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**To cite this article:** Daria Larsson, R. M. Chandima Ratnayake & S. M. Samindi M. K. Samarakoon (13 Aug 2025): Agile Balanced Scorecard and Strategy Map Framework for Engineering-to-Order Projects: Enhancing Adaptability and Performance, Engineering Management Journal, DOI: [10.1080/10429247.2025.2538065](https://doi.org/10.1080/10429247.2025.2538065)

**To link to this article:** <https://doi.org/10.1080/10429247.2025.2538065>



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Published online: 13 Aug 2025.



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# Agile Balanced Scorecard and Strategy Map Framework for Engineering-to-Order Projects: Enhancing Adaptability and Performance

Daria Larsson , R. M. Chandima Ratnayake , and S. M. Samindi M. K. Samarakoon 

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## ABSTRACT

Engineering firms often measure performance by design costs and project revenue, focusing on meeting deadlines within budget. However, financial metrics alone may not fully capture project success or long-term viability. Modern engineering organizations need a Balanced Scorecard (BSC) that adapts to market changes and environmental challenges. This study aims to develop an agile, sustainability-focused BSC framework for engineering-to-order project-based organizations (ETOPBO) by integrating AHP. The framework synthesizes existing literature to form a comprehensive solution. Findings include KPI digital dashboards based on AHP analysis and strategic maps for the case study organization. The novel BSC framework incorporates sustainability and agile principles, enabling practitioners to monitor assets and execute strategies effectively. The agile BSC allows companies to track daily KPIs, analyze trends, and respond swiftly to changes, improving organizational performance and decision-making. This paper introduces the agile BSC concept in the engineering private sector, previously unexplored in literature.

## KEYWORDS

Agility; sustainability; KPI; balanced scorecard; project-based organizations

## EMJ FOCUS AREAS



Strategic management; organizational & performance assessment; organization development & change; knowledge management

## Introduction

According to the findings from the research report (Murton Beets, 2018), engineers' most significant current challenges are a lack of time to perform demanding engineering tasks due to tight project deadlines and task overload. There is also a growing concern, especially among young engineers, related to knowledge loss as a result of experienced engineers leaving the organizations. Researchers and practitioners agree that engineering companies face challenges due to prioritizing financial measurements over other areas such as human factors and intellectual capital (Tyrrell, 2018; Weqar et al., 2021). As a consequence, engineers are changing companies more frequently due to a toxic corporate culture; the lack of possibilities to grow, or failure to recognize employee performance (Sull et al., 2022). Engineering companies also neglect other organizational aspects in order to increase revenues, such as safety or quality of the processes and products, which, in the case of Boeing (Cusumano, 2020), as well as BP (De Wolf & Mejri, 2013; Viglione, 2020), has resulted in the death of people. Therefore, it is vital for engineering organizations to monitor and control critical areas of activity, by measuring financial and operational key performance indicators (KPIs) equally, as no single measure such as project revenue can provide a clear view of the whole organization (Kaplan & Norton, 1992; Van de Ven et al., 2023). While monitoring balanced performance measurements, organizations are capable of better decision-making, affecting day-to-day activities (Gutierrez et al., 2021).

The engineering-to-order project-based organization (ETOPBO) is structured around integrated business functions that revolve around project lines, ensuring seamless coordination and execution (Gareis, 2000; Sankaran et al., 2023). This organizational framework is particularly adept at handling the complex and costly nature of final product development within ETOPBO. Here, detailed planning and execution are essential, given the complex nature of the projects undertaken. ETOPBO's expertise finds significant relevance in industries marked by complicated project requirements, including aerospace, military, construction, and oil & gas sectors. These industries demand tailored solutions for success, making ETOPBO a crucial player in meeting their specialized needs.

There are several challenges that ETOPBOs deal with due to their nature. From the engineering-to-order (ETO) perspective, organizations are challenged by complex and costly engineering, frequent changes in purchase orders or schedule overruns. The design process in ETO is typically complicated and challenging to schedule since the needs for the product frequently change as the project moves along (Jünge et al., 2021). On the other hand, the most common problems faced by a project-based organization (PBO) are related to the organization's strategy (Kaplan & Norton, 1996; Gan & Salter, 2000; Sankaran et al., 2023; Tharp, 2007). Typical examples of PBO' challenges are the failure to share strategy within the organization, a lack of alignment between budgets and strategy plans (Hamdan & Jaafar, 2014; Kaplan & Norton, 1996) or a lack of alignment between projects and the strategic direction

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Refereed Applied Engineering Management Manuscript Accepted by Handling Editor: Davide La Torre.

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of the organization (Gan & Salter, 2000). PBO employees often do not understand the strategy and key initiatives in the organization (Tharp, 2007), which can impact performance improvement. Typically, the employees are neither aware of the performance measures, nor do they know how their work affects the results achieved in the company (De Groot et al., 2022; Tharp, 2007). Therefore, monitoring assets and measuring performance in project organizations is a challenge.

To address these challenges, the authors propose using the Balanced Scorecard (BSC) as a tool to enhance performance in companies and facilitate asset monitoring (Bshayreh et al., 2024). The BSC is particularly recommended for PBOs as it enables employees to better comprehend organizational strategy (Cokins, 2004) and aligns project KPIs with overarching company objectives (Govindan et al., 2023; Kaplan & Norton, 1992). Furthermore, the literature highlights the positive impact of BSC implementation in ETO companies (Larsson et al., 2021). Specifically, in ETO environments, the BSC has proven effective in monitoring engineering projects, providing improved control over engineering hours, schedules, and budgets (Larsson et al., 2021).

