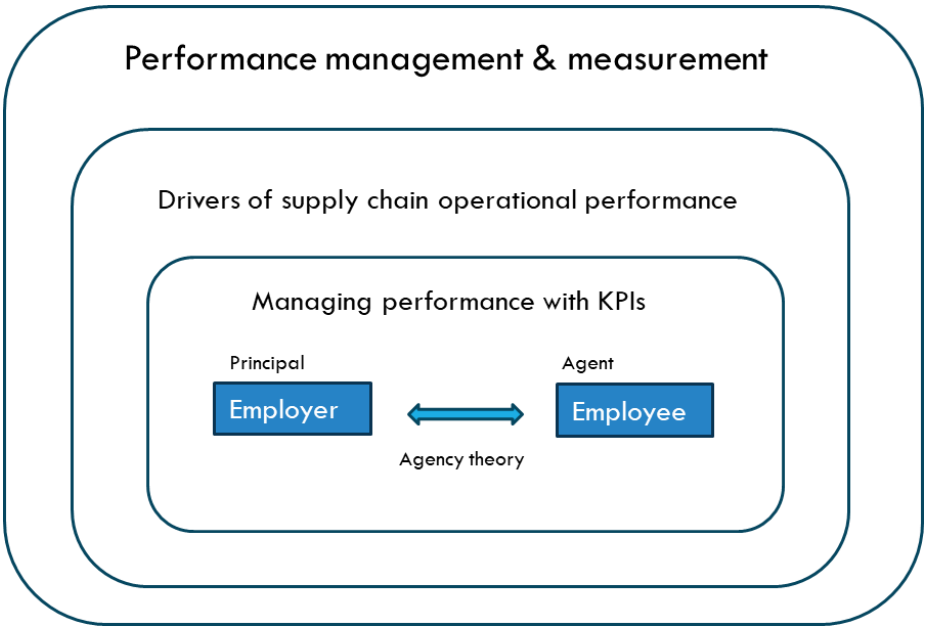

FIGURE 4: Framework of thesis

Measuring performance alone is not enough to ensure success. It is also important to understand the context in which performance metrics affect a company's financial results. Supply chain costing establishes a cause-and-effect relationship between activities and the factors driving costs and performance outcomes (Cokins et al., 2021, p. 186). This helps managers align cost and performance factors to achieve desired outcomes. By combining supply chain cost and performance information, managers gain visibility interrelationships between them. In addition, supply chain costing translates these changes into costs, which, combined with DuPont analysis, reflects the company's financial performance (Cokins et al., 2021, p. 186).

This thesis mainly focuses on the perspective of manufacturing production, so there is a particular attention on inventories and cost of goods sold (CoGS). In addition, factors related to production of new products development are considered, considering the factors within the target company's sphere of influence. Although no actual simulation is performed in this study, the DuPont model provides a solid basis for visualizing the relationships between metrics, particularly their impact on financial results, which is of certain interest in this context.

As stated in the first chapter when formulating the research problem, the empirical part aims to investigate the relationships between financial performance metrics and performance metrics in the context of the case study company. More specifically, it seeks to identify the metrics that directly affect an organization's financial results, the drivers of financial performance, and the relationships between metrics. Figure 5 represents drivers of cost of goods sold and inventory costs and what influences on them. To choosing right KPIs for performance management, it's important understand what drives these costs and overall financial performance.

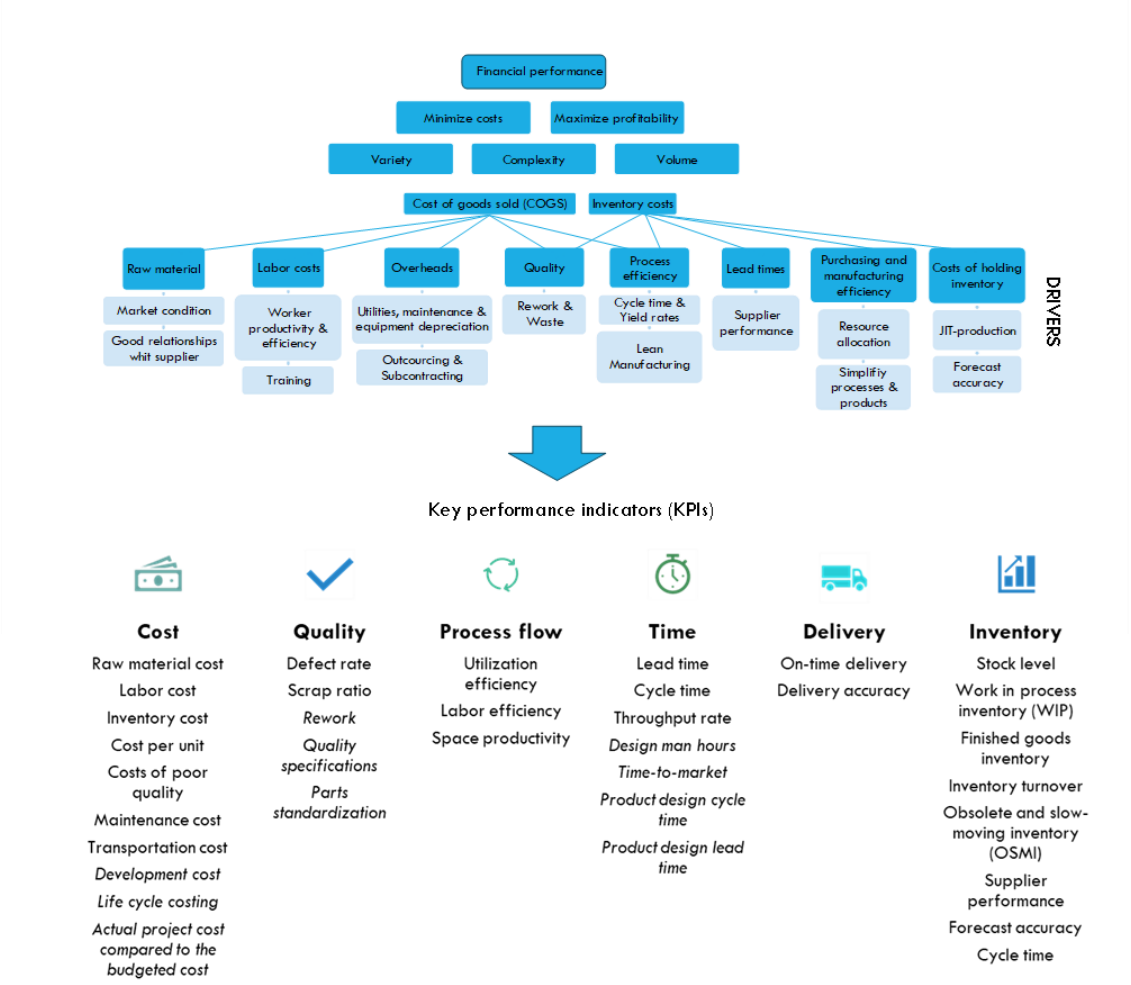

FIGURE 5 Drivers of operational performance in manufacturing

As discussed in Section 2.2.1, there are different names for metrics, and metrics with the same name may be calculated differently. Thus, it is important to every organization to carefully consider what are the best metrics for them. On

the other hand, there are few main categories that are measured in supply chain and manufacturing companies: efficiency, costs, inventory levels, customer service, time and delivery performance. Metrics related to Lean manufacturing has been discussed in subchapters 3.3.1 and 3.3.2. Lean manufacturing have been connected to higher revenues, shorter lead times, better workforce safety, better productivity, greater flexibility, lower inventory, better quality, and better customer service. These all lead to better customer satisfaction, which is an important factor for any business.

In addition, from the perspective of agent theory, four primary factors emerge in performance management: the effect of risk, adaptation to work tasks, distortions, and the possibility of manipulation. These have been discussed in section 2.1.4. Performance management reflects one perspective of the principal-agent theory, so when using metrics in management, it is necessary to take these factors into account. So, when choosing suitable metrics to manage organizations performance, it requires more evaluation than direct effect on cost drivers of financial performance.

4 DATA AND METHODOLOGY

In this chapter the case company and the data used in empirical analysis and data analyzation method in this thesis is presented. Firs, quick overview the case company and scope of the research. Second, the research design will be presented. The research strategy in section 4.2.1 drills deeper down into choices made for this research. Data collection and methods for analysing data are discussed next. The results and analysis will be discussed in next chapter.

4.1 Case company

The case company is a global high-tech industrial group specializing in mining and rock excavation products and services. This empirical research delves into a division comprising five production units (PUs), with a particular emphasis on the unit situated in Finland. The division's product portfolio is comprehensive, often customized to meet diverse customer needs. Consequently, products frequently necessitate individualized engineering. Nevertheless, the division also manufactures standard products with consistent demand. The Finnish production unit boasts the capability to manufacture all product types offered by the division. The production volume is relatively low, and the production mix varies, leading to corresponding variations in resource requirements.

4.2 Research design

Research design refers to the combination of the research problem, the empirical data used, and the methods of analysis employed (Kallinen & Kinnunen, 2021). It should explicitly indicate whether the purpose of the research is exploratory, descriptive, or explanatory. Furthermore, it should provide clear justifications,

supported by compelling arguments, for why the research is aligned with a particular purpose.

The most suitable research approaches for exploring challenges related to performance management and interrelationships between metrics are explanatory and descriptive studies. Explanatory research seeks to uncover explanations for the challenges and identify causes and their consequences (Hirsijärvi et al., 2013). Descriptive research aims to provide detailed descriptions of events or situations and document key features.

Due to the diverse and highly customized nature of the product portfolio, coupled with relatively low manufacturing volumes, measuring and managing becomes challenging. Each product type requires varying amounts of input resources, leading to a lack of a comprehensive overview of the decisions' impact on financial performance. The aim of this exploratory research is to bridge this gap by identifying the performance indicators that have the greatest impact on financial performance. Additionally, it seeks to elucidate the interrelationships among these indicators to enhance their selection and implementation processes.

The study is guided by the following research questions:
RQ1: How do supply chain performance metrics affect an organization's financial performance?

Sub questions:
SQ1: What kind of interrelationships can be detected between performance metrics?
SQ2: Which metrics have the strongest effect on financial indicators?

Subsequently, in order to address these questions, the research strategy, methods of data collection, and analysis are presented below.

4.2.1 Research strategy

The research strategy of this thesis can be defined as a theoretical case study, where qualitative research methods are used in the empirical section. The research strategy outlines the approach, choices, and methods guiding the study (Jyväskylän Yliopisto, 2014). Research can be categorized into empirical or theoretical studies (Jyväskylän Yliopisto, 2014). Theoretical research involves conceptual model development, explanations, and structural frameworks based on existing literature. In contrast, empirical research relies on tangible observations of the subject, alongside their measurement and analysis.

Studies are often classified as quantitative or qualitative based on the research methods used. However, it's also possible to employ a mixed-method approach, combining both qualitative and quantitative research. Qualitative research aims to understand the nature, characteristics, and meanings of the subject comprehensively, using various methods (Ghauri et al., 2020, p. 119). Quantitative research, on the other hand, often focuses on classifications, cause-and-effect relationships, comparisons, and explaining phenomena based on

numerical results. Quantitative research involves extensive use of computational and statistical analysis methods. Quantitative and qualitative approaches can be also seen as complementary (Hirsijärvi et al., 2013, p. 136-137).

In the realm of economic research, there has traditionally been a heavy reliance on quantitative methods. Leeson (2020) points out that some economists argue that economic analysis always requires quantitative methods. However, he stresses that at its core, economic analysis is primarily a theoretical framework—a way of thinking. Thus, it's not merely about empirical observation, mathematical testing, or statistical analysis. On the other hand, Skarbek (2020) suggests that economics is often defined by the methods employed rather than the subject matter itself. Currently, there's a significant emphasis on causal identification in economic research. Yet, a singular focus on causal relationships may overlook crucial questions about the underlying reasons for changes (Skarbek, 2020). Moreover, it can sometimes lead to multiple plausible explanations—a situation known as 'equifinality'. For instance, consider studies linking the number of police stations to crime rates. While quantitative research may establish a correlation between police presence and reduced crime, it may fall short in explaining why this relationship exists. Here, qualitative analysis could unveil nuanced factors like police visibility or crime prevention strategies (Skarbek, 2020).