A critical aspect of BSC deployment is the selection of appropriate KPIs. Numerous authors have emphasized the use of the Analytic Hierarchy Process (AHP) as a systematic approach for KPI selection within the BSC framework (Elhadjamor & Ghannouchi, 2022; Lin et al., 2023; Munier & Hontoria, 2021; Tavana et al., 2023). Some researchers suggest that integrating AHP with the BSC framework improves performance in complex organizations by combining qualitative and quantitative criteria for enhanced decision-making (Bentes et al., 2012). The significant number of publications where authors combine AHP and BSC supports the assertion that integrating these methodologies is beneficial (Azizi et al., 2013; Bentes et al., 2012; Chan & Chan, 2004; Larsson et al., 2021). KPIs derived from the AHP method can be customized to meet the specific needs of any organization. Deriving KPIs using AHP means creating a structured, multi-criteria decision-making approach to ensure that selected KPIs are in align with strategic priorities of the organization. This process can be customized to meet the specific needs of any organization and includes the steps: defining objective, identifying criteria and sub-criteria, listing potential KPIs, building AHP hierarchy, pairwise comparison of criteria and sub-criteria, calculating weights, ranking of KPIs, selecting KPIs based on the obtained ranking.

However, a critical question remains: which BSC framework is most appropriate for modern organizations, given the diverse variations of the BSC presented in current research? (Hansen & Schaltegger, 2016; Wiraeus & Creelman, 2019). In recent literature, significant doubts have been raised regarding the effectiveness of Kaplan and Norton's "traditional BSC" (1992) in the current business landscape, with scholars arguing that it lacks the flexibility required to address contemporary challenges, including external risks (e.g., market volatility, competitive pressures) and sustainability considerations (Hansen & Schaltegger, 2016; Jaiswal & Thaker, 2024; Kumar et al., 2023). Additionally, scholars point out that the "traditional BSC" fails to support real-time data processing

and continuous feedback (Hansen & Schaltegger, 2016; Jaiswal & Thaker, 2024; Kumar et al., 2023). This issue is particularly pronounced in engineering-driven, project-oriented organizations, where adaptability and responsiveness are critical (Hansen & Schaltegger, 2016; Soderberg et al., 2011).

Although several Balanced Scorecard (BSC) adaptations—such as the Agile BSC (Wiraeus & Creelman, 2019), the Agile-V Scorecard (Beaver, 2007), and the Sustainability Balanced Scorecard (SBSC) (Mio et al., 2021)—have been proposed, there is still no clear consensus on best practices for effectively integrating sustainability and agility into the BSC framework (Jaiswal & Thaker, 2024; Soderberg et al., 2011). This lack of agreement is further underscored by systematic reviews that examine the evaluation and adaptation of the BSC in sustainability contexts (Al-Mawali, 2023; Hansen & Schaltegger, 2016; Tawse & Tabesh, 2023).

This ongoing lack of consensus underscores a critical gap in strategic management—particularly for industries that require agile responsiveness, innovative performance metrics, and the integration of sustainability into their strategic frameworks. Developing a modern BSC framework is critical, as project-oriented engineering organizations increasingly require tools that support rapid decision-making and integrate advanced technologies, such as Business Intelligence (BI) and interactive dashboards that foster innovation (Sankaran et al., 2023). Research underscores the necessity of combining sustainability and agility within the BSC, as noted by several scholars (Chalmeta & Ferrer-Estévez, 2023; Jones, 2011).

To bridge this gap, this research proposes an agile BSC that extends current frameworks through the integration of agile principles and sustainability considerations. Building upon previous studies, this research aims to enhance the adaptability and relevance of the BSC in addressing contemporary organizational challenges.

The following research questions will guide this study:

- (1) How can agility be integrated into the BSC to enhance its responsiveness and flexibility?
- (2) How can companies utilize the BSC to make faster, data-driven decisions?
- (3) How can the BSC be modified to support sustainable transitions in modern engineering organizations?
- (4) What role can BI and interactive dashboards play in enhancing the BSC's functionality?

To address the aforementioned research questions, a case study was conducted at a Norwegian company specializing in executing complex engineering projects within the electrical industry. The chosen Norwegian ETOPBO serves as a representative case, exemplifying the typical characteristics and challenges faced by similar organizations in this industry. By studying this organization, the research aims to uncover broader trends and patterns that can be generalized to other ETOPBO firms. This representative case (Yin, 2013) provides valuable insights into common practices and issues, enhancing the understanding of industry-wide phenomena.

In this paper, the KPIs were chosen based on the ranking, selecting and prioritization of the most significant

performance indicators (PIs) out of a large number of defined PIs. The methodology developed for that purpose was created building up based on the existing research (Bentes et al., 2012), and following the two concepts: the BSC tool (Kaplan & Norton, 2000) and the AHP method (Saaty, 2005). Additionally, this study uses the digital dashboards which are designed for the knowledge workers to support the organization's performance. Hence, an agile BSC and strategy map framework has been developed.

The proposed agile BSC framework makes a significant contribution to the existing body of research by introducing a novel approach that enriches the literature on performance measurement systems. Building on the extensive body of work surrounding the BSC, which has evolved and expanded over time, this study advances the field by presenting a streamlined yet comprehensive framework. It integrates key modern elements such as sustainability, digitalization and BI, addressing the critical needs of contemporary organizations while maintaining simplicity and practical applicability. This contribution fills a gap in previous research, offering a solution that is both agile and sustainability-focused.

The methodology proposed in this paper offers valuable insights for managers of ETOPBOs and similar organizations in selecting KPIs to enhance performance. It highlights the importance of balance within performance metrics, making it relevant for a wide range of industrial organizations. The implementation of an agile BSC can support engineering knowledge-based organizations in effectively monitoring assets and execution plans. This paper is recommended for managers and directors of organizations with characteristics similar to ETOPBOs, who seek to improve their organization's overall performance.

## Literature Overview

### ETOPBOs from the Strategic Perspective

As ETOPBOs combine the features of ETO organizations, which are structured as PBOs, they can be considered from the two perspectives of ETO and PBO (Exhibit 1).