Qualitative methods in economics are gradually shifting towards greater scientific value. Despite the common perception of quantitative superiority in economics, both quantitative and qualitative approaches offer unique strengths and weaknesses (Leeson, 2020). Qualitative research in economics embodies openness to diverse data sources. Unlike quantitative research's reliance on established metrics, qualitative research in economics emphasizes key phenomena and their interaction within the research context. Thus, it is justified to argue that economics is a way of thinking, and qualitative research also has its place in economic inquiry (Leeson, 2020).

To grasp the functioning of qualitative research methods, it's beneficial to consider a prevalent application: case studies. A case study research is particularly valuable when the phenomenon being investigated is challenging to study outside its natural setting, and when the concepts and variables under scrutiny are difficult to quantify (Ghauri et al., 2020, p. 101-102). A case study refers to a research strategy aimed at thoroughly examining one or a few specific subjects or phenomena. The subject under investigation can vary widely, but it is often understood as a distinct entity or unit in some way. Case studies strive to generate detailed and intensive data about the chosen case. While the case study approach is frequently associated with descriptive or exploratory research, it is not confined to these domains (Ghauri et al., 2020, p. 123). As a research strategy, case study is broadly defined and can be implemented using various analytical methods (Jyväskylän Yliopisto, 2014) Both quantitative and qualitative evidence are vital in case study research. However, for in-depth analysis, case studies often rely on qualitative evidence for its nuanced insights. Qualitative data supplements quantitative findings, providing a broader perspective and

uncovering details that quantitative data may miss, especially in understanding complex concepts (Skarbek, 2020).

This thesis, focusing on a specific organization, automatically adopts a case study approach to investigate how performance metrics influence financial results and their interconnectedness. It explores performance management theories, the challenges they present, and factors affecting operational performance within the production organization. With the help of a theoretical framework, this study aims to reveal the cause-and-effect relationships between the metrics and examine the metrics of the case organization against it. Due to the broad nature of the product portfolio, highly customized products, relatively low production volumes and the complexity of the operating environment, statistical analysis does not necessarily produce reliable information. For this reason, a theoretical and qualitative approach is considered more appropriate in this thesis.

4.2.2 Data collection

The empirical data for the study was collected in two ways: background information was gathered by observing the operations at the target company, examining its internal documents, and engaging in discussions with its personnel. However, the bulk of the actual research data was collected through interviews with key personnel working there. The internal documents used for obtaining background information included, among other things, the performance metrics used in organizational monitoring.

Data acquisition methods refer to how empirical data is collected for research (Jyväskylän Yliopisto, 2014). Data can be either self-collected or obtained from existing sources. The choice of data acquisition method is influenced by the research question's formulation. Research datasets can take various forms, leading to a variety of data acquisition methods. The selection of data acquisition methods depends on how the data is intended to be utilized in the research. Certain types of data are suited to specific research questions, and likewise, specific data acquisition methods lend themselves to particular types of analysis.

Observation is a method of data acquisition involving the gathering of information about the phenomenon under investigation through careful observation and note-taking (Jyväskylän Yliopisto, 2014). Interviews instead are considered a useful method and might deliver data that is not available or found in other ways. An interview is a data acquisition method in which the researcher actively engages in generating data through interactive communication. Interviews can be categorized based on the degree of interaction between the interviewer and interviewee. Interviews may be structured as unstructured (open) interviews, semi-structured interviews, or structured (survey) interviews. Open interviews often resemble a conversation between the interviewer and interviewee.

The interviews were conducted in the form of semi-structured individual interviews, wherein discussion topics and themes were predetermined, but the questions did not rigidly constrain the conversation. The term 'theme interview'

is not widely recognized in English; instead, semi-structured interviews are more commonly referred to (Kallinen & Kinnunen, 2021). However, interviews in this study followed predetermined themes and supplementary questions. The themes were based on the study's theoretical framework and were selected to effectively address the research questions.

Interviewees were asked the same set of questions, with additional questions tailored to specific situations. In qualitative research, it is important that the individuals from whom data are collected have extensive knowledge or experience regarding the phenomenon under study (Tuomi & Sarajärvi, 2018). Hence, interviewees were selected through purposive sampling, meaning individuals with the most knowledge of the research topic were chosen to participate, thereby providing a comprehensive understanding of the subject under study. A total of three supervisors from the target organization, responsible for overseeing the performance management of their respective teams, participated in the interviews. The interviews utilized the DuPont chart and a list of performance metrics as aids.

The interviews conducted in February 2024 via Microsoft Teams calls, which were recorded. Interview questions can be found from appendix 1. The interviews were transcribed using Microsoft Teams' transcription feature, and the transcriptions were subsequently reviewed and corrected manually. Finally, the content of the transcribed interviews was analyzed.

4.2.3 Methods used for analyzing data

The analysis of the research data has been conducted through theory-guided content analysis. Unlike other forms of content analysis, which may adhere to specific theories, theory-guided content analysis offers a more flexible approach, allowing for the application of various theoretical perspectives (Tuomi & Sarajärvi, 2018, p. 103). In this study, the analysis has been guided by the theoretical framework established for this research, providing a lens through which to interpret the findings. This method involves starting with the data itself and then integrating empirical evidence with theoretical insights (Tuomi & Sarajärvi, 2018, p. 133). Theory serves as a supportive tool in reporting research results, facilitating a fruitful dialogue between theory and empirical evidence.

The analysis of interviews began by manually reviewing the transcripts generated by Teams, ensuring accuracy through careful examination during playback. Subsequently, a thorough familiarization with the data was achieved by reading and annotating it extensively. Following this immersion, the data underwent a process of summarization. This involved condensing, segmenting, and refining the data to focus on essential aspects pertinent to the study. Despite the wealth of intriguing details contained within qualitative research data, it was crucial to prioritize information directly relevant to the research objectives (Tuomi & Sarajärvi, 2018, p. 104). Therefore, in addition to summarization, certain parts of the data required trimming.

5 RESULTS AND ANALYSIS

In this chapter, the research findings obtained from empirical data are analyzed and reflected against the theoretical framework of the research. The research findings are examined through the sub-questions of the research: at first, the first sub-question of the research is reviewed, aiming to identify the key performance indicators in the target organization that have the strongest connection to financial outcomes. Following this, the research findings are considered from the perspective of the second sub-question, seeking to determine the relationships that can be observed among the metrics. The goal is to understand the interconnections between the metrics and their impact on the organization's results. Thirdly, the chapter discusses the challenges encountered in the target organization related to the existing metrics and managing with them. Finally, other topics raised in the interviews will be discussed.

The DuPont model is used to help review the results, and the analysis focuses primarily on inventory and cost of goods sold (COGS) analysis. These are precisely the areas that are the core functions of the target organization, making it relevant to concentrate particularly on them. The DuPont model served as a good reference alongside the metrics derived from observations and interviews. The interviews aimed to identify the factors influencing the target company's performance and the metrics used for performance evaluation. Additionally, the interviews provided valuable insights into the perspectives and experiences of the interviewees regarding the interaction between the metrics. Based on the interview results, the interviewees' understanding of the relationship between the metrics and financial indicators is also explored.

5.1 Metrics with the strongest effect on financial indicators

This section examines the target organization's performance metrics that have the strongest connection with the organization's financial performance. The purpose was to find the metrics that should be considered when creating the simulation

model. Thus, the quantitative nature and appropriateness of the metrics guided the selection. This section seeks to answer the first sub-question: Which metrics have the strongest impact on financial indicators?

As previously mentioned, inventory and cost of goods sold are central to the target company's operations, so the results focus on these areas. Figure 6 reveals that inventory includes work in progress (WIP) and component inventory, while cost of goods sold (COGS) consists of direct manufacturing costs, overhead, and other expenses. By looking at these components, we can gain insight into the factors behind them. DuPont analysis is a good tool for understanding the overall performance of an organization and its components. However, organizational performance is the sum of many factors, so the DuPont model may not cover all relationships. The components presented in the model are dependent variables that are influenced by several factors. These factors and the interrelationships of the metrics are discussed later in section 5.2.

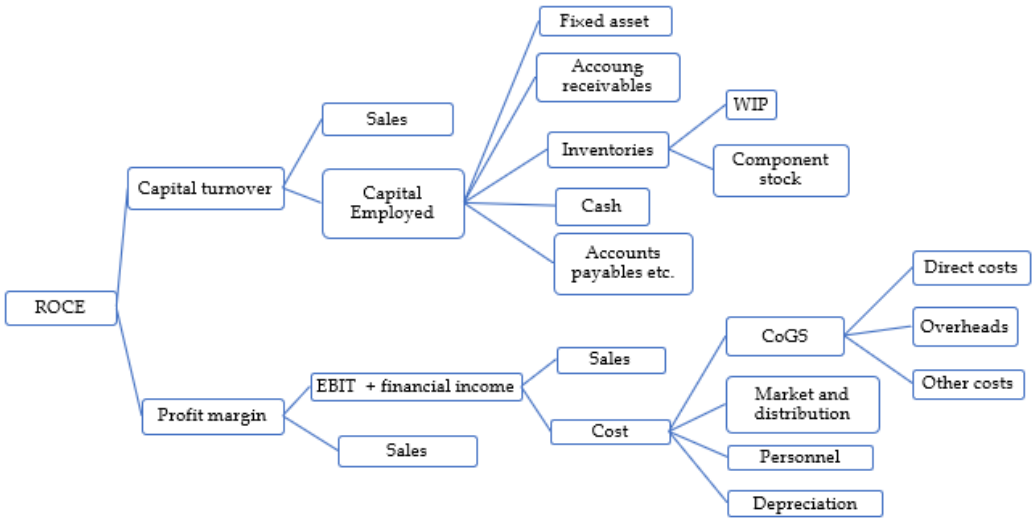

FIGURE 6 Detailed composition of ROCE in case organization

At the beginning of the research, more than 150 metrics, tools and dashboards related to the target organization's production, new product development production and inventory were listed. First, these were all documented and collected to make them easier to process and categorize. Second, a list of metrics (presented in Table 3) was compiled that, based on observations and interviews, were considered to be most strongly related to financial performance. Based on the listing, it can be concluded that the metrics that have the most impact on the result are related to efficiency, cost savings, customer satisfaction and delivery performance. The result is in line with the survey of European companies presented in section 2.2.1, where these areas

emerged as the main areas of interest among the most used supply chain performance metrics (Camerinelli, 2016, p. 96).

TABEL 3 Metrics with a strong connection to financial performance

Production
Efficiency
Inner on time deliveris
On time deliveris
Overheads
Planned load vs. actual load by working
Work in process (WIP)
Works by finish date
Production of New Product Development (NPD)
Inner on time deliveris
Total labor hours
Work cost development
Inventory
Inventory turnover
Obsolecne and slow moving inventory (OSMI)
Stock

In the target company, adhering to schedules is a key factor for success. Delays in schedules can affect the number of devices completed, which in turn can lead to delays in customer deliveries, impacting invoicing, customer satisfaction, and potential new orders. When manufacturing new products, a learning curve is also used to monitor and update schedules, helping to set realistic timelines and goals. Therefore, schedules and lead times play a crucial role in the target company's operations, and it is important to comprehensively understand their impacts. For this reason, the key metrics selected are internal and external on time delivery, works by delivery date/month and works by finish date.

Employee productivity and efficiency are important factors influencing business profitability. Well-trained employees can produce more units in less time, reducing labor costs per unit. Efficiency is also considered a very important factor in the target organization because it has a significant impact on the organization's results. Additionally, one key financial metric is the monitoring of planned versus actual hours, as it correlates with the profit margin. Therefore, efficiency, planned load vs. actual load by working, and total labor hours emerged as the most significant metrics for tracking and managing efficiency. As mentioned earlier in section 3.2.2, direct labor costs, including the wages, salaries, and benefits of production employees, are a significant component of COGS. Consequently, work cost development also became an important metric, especially in the production of new products.