According to Huemann (2014), PBOs define "Management by Projects" as an organizational strategy. In practice, this means that project-based companies organize most of their activities and operations as projects, which play an important role in the core business of the organization (Gemünden et al., 2017; Miterev, Engwall, et al., 2017). PBOs deal with the customized nature of the orders from their customers and are often seen as organizations that are well matched to flexibly respond to shifting customer requirements and to manage knowledge work and non-routine and complex tasks (Hobday, 2000; Miterev, Engwall, et al., 2017; Nightingale et al., 2011; Sankaran et al., 2023; Turner & Keegan, 2001).

However, PBOs face a lot of challenges, which affect their ability to improve organizational performance. According to authors, one of the challenging characteristics for PBOs is the temporary character of projects, which has a negative effect on organizational innovation, learning, knowledge management, capability, development and therefore performance enhancement (Cattani et al., 2011; DeFillippi, 2001; Sankaran et al., 2023; Sydow et al., 2004). Moreover, project experiences are not shared continuously with the organizations, but at the end of the projects (Backlund & Sundqvist, 2018) in the form of unsatisfactory post-project reviews such as lessons-learned reports (Antoni et al., 2005; Scott, 2023; Swan et al., 2010), which negatively affects learning from and between projects. Managing projects in those PBOs is a short-term oriented approach, highly stressful (due to time pressure) and including communication problems (Antoni

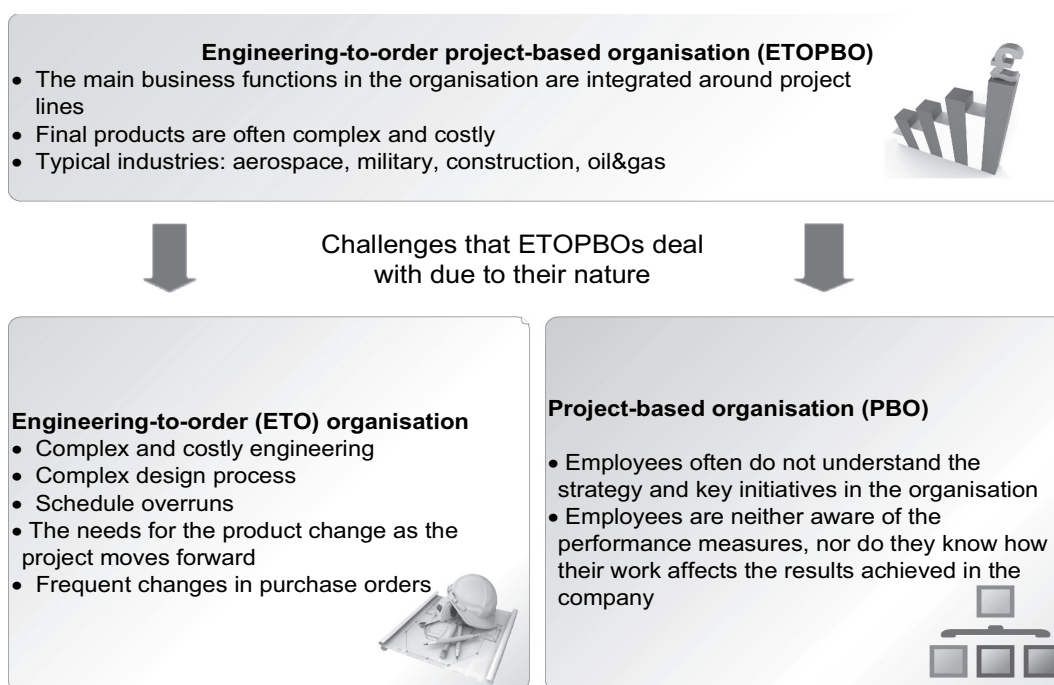


Exhibit 1. Engineering-to-Order Project-Based Organisation (ETOPBO)

et al., 2005; Gieskes & TenBroeke, 2000; Kotnour, 2000; Sankaran et al., 2023). As different types of projects require specific and different solutions (Sankaran et al., 2023; Shenhar, 2001), companies hire temporary project managers or consultants. While working on temporary and short-term tasks, it is highly challenging to adapt quickly to the organizational environment. Consequently, the project and operative focus among project managers collides with improvement initiatives within organizations, which affect PBOs' ability to improve their performance (Backlund & Sundqvist, 2018; de Groot et al., 2021).

As companies nowadays run many projects simultaneously, this increases the need to coordinate and control complex project environments, so that the projects can be aligned to the strategic goals (Gemünden et al., 2017). According to the literature review, PBOs try to select the most suitable project arrangements to match the organization's needs, tending to imitate each other's structure, and practices, and strategies with little reflection given to the effects on performance (Miterev, Turner, et al., 2017).

There are repercussions when project managers have a high level of autonomy, which affects performance improvement in PBOs. Project management practices reflect poor compliance with organizations' procedures and processes. Additionally, the degree of independence allows project managers to fully concentrate on a specific project's performance, with less concern for the overall organizational performance (Backlund & Sundqvist, 2018).

According to Gemünden et al. (2017), one of the tasks of the PBO is to provide sustainable project results to satisfy the organization's stakeholders. In order to do that, project management together with project portfolio management and the organization's leadership need to be aligned and integrated (Gemünden et al., 2017). Therefore, it is vital for the organizations to focus on achieving goals through a organised process of management control, measuring the actions of employees to improve constantly the organization's productivity and efficiency (Pecchia et al., 2013; Sankaran et al., 2023).