Raw materials and components are primary drivers of COGS. Efficient inventory management is also connected to costs. Consequently, unfinished

inventory (WIP), component inventory, obsolete and slow-moving inventory (OSMI) also played an important role in the company. Inventory turnover is a significant financial metric related to inventory and was also seen in the target company as the most important metric impacting financial performance in terms of stock management in the target company.

Overhead costs directly impact financial performance and play a significant role in the target organization. overhead costs are essential for maintaining the operations of a business but cannot be directly attributed to a specific product, service, or project. Instead, they encompass various indirect expenses necessary for the general functioning of the business, such as rent, utilities, administrative salaries, and office supplies. These costs contribute to the overall infrastructure and support the revenue-generating activities of the business. In the target company, the manufacturing labor costs are allocated to the jobs according to the calculated hourly price, and the excess portion is allocated as overhead costs.

In the production of new products, the relationship between total labor hours, labor cost development, and internal on-time deliveries is the strongest in relation to financial performance. Additionally, the same metrics used in other manufacturing processes are also important in new product production. Working on new products is examined from two perspectives: prototype assembly and ramp-up phase. During prototype assembly, measuring performance efficiency is less meaningful; staying on schedule and managing total hours are more critical. In the ramp up phase, the efficiency can be monitored. In addition, the learning curve can be monitored. Schedules and delivery times are generally important in the production of new products as well.

Furthermore, in interviews, order backlog and order intake were also highlighted as important metrics to track, given their strong connection to financial performance and their operationally informative nature. However, these metrics were not included in this list because they are primarily drivers that guide production rather than metrics intended to influence production operations directly.

As previously summarized in the theoretical section, Figure 5 provides a good reference point for these selected metrics. According to it, minimizing costs and maximizing profitability are critical to the company's financial performance. Factors influencing these include the breadth of product range, product complexity, and production volumes within the production organization. In the target company, the product range is broad, products are complex, and production volumes are relatively low. All these factors contribute to raising costs in the company's operations.

5.2 Interrelationships between metrics

This section examines the relationships between metrics and aims to answer the second sub-question of the study: What kind of interrelationships can be observed between the performance metrics? The analysis considers the

connections identified by the interviewees and reflects them against the connections identified in the literature.

Manufacturing costs affect competitiveness and the price at which products can be offered to customers. Therefore, minimizing costs and maximizing efficiency are important for maintaining competitiveness. Labor costs are one of the most significant cost factors for a company, and productivity and efficiency are strongly related to these costs. High overtime rates and inefficient work schedules can increase these costs. Interviewees also identified schedules and efficiency as the most important factors affecting financial performance. Investing in workforce training and optimizing schedules are effective strategies for managing labor costs.

According to the interviews, forecast accuracy emerged as one of the important success factors in production operations. This metric compares sales forecasts to actual demand levels, facilitating understanding of inventory fluctuations and demonstrating the reliability of forecasts. Effective production forecasting is linked to inventory forecasts and thus to suppliers' own forecasts and supplier delivery reliability. On the other hand, the supply reliability of suppliers plays a decisive role in the company's operations, as it directly affects the value of the inventory, compliance with production schedules and external supply reliability.

Delivery reliability is a metric that also plays a significant role in a company's success, and it was found to be strongly correlated with financial metrics. Delivery reliability also impacts other metrics. Internal delivery reliability and adherence to schedules are directly related to work-in-progress (WIP) inventory and the overall inventory value. WIP, in turn, correlates with return on investment and costs. In addition, internal delivery reliability is linked to external deliveries. External deliveries affect the company's delivery reliability and are connected to invoicing, thereby directly influencing revenue from product sales. Delivery reliability itself is tied to customer satisfaction, which directly affects sales.

The high inventory turnover rate is a metric used by the target company, strongly correlated with its financial performance. It is associated with increased revenue, and profit margin. Conversely, a decreased inventory turnover rate is a consequence of declining demand, which in turn leads to excess inventory, reduced revenue, and decreased profitability.

Cost minimization therefore plays an important role in the operations of a manufacturing company. However, the Lean Manufacturing approach emphasizes other aspects beyond just cost reduction. Quality, lead times and cycle times are essential factors to guarantee operational efficiency and long-term success. Agus and Hajinoor (2012) research results showed that lean production has a positive and significant indirect effect on the company's financial performance through product quality.

Quality can be considered the cornerstone of Lean Manufacturing, but the interviews revealed a lack of clear monitoring and visibility of quality metrics in the target company. Specifically, there was no precise data available on quality-

related costs and their broader impacts. For example, the interviews highlighted that quality issues often lead to longer wait times, which in turn reduce measurable efficiency. Additionally, they increase the amount of work-in-progress (WIP) and elevate costs through repairs, testing, delays, handling costs, and expedited shipping. Agus and Hajinoor's (2012) research showed that quality has a clear, but indirect effect on a company's financial performance. Measures aimed at improving quality could reduce costs related to rework and waste, as well as reduce production costs in the target company.

Lead time is another critical aspect of Lean thinking that significantly affects a company's ability to balance conflicting goals. Lead time measures the time from order to delivery (order fulfillment). Shorter supplier lead times can reduce invested capital and improve performance (Alexander, 2018, pp. 410-411). Improving supplier performance can shorten lead times and thus also reduce inventory levels and increase operational flexibility. According to Haverila et al. (2009, p. 404), reducing lead time is an effective way to achieve conflicting goals in production control.

In the target organization, much attention was paid to production schedules, and they were considered crucial success factors. Cycle time measures production time per unit. Shorter cycle times reduce costs, lower inventory levels, and increase flexibility. It also allows, according to Neely et al. (1997), for increased production volume. Product design can also affect cycle time by making products easier to manufacture, simplifying assembly processes, and using common components in products (Alexander, 2018, pp. 410-411).

The target organization manufactures several different products, but the similarity of product components is surprisingly low, which is related to higher inventory levels and a large number of stock keeping unit items. This, in turn, reduces order quantities for certain components and is therefore also related to costs. Larger order quantities are also related to how important a supplier perceives the target organization and how it prioritizes the importance and timeliness of deliveries. Larger order quantities thus provide negotiation leverage in both price and availability issues.

According to the literature, flexibility is one of the factors affecting a company's success. It provides a buffer for handling fluctuating demand and other changes. Flexibility increases a company's ability to respond to changes even in challenging situations, but in practice, increasing flexibility also means an increase in inventory levels, which in turn increases costs. This creates conflicts between goals in challenging economic situations, where the focus is on minimizing costs and operating as efficiently as possible. The target company lacked a clear metric for monitoring flexibility, and it did not emerge in the interviews at all.

The example mentioned above is not the only contradiction observed between metrics. Interviews revealed that the target company has recently emphasized both operational efficiency and on-time deliveries simultaneously, highlighting the contradiction between them in daily management. When emphasizing operational efficiency, it is important to avoid overtime costs as

they impair efficiency. This, in turn, leads to longer cycle times and delays in product completion. As a result, delivery may be delayed, leading to a deterioration in delivery reliability.

Furthermore, in addition to direct and relatively short-term effects, there may also be longer-term effects. For example, in the target organization, overtime costs in production also affect the calculated hourly rate for the following year, which determines how costs are allocated to different products. Thus, too tight schedules or insufficiently resourced labor also affect next year's costs. It should also be noted that management focused on numbers and ratios is associated with short-sighted management, and therefore non-financial indicators, which mostly affect long-term success, should also be measured.

In summary, production management requires a holistic approach that extends beyond cost considerations to include quality, lead times, cycle times, flexibility, general cost management, and inventory control. Each of these elements plays a crucial role in the company's financial success. By considering these factors, sustainable success can be achieved. The following chart has been prepared with the help of literature and empirical research to depict the most important components affecting financial performance, focusing on inventories and cost of goods sold (COGS). It also reveals the relationships between metrics. The same chart is available in a larger size in attachment 2.

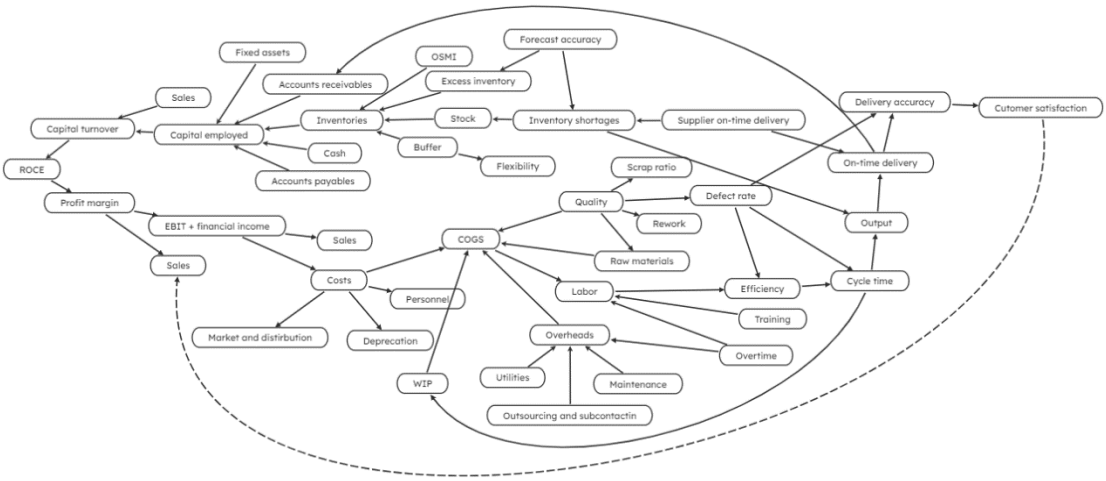

FIGURE 7. Relationships between metrics and financial outcomes

5.3 Challenges related to metrics and managing with them

This section examines the challenges related to the management of the interviewed metrics. Although the primary purpose of the study was to identify which metrics correlate most strongly with financial performance and investigate the relationships between metrics, it is also important to highlight the challenges associated with utilizing metrics. These challenges have also been documented in Table 4.

There are numerous challenges associated with existing metrics, some of which relate to the industry and others to the metrics themselves or their management in general. Firstly, the interviewees considered the abundance of metrics to be a challenge, which makes it difficult to identify and focus on the most important metrics for management. It was difficult to determine which metric would be most effective in guiding actions in the right direction in each situation. As mentioned in section 2.1.2, focusing on the right metrics is important. Incorrect metrics lead to distortions and easily guide actions in the wrong direction, diverting the organization's activities from its goals. Therefore, it is important to identify the metrics that have the greatest significance and impact on the organization's objectives.

TABLE 4 Challenges related to performance management

Challenges	
Usability	2
Data quality	2
Realiablity	2
Errors	1
Requires interpretation	1
Conflicts between metrics	3
The number of metrics	1
Determining the target value is challenging	1
The challenges related to the industry	
Highly varied products	3
Low volumes.	1
Strong dependence on supplier delivery reliability	1
The complex product structure	1
Rapid changes in demand	1
Long development projects	1

Additionally, usability and accessibility of metrics were perceived as challenging in some cases. Usability and accessibility involve two main problems, one related to the abundance of metrics and the other to the usability of the system. The large number of metrics also made it challenging for some

interviewees to find rarely used metrics in the system. This leads to time-consuming searches, complicating the use of these metrics in daily management. Furthermore, it was highlighted in the interviews that certain metrics require precise data selection to achieve the desired perspective, which was perceived as hindering the usability of the metric. With such metrics, there is a risk of accidentally selecting incorrect filters, resulting in inaccurate information provided by the metrics. This easily leads to incorrect interpretations and conclusions. A solution could be personalized dashboards, where necessary information is easily accessible, and desired selections can be saved to make the information provided by the metric more reliable.

The reliability of metrics was also perceived as one of the challenges. Interviewees felt that there was not always certainty about the source of measurement data and whether the data was reliable. Sometimes, user errors affect the metrics, distorting the actual results. For example, incorrectly marked delivery dates can distort delivery reliability, which in turn distorts performance-based pay tied to it. Metrics may therefore be subject to uncontrolled risks in the sense that they are susceptible to the effects of errors, making it impossible to demonstrate true performance.