## **2.2. Measuring Performance in Knowledge Work in ETOBPO**

Recent studies highlight the dynamic nature of knowledge work (KW) in today's digital and technology-centric landscape (Vuori et al., 2019). Traditionally associated with tasks demanding specialized expertise, cognitive abilities, problem-solving, and information processing to generate value, KW is now frequently conducted remotely due to advancements in digital communication tools and remote work technologies (Nwankpa & Roumani, 2024). This shift is particularly significant in sectors where the primary outputs are intangible, such as decisions, strategies or innovation, rather than tangible products (Vuori et al., 2019). As organizations increasingly rely on knowledge-intensive activities, the role of digital integration and organizational flexibility becomes more crucial in optimizing this form of work. Evaluating intangible performance metrics remains a significant challenge (Gunasekaran & Kobu, 2007; Hasyati & Kurniawan, 2022). Metrics like knowledge, employee-centric, innovation, and process

efficiency are crucial for organizational effectiveness. Among these, knowledge KPIs are particularly impactful, assessing knowledge creation, sharing, and utilization (Nappi & Kelly, 2021). They enhance decision-making, foster innovation, improve customer satisfaction, and streamline efficiency, driving success in knowledge-driven environments.

Organizations face significant challenges arising from an imbalance between financial and non-financial performance indicators, such as knowledge KPIs (Mahidhar & Schatsky, 2019). This issue is particularly critical for organizations that rely heavily on intangible outputs such as knowledge, which are difficult to quantify (Mahidhar & Schatsky, 2019). Unlike financial and physical assets, intangible assets present unique challenges due to their invisibility, the prevalence of multi-tasking, and task completion delays caused by dependencies such as managerial or customer approvals (Chen & Cox, 2012; Iazzolino & Laise, 2018; Tawfek & Bera, 2018). The impact of knowledge KPIs on financial performance is often indirect, driven by complex cause-and-effect relationships within the organization (Kaplan & Norton, 2004; Larsson et al., 2021). As a result, the majority of businesses rely on tangible KPIs, like project profit or sales, as the primary basis for operational and managerial control systems (Kaplan & Norton, 1992; Larsson et al., 2021). However, this over-reliance on financial indicators often leads to insufficient alignment of metrics with strategic goals (West et al., 2024), and a limited ability to measure long-term success in fast-evolving and innovative environments (West et al., 2024). To address these limitations, balancing traditional KPIs with knowledge KPIs is essential for creating a holistic performance measurement system (Mahidhar & Schatsky, 2019). Integrating both types of KPIs allows businesses to build a monitoring system that is more accurate since it provides a whole view of the company and helps decision-making inside the organization (Larsson et al., 2021; Sirikrai & Tang, 2006).

## **2.3. KPI within the Project-Based Engineering-To-Order Organisation**

When selecting KPIs for a company, two elements are crucial: type of metrics and selection method. Informed decision-making is enabled by good metrics, yet weak or inaccurate data can result in poor management choices (Kerzner, 2011). It's not always easy to select particular PIs from the many that are available and make sure they align with the organizational environment and goals (Coskun & Senyigit, 2010).

Extensive research exists on the general selection of KPIs across various companies and sectors. However, from the perspective of ETO companies, research on specific guidance for KPI selection remains relatively sparse. The authors only offer general recommendations for choosing KPIs, such as preserving equilibrium between leading and lagging KPIs, and following organizational context (Podgórski, 2015; Zheng, 2018). The research highlights several KPIs relevant for the engineering and design companies such as: utilization rate, defect rate, on-time delivery, cost performance index (CPI), and return on investment (ROI) (Beisheim & Stotz, 2013). Some authors recommend to reduce number of KPIs due to the possible growing information overload, which may adversely affect

managers (Podgórski, 2015). Another consideration is the practical implementation of sophisticated measuring systems, which may be challenging given the time, money, and training required to conduct measurements, gather data, and process it (Podgórski, 2015).

From the perspective of PBOs, recent research on KPIs highlights the importance of aligning these metrics with strategic goals, especially in dynamic business environments (Van de Ven et al., 2023). Engineering PBOs, due to their complex and evolving nature and sensitivity to technological advancements, require a different approach compared to manufacturing industries (Cruz Villazón et al., 2020). Non-project-oriented organizations, such as manufacturing firms, focus on stable, process-driven KPIs that prioritize long-term operational efficiency and consistency, centered on continuous and repetitive tasks. In project-based settings, it is critical that project outcomes align with broader business objectives; misaligned KPIs can lead to project failure (Bosch-Sijtsema et al., 2009; Cruz Villazón et al., 2020). Engineering projects are particularly vulnerable to risks, delays, and technical challenges, making KPIs crucial for providing early warnings and enabling proactive measures. This allows the company to make necessary adjustments in a timely manner.

## 2.4. Balanced Scorecard (BSC)

### 2.4.1. Comparison to other frameworks

Over the past 30 years, various frameworks have emerged in the literature to support the design and implementation of performance measurement systems (PMS). Key examples include the Integrated Performance Measurement System (IPMS) (Bititci et al., 1997), the Performance Prism (Kennerley & Neely, 2000), the Performance Pyramid (Lynch & Cross, 1988; Stotzer, 2023), the Performance Measurement Matrix (Keegan et al., 1989; Malloch, 1999), and the Goal Question Metric (GQM) approach (Basili et al., 1994; Calvo & Beltrán, 2024).

Each framework has its strengths and weaknesses. For instance, the Performance Pyramid can be somewhat rigid, limiting its ability to adapt to the evolving nature of modern business, especially when compared to the more flexible BSC (Parida et al., 2015). The Performance Measurement Matrix, while effective in some contexts, lacks the strategic integration that the BSC offers (Parida et al., 2015). The Goal Question Metric approach is highly focused but may not provide a comprehensive view of an organization in the way the BSC does (Biazzo & Garengo, 2012). The Performance Prism, while thorough, can be resource-intensive and may require more effort to effectively manage stakeholder relationships compared to the BSC (Parida et al., 2015).

Ultimately, the choice of framework depends on the specific needs of the organization. However, many researchers agree that the BSC remains the most widely adopted and recognized framework (Van de Ven et al., 2023).

### 2.4.2. Is the BSC still in use?

The “traditional BSC” (Kaplan & Norton, 1992) integrates financial and operational metrics, with operational measures like the customer, internal business process, and learning and

growth perspectives acting as leading indicators, while financial measures are lagging indicators (Kaplan & Norton, 1992; Lee et al., 2008). It has been applied in various industries, including construction (Nogueira Rivera et al., 2014), health-care (Coskun & Senyigit, 2010), automotive (Nagynova & Sütőová, 2014), renewable energy (Jordão et al., 2011), and engineering (Ogata & Spraakman, 2013), proving effective in aligning performance with organizational goals (Öztaysi & Uçal, 2009). The BSC remains in use, as evidenced by recent literature (Bshayreh et al., 2024). Research by Bshayreh et al. (2024) indicates a positive association between the BSC and firm performance. Their findings suggest that the BSC offers a balanced and integrated approach to performance measurement, aligning objectives across different areas of an organization. Kumar et al. (2024) also emphasize that the BSC played a critical role during the COVID-19 pandemic, helping organizations manage and respond to strategic changes.

Tawse and Tabesh’s (2023) review of BSC usage over the past 30 years supports the idea that the BSC has made significant contributions to organizational outcomes. However, their analysis notes a declining trend in BSC-related research over the last 15 years, potentially due to the rise of new management ideas and practices. They suggest that future research should focus on adapting the BSC to external factors, particularly with an emphasis on agility, efficiency, and effectiveness in response to externalities (Heidt et al., 2023; Tawse & Tabesh, 2023).

Another important direction for future development is the incorporation of sustainability into the BSC framework, reflecting the growing emphasis on organizations’ environmental and societal impacts as stakeholders increasingly hold them accountable (Tipu, 2022). The “traditional BSC” limitations in dynamic environments have led to adaptations, such as the “Agile-V Scorecard” (Beaver, 2007), which incorporates agile metrics like burn-down and burn-up charts to align team performance with business objectives. These agile adaptations emphasize real-time feedback and continuous improvement, balancing leading and lagging indicators for timely decision-making (Wiraeus & Creelman, 2019). Despite these advancements, research on agile BSC models remains limited, with gaps in developing frameworks tailored for fast-changing environments (Van de Ven et al., 2023; Wiraeus & Creelman, 2019).

### 2.4.3. Digital dashboards, business intelligence (BI) and BSC integration

BSC is now often used as a dashboard linked to digital platforms, fueled by increasing data volumes and BI tools (Kumar et al., 2024; Sahoo et al., 2023; Sharma et al., 2024). Research highlights how Power BI enhances strategic management through data visualization, with a focus on integrating sustainability into BSC (Chalmeta & Ferrer-Estévez, 2023; Jaiswal & Thaker, 2024; Tawse & Tabesh, 2023). Integrating BI systems with BSC improves non-financial metric tracking and supports sustainability goals.

Research shows that both engineering and non-engineering organizations increasingly use BI tools to visualize, track, and manage KPIs in real time, improving the effectiveness of the BSC. Power BI, for instance, enables companies to build dashboards that display real-time data across BSC perspectives,

allowing for quick responses to performance issues (Govindarajan & Ananthanpillai, 2024). Utilizing advanced data analysis, companies gain insights that enhance operational efficiency, inform decision-making, optimize product designs, and refine marketing strategies (Ren & Tao, 2012).

Research often examines how BI tools can be configured to display BSC metrics, with case studies showcasing its use in various sectors through interactive dashboards. These studies emphasize the importance of user-centric design, noting that different stakeholders, such as lower-level management and directors, require different KPIs. By integrating BSC into BI, organizations gain a platform that tracks KPIs and links them to strategic initiatives, enabling quicker responses to daily operations and offering a dynamic performance management tool.

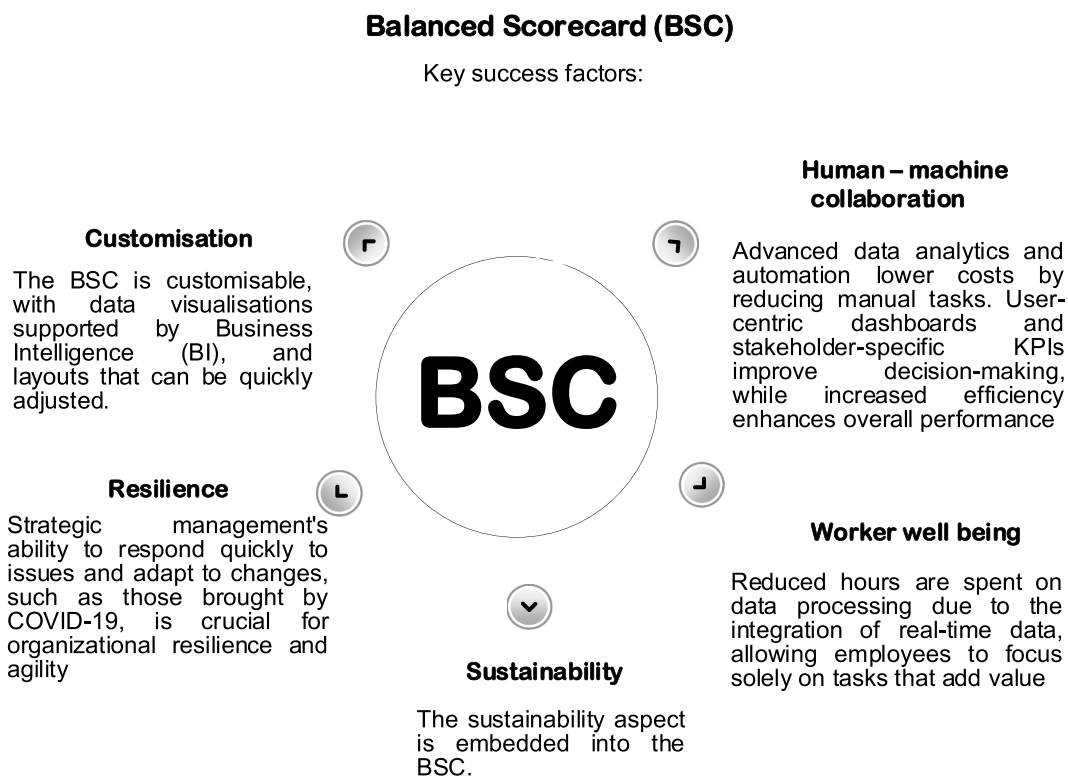
Exhibit 2 summarizes the key success factors for the BSC as outlined by various scholars (Chalmeta & Ferrer-Estévez, 2023; Jaiswal & Thaker, 2024; Tawse & Tabesh, 2023). Furthermore, drawing on the research by Narkhede et al. (2024), modern performance measurement systems, such as the BSC, are increasingly evolving toward more value-driven, human-centric, and resilient frameworks. These frameworks emphasize adaptability, sustainability, and human-machine collaboration, reflecting the shifts in industrial paradigms (Exhibit 2).

#### 2.4.4. BSC and sustainability

Research on integrating sustainability into the BSC has been increasing (Chalmeta & Ferrer-Estévez, 2023; Jaiswal & Thaker, 2024; Tipu, 2022). Some authors incorporate sustainability into the existing four pillars of the BSC (Thanh & Nguyen, 2020), while others propose adding additional pillars

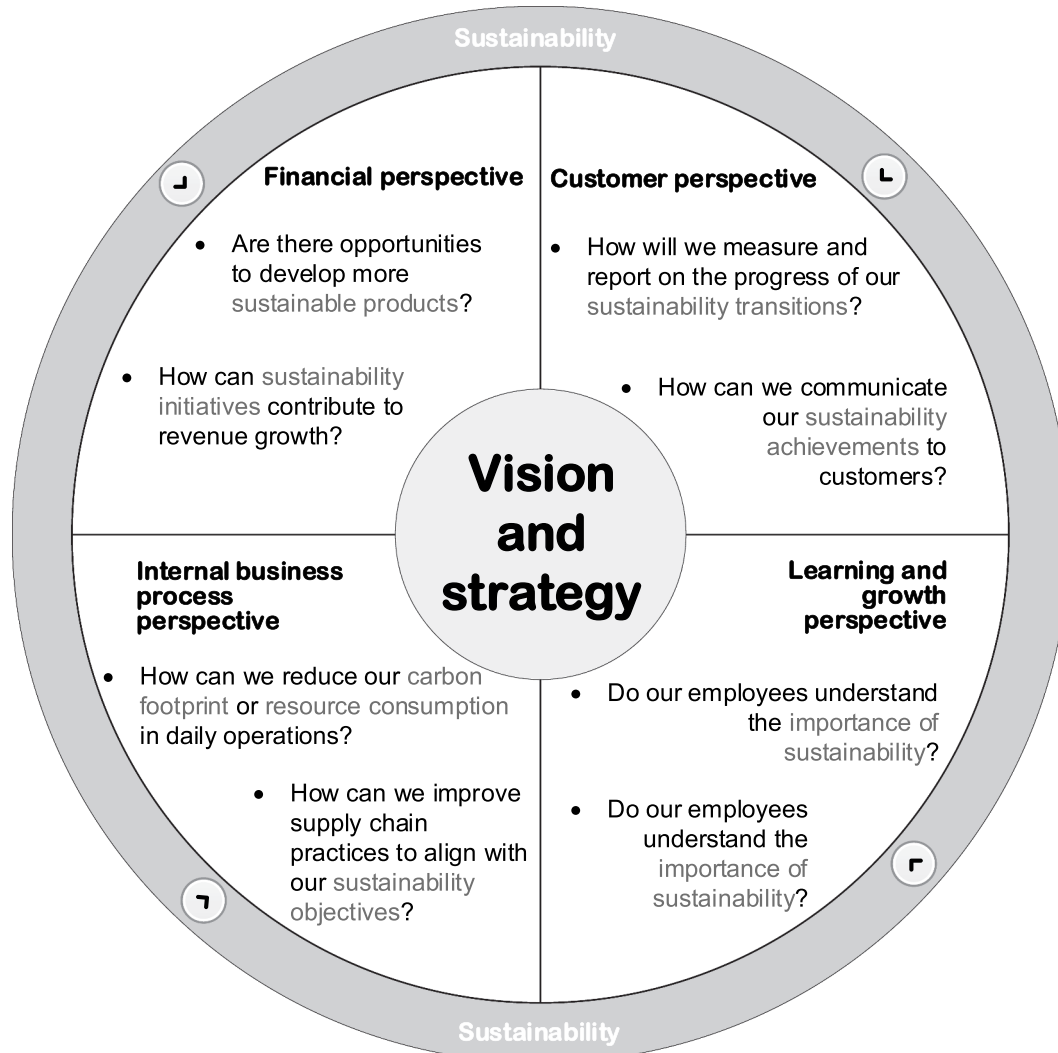
(Kang et al., 2015) or replacing existing ones to emphasize sustainability (Schaltegger & Lüdeke-Freund, 2016). Each approach has its proponents and critics. For the purpose of this paper, the model in Exhibit 3, which integrates sustainability into the four existing pillars without adding a separate pillar, will be applied in the case study. This approach integrates sustainability into the organization's strategy without the need for a distinct pillar, ensuring that environmental thinking permeates all aspects of performance measurement.

Integrating sustainable transitions into the BSC necessitates embedding transformative sustainability-oriented objectives and actions across all BSC perspectives. Contrasting general sustainability, sustainable transitions emphasize systemic shifts that redefine business practices, foster innovation, and address long-term environmental and social challenges. This involves not only measuring sustainability outcomes but also aligning the organization's core strategy with the principles of sustainable development. As illustrated in Exhibit 3, such objectives might include revenue generation from green products (financial perspective), employee training on sustainability topics (learning and growth perspective), reductions in carbon emissions (internal processes perspective), and the development of a sustainability index to monitor progress in sustainable improvements (customer perspective). Moreover, it is vital to incorporate the financial objectives tied to sustainability-driven innovation, such as revenue growth from sustainable product lines, cost savings from energy-efficient processes, or investments in circular economy models. This moves beyond isolated green product revenue and emphasizes systemic financial restructuring for sustainability.



**Exhibit 2.** A Summary of the Current Expectations for the Balanced Scorecard (BSC) as Presented in Recent Literature; Adapted from Kaplan and Norton (1992)

## Examples of sustainable objectives integrated into the BSC



**Exhibit 3.** The Sustainability Aspect is Integrated into the Existing Perspectives of the BSC, Adapted from (Kaplan and Norton, 1992)

The concept of a sustainability index often raises questions among organizations regarding its definition and methods of calculation (Guo et al., 2015; Farahdel et al., 2024; Moghaddam et al., 2014). The literature highlights diverse methodologies tailored to specific industries for developing sustainability indices (Farahdel et al., 2024; Moghaddam et al., 2014), reflecting the multifaceted nature of sustainability assessment. The complexity of constructing a sustainability index depends on variables such as organizational size, industry context, available resources, and sustainability goals (Guo et al., 2015).

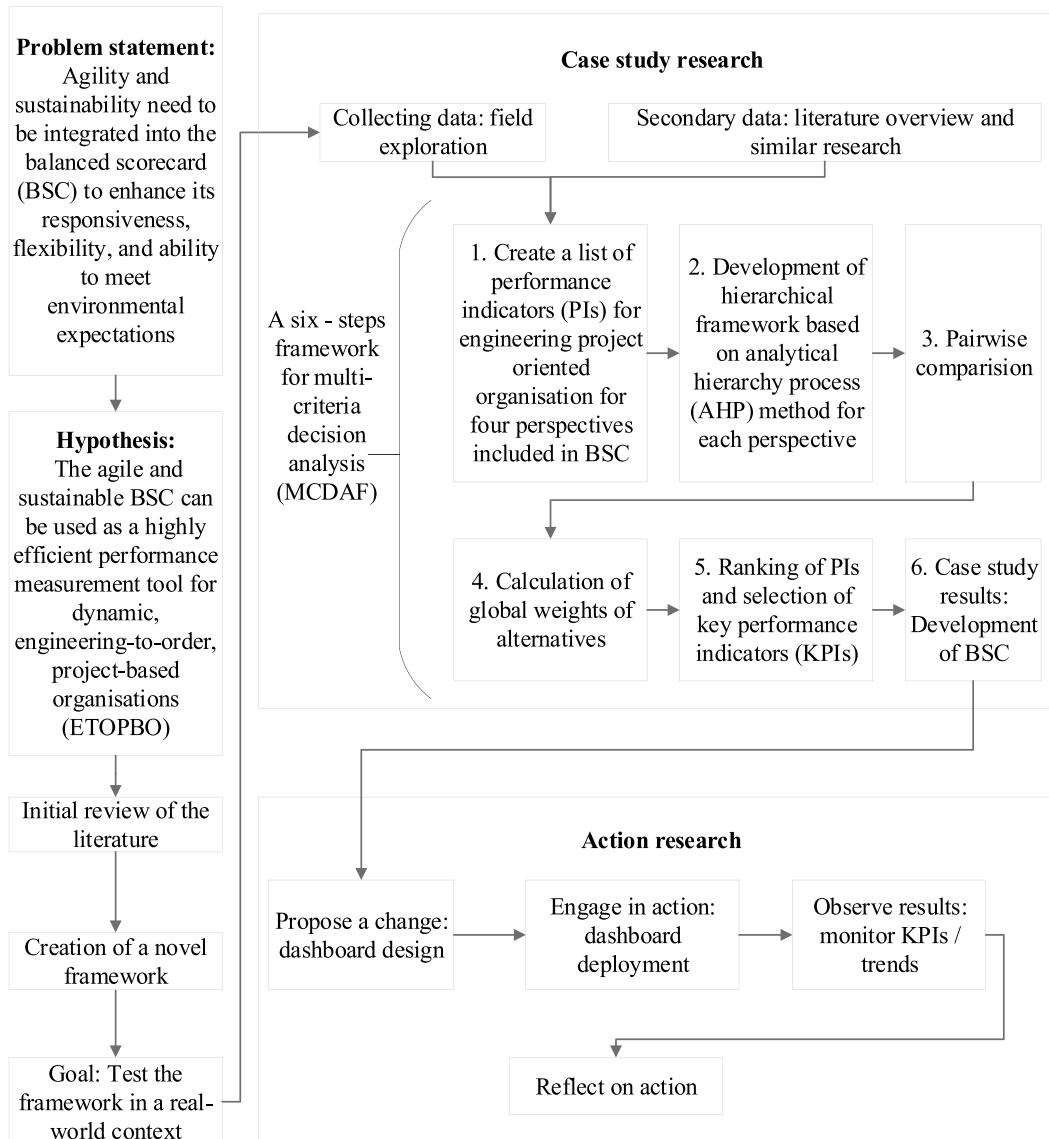
To operationalize sustainable transitions effectively, organizations can align their BSC with global frameworks like the United Nations Sustainable Development Goals (SDGs) or ISO 14,001. These frameworks ensure that sustainable transitions are measurable, comparable, and aligned with international benchmarks. Furthermore, external audits by third-party organizations, such as SB Insight (SB Insight, 2024), validate the effectiveness of sustainability transitions and offer benchmarking against industry peers.

In summary, by embedding sustainable transitions across all BSC perspectives and focusing on transformative, systemic changes rather than isolated metrics, organizations can achieve long-term sustainability goals.

### Research Methodology

An agile BSC and strategy map framework for ETOPBO has been created by combining case study-based research with action research in accordance with the guidelines provided by Yin (2013), AHP, and BSC principles. Exhibit 4 illustrates the overarching methodology. As depicted in Exhibit 4, the research objective was formulated and then a thorough literature analysis was carried out by searching academic databases, namely Oria. The search parameters were tailored to retrieve articles pertinent to KPI selection for engineering knowledge work, the BSC concept, and AHP. A search string is presented in Exhibit 5.

The concept of BSC was used to group PIs into four categories according to the four BSC perspectives. This was done with the intention of finding indicators that would represent the



**Exhibit 4.** Research Methodology and Research Methods

**Exhibit 5.** Search String and Keywords

Keyword	Intervention
"ETO" OR "Engineering-to-order" OR "low volume" OR "PBO" OR "Project-based organisations" OR "Project organisations" OR "BSC" OR "Balanced Scorecard"	"Agile" OR "Strategic tools" OR "Strategy maps" OR "KPI" OR "Dashboard" OR "BI" OR "Business Intelligence" OR "AHP"

most important areas of the organization, in such a way that the number of selected KPIs was similar for each group, and therefore balanced. The final result of the case study (a set of selected priority KPIs) was approved by the company's leaders, and thus accepted for further use. The KPIs acquired were utilized to generate a KPI dashboard and to build a comprehensive BSC.

### Selection of PIs Using AHP Hierarchical Structure

The literature review discusses various methods developed for multi-criteria decision-making (MCDM) such as AHP,

Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Weighted Scoring Model (WSM), Best-Worst Method (BWM), Fuzzy AHP, Simple Additive Weighting (SAW), or VIKOR (Chorfi et al., 2015; Gonçalves et al., 2015; Kaganski et al., 2018; Kibira et al., 2017; Radulescu & Radulescu, 2024). A decade ago, Chorfi et al. (2015) argued that, despite the existence of several popular MCDM techniques, AHP is the most effective tool for KPI ranking. According to recent research, TOPSIS and BWM are becoming more popular as they are faster and less resource-intensive comparing to AHP (Lin et al., 2023). Despite the growing popularity of alternative methods, such as TOPSIS and BWM, studies indicate that AHP remains widely used for various decision-making purposes and continues to be a popular method for KPI selection, particularly in complex, multi-criteria environments (Tavana et al., 2021; Elhadjamor & Ghannouchi, 2022; Lin et al., 2023). This is justified by the fact that the AHP depends on the knowledge, experiences, and intuitions of the decision makers (DM) rather than a large volume of data (Chorfi et al., 2015). Another argument is that

AHP provides a structured approach capable of integrating both qualitative and quantitative factors (Elhadjamor & Ghannouchi, 2022).

As this manuscript focuses on enhancing the BSC framework, the AHP has been selected for KPI selection due to its extensive testing in the literature, particularly in combination with BSC ... There are several reasons why the AHP is a suitable method for selecting performance indicators for an ETOPBO. First, AHP is a well-established and widely recognized decision-making tool that is easy to use, flexible, and supported by accessible, user-friendly software (Emrouznejad & Marra, 2017; Munier & Hontoria, 2021; Poveda-Bautista et al., 2012). These characteristics make it particularly appealing to company stakeholders who prioritize straightforward and time-efficient solutions.

One of the key advantages of the AHP is its ability to structure complex decision problems hierarchically and to facilitate judgments while verifying their consistency (Emrouznejad & Marra, 2017; Ishizaka & Labib, 2011). This structured approach helps stakeholders better conceptualize the problem and express their opinions in a systematic and transparent manner. As Farkas (2010) asserts, hierarchy is the most effective way to structure decision problems. AHP is particularly valuable when selecting performance measures in organizational contexts where the individuals impacted by the decision are also the ones making it (Munier & Hontoria, 2021)—a scenario that directly applies to the context addressed in this manuscript.

The decision-making problem was represented by a hierarchical structure (Exhibit 6). A hierarchical framework was designed for each perspective of BSC based on a defined group of PIs (Exhibit 7) and defined criterium of choice (Exhibit 6). A pairwise comparison method was used to find the most significant KPIs. In order to perform a pairwise comparison of the PIs, several interviews were undertaken with DMs.

DMs play a pivotal role by offering expert insights, maintaining consistency in the decision-making process, and steering the analysis toward a conclusion that aligns with the organization's key priorities and goals.

The questions posed to the DMs during the interviews followed a uniform framework. It took around an hour for each interview. The DMs belonged to the management of the case study company, whereas the interviewer was a university representative.

## Case Study Research

### KPI Selection Methodology

In order to rank and choose PIs in accordance with the AHP method, a multi-criteria decision analysis framework (MCDAF) was developed specifically for this article (Exhibit 4). The six processes that make up the MCDAF are explained in the paragraphs that follow. The BSC tool created by Kaplan and Norton (2000) and the AHP approach created by Thomas Saaty (2005) serve as the foundation for the methodology that is being suggested.

A decision-making challenge arises when deciding which of a comparatively large number of defined performance indicators (PIs) are the most meaningful and representative. This demand the question of how to prioritize those indicators and which KPIs should be chosen from a given collection of PIs. The next step is to determine the criteria for KPI selection and evaluation. Based on the literature review, AHP was selected as the method for decision