Efficiency has become an important metric to track in the target organization but comparing it within the organization is difficult due to differences in the accuracy of estimated hours. Many other external factors also affect efficiency, leading to distortions in efficiency metrics. This includes many uncontrolled risks from the employee's perspective. When a metric is associated with many uncontrolled risks, its use as a management aid should be carefully considered. Especially when combined with incentives, uncontrolled risks should be compensated with a better incentive factor, a so-called risk premium.

Metrics were also perceived as conflicting in some respects. Emphasizing one metric can lead to problems in another equally important area. As previously mentioned, one example highlighted in the interviews was the risk associated with emphasizing efficiency and avoiding overtime, which could result in extended schedules because tasks are attempted to be completed with fewer staff. This can reduce the number of completed devices delivered to customers, affecting both the number of devices delivered to customers and external delivery reliability. Device delivery is directly related to revenue, and delivery reliability significantly affects customer satisfaction. On the other hand, if overtime is required or more employees need to be hired to stay on schedule and improve delivery reliability, this leads to a decrease in efficiency. The same problem arises, according to the interviews, for example, when emphasizing reducing inventory levels, but at the same time, ensuring that there are enough components in production. Forecasting is very important, but it is also challenging. An optimal inventory level should be defined for each situation. This requires interpretation, and therefore, a metric measuring inventory level is not a clear and user-friendly management tool.

Clarity of metrics was also perceived as challenging in certain situations. For example, blue-collar workers need clear metrics to guide their work. Metrics

cannot be very open to interpretation in these cases. The more direct and clear the metric, the better it serves as a management tool. With white-collar workers, metrics can be interpreted to some extent and used as part of management, even if they are not directly suitable metrics. This was emphasized, for example, in the production of new products. Product development involves many stages, and, for example, tracking efficiency is not very sensible in the early stages, but in the ramp-up phase, it begins to have more significance, especially for learning monitoring.

The organization's product range and operational nature also significantly affect measurement challenges. The target company has a wide product range, custom-made products for customers, and small production volumes. As mentioned earlier, a wide product range increases inventory level. On the other hand, small production volumes do not produce economies of scale in production, so production costs must be managed in other ways. The materials and work hours of the products vary, making standardization and comparison difficult. The product range under production has a significant impact on the operational requirements of the company. For example, if about 30 products are manufactured in a month, and their resource requirements vary relative to each other, it affects the required parts, their quantity, and the number of employees. A product that takes longer to manufacture also uses production floor space longer than a faster-to-manufacture product. Therefore, production volumes are not directly comparable monthly because the product range of manufactured products varies every month.

On the other hand, product differences pose challenges in inventory management, as the compatibility of product components is surprisingly low. This means that rapid changes in production decisions can be difficult if suitable components are not in stock and obtaining them quickly can be challenging. The industry is also heavily dependent on supplier reliability, as large buffer stocks cannot be maintained. Managing several different inventory items is also challenging. Interviews also highlighted industry-specific challenges, such as cyclicality. The industry is heavily influenced by the state of the global economy, which in turn quickly affects demand. Order intake and economic indicators vary significantly. Production schedules are adjusted according to demand, which directly affects plant utilization rates.

5.4 Other considerations

Interviewees felt that there are enough metrics, perhaps even too many, but on the other hand, visibility into the effects of some factors affecting costs remained unclear. For example, there is no clear understanding of the actual costs of quality and how much quality issues distort other metrics. For instance, the waiting time for repairing or replacing faulty parts affects the overall hours and efficiency metrics of a product. If the delivery of a device is delayed, not all factors affecting it can be closely monitored. Although major quality issues or component

availability problems are known, precise information about all influencing factors is not available, nor is there information on exactly how they impact costs. Additionally, waiting for parts consumes time, thus increasing both inefficiency and costs, and may cause delays.

In addition to quality costs, there was a desire for more visibility into environmental, health, and safety (EHS) metrics, such as real-time information on the impact of sick leave and accidents. In inventory management, it is essential to identify components of declining products that are no longer needed in other devices to manage inventory reduction effectively. When these are identified in a timely manner, the end of demand for these components can also be communicated to suppliers in a timely manner. Currently, this information needs to be manually retrieved, which is slow and labor-intensive.

Improvements are forthcoming in tracking learning curves for new product production, as well as updating project statuses or related metrics to better reflect the actual situation. During the ramp-up phase, maturity metrics are being developed to monitor how material costs and workforce skills begin to evolve. Overall, it was seen positively that more attention is being paid to the impact of various factors on financial results and visibility has been increased. However, it was considered that regular review of these matters from a broader perspective would be beneficial for the overall picture.

6 CONCLUSIONS

In this master's thesis, the impact of supply chain performance metrics on an organization's financial results was examined. The aim was to clarify the connections between performance metrics and financial outcomes in the target organization, with particular emphasis on its operational context. Additionally, sub-research questions aimed to identify which metrics have the strongest correlation with financial results and how these metrics are interrelated. Since metrics themselves do not directly influence outcomes but are used as management tools, the agency theory provided a suitable framework for examining the effects of metrics on company performance. The agency theory analyses two parties and their agreements and attempts to influence each other's actions. In this case, the agents represent all white-collar and blue-collar employees, while the principals represent the functional managers.

The research was conducted as a case study, with data collected through observations, discussions, and semi-structured interviews at the target company. The case study aimed to identify the metrics used by the target company and their strongest connection to financial results. Additionally, it examined whether the metrics used were relevant and whether there were clear deficiencies in the metrics. The main objective of the study was to identify metrics that are linked to the organization's financial goals and evaluate the impact of performance metrics on the company's financial results. It is important to pay attention to what drives the organization's operational success and cost structure. Figure 5 in the summary of the theoretical part clarifies these factors.

Performance management and measurement have been extensively studied in the context of supply chains and production environments. However, due to the complexity of the subject, there is no clear consensus on the impact of these metrics on financial outcomes. Most studies agree that effective supply chain management and performance management positively influence financial results. The research also largely concurs that Lean Manufacturing is an effective method to improve a company's performance. The literature highlights that efficiency, cost savings, inventory levels, customer service, time, and delivery performance are key focus areas for production companies. The metrics include defect rate,

cost per operation hour, lead time, cycle time, stock level, work in process (WIP), finished goods inventory, inventory turnover, on-time delivery, capacity utilization, and labor efficiency. The figure presented in the summary of the theoretical section also considers metrics favoured by Lean manufacturing, particularly those related to quality, such as defect rate, scrap ratio, and cost of poor quality.

The findings of this master's thesis are in line with previous literature. The target organization already had a range of performance metrics in place, which, based on the literature, are relevant for managing production operations in a manufacturing company. However, gaps were identified in the metric system, particularly concerning the tracking of quality costs. From a Lean philosophy perspective, quality is essential for success, and poor quality can significantly impact financial results. Therefore, it is important to consider quality and its costs and to increase the visibility of their true impact.

During the study, the metrics in the target company that had the strongest connection to organizational outcomes were identified and compiled in Table 3. The empirical findings were consistent with the literature, showing that the most important metrics for the company's performance relate to efficiency, cost savings, delivery performance, and customer satisfaction. The study also focused on examining the relationships between metrics. These connections are multidimensional, with a single metric potentially affecting multiple areas of performance, making it essential to understand these impacts. The relationships between the metrics and financial outcomes, as well as their interconnections, are illustrated in Figure 7.

Interviewees' experiences of metrics often being contradictory were also in line with the literature. From the perspective of agency theory, distortions are a significant reason why performance management can fail. According to the literature, time-based metrics can effectively guide a company towards more efficient operations, especially when its goals are conflicting. Lean philosophy also emphasizes the importance of time-based metrics.

Furthermore, additional problems with using performance metrics in management were identified. From the perspective of agency theory, managing with metrics can pose challenges related to their suitability (risk and fit with the job), their manipulability, or the distortions they can cause. The issues described by the interviewees highlighted the significance of these challenges. Excessive focus on one metric can create problems in other areas and steer the company away from its goals. Additionally, some metrics were sensitive to human errors either during data entry or due to usability issues.

Some metrics were also tied to performance-based compensation and were used as management tools. In such cases, it would be best to use the broadest possible metric, as it is less sensitive to distortions. However, the risk with using such a metric is that employees may not have a clear understanding of how they can influence it, making it difficult to track the actual impact of their actions. Therefore, the metric may not be closely connected to the job role and may involve significant uncontrolled risk.

When investing in performance measurement and the development of metrics systems, the benefits and costs associated with them need to be evaluated. From the company's perspective, the investment is worthwhile if productivity increases by at least the amount required to cover the costs of developing and maintaining the systems. It is essential to consider whether the benefits of using multiple different metrics outweigh the costs of measuring and maintaining the system. Simultaneously, it is advisable to consider the implementation of a simulation model from a cost perspective. Given that the target organization's product portfolio is extensive, highly customized for individual customers, and complex, scenario-based simulation may be challenging due to the difficulty of accounting for all influencing factors. Additionally, the maintenance costs of such a model may exceed the benefits derived from it.

This master thesis confirmed the notion that the topic is multifaceted, and drawing unequivocal conclusions from the results is challenging. Despite a wide range of literature, there is no consensus on which metrics are most effective in leading an organization because each organization has its own goals that the metrics should support. The metrics most strongly related to the financial result and the relationships between the metrics were identified from the target organization. In addition, based on the results of the research, the target company could benefit from a more accurate measurement of quality costs. Emphasizing time-focused metrics could also be useful in navigating the conflicting goals of production management. Additionally, it would be interesting to study the target company's incentive system from the perspective of finding the most effective way to link incentives to performance measurement.

The target organization's need to clarify management through a simulation model served as the basis for this study. In the simulation model, the DuPont model could be used as a basis to compare percentage figures, providing a directional understanding of the impacts. Since the mix of equipment in production varies, it would be wise to compare on a model-by-model basis. The DuPont model is originally a historically based model and is not intended for direct forecasting or impact assessment. Instead, its benefits lie in retrospectively identifying the reasons behind changes in financial metrics. This type of assessment could provide the necessary information to determine correlation coefficients, which could then be utilized in the simulation model.

Furthermore, despite extensive literature, the topic still requires further research to better understand the effects of production metrics on a company's financial performance and other performance metrics. For future research, it would be interesting to pay more attention to longitudinal data, as insights into the effects of decisions on metrics and the impact of metric-driven management on a company's financial success could be obtained through long-term monitoring. On the other hand, research should also be conducted using quantitative methods in a production environment where the product range is simpler, and variations in products do not cause such significant variations in results. Generally, a simpler approach is more efficient in investigating complex matters while still providing viable solutions for more complicated issues.

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APPENDICES

APPENDIX 1: "Interview body"

TAUSTA

1. Missä organisaatiossa työskentelet ja mikä on sinun roolisi?
2. Onko tässä listauksessa mittarit sellaisia, jotka ovat tällä hetkellä käytössä?

MITTAREIDEN YHTEYS TALOUDEN LUKUIHIN JA MUIHIN MITTAREIHIN

3. Mitkä mittareista ovat suoraan yhteydessä talouden lukuihin?
   - mihin nämä mittarit vaikuttavat?
4. Mikä on mielestäsi oman osastosi tärkein mittari, jolla on suora vaikutus taloudellisiin tavoitteisiin?
   - Mikä muista mittareista on merkityksellisin, jos halutaan vaikuttaa näihin talouden lukuihin? Miksi?
   - Miten usein seuraat näitä mittareita?
5. Millaisessa yhteydessä nämä mittarit ovat muihin mittareihin?

MITTAREILLA JOHTAMINEN

6. Mihin mittareihin kiinnität eniten huomiota?
7. Minkälaisia haasteita olet kohdannut mittareilla johtamiseen liittyen?
8. Minkälaisia ongelmia näihin mittareihin liittyy?
9. Onko jokin toimialaan liittyvä seikka, joka vaikuttaa näihin mittareihin?

LOPUKSI

10. Onko suunnitteilla / kehitteillä uusia mittareita?
    - Jos on, millaisia ne ovat?
    - Onko niillä suora yhteys talouden lukuihin?
11. Muuta mielentulevaa sanottavaa tai kysyttävää aiheeseen liittyen?

APPENDIX 2: ”Interrelationships between metrics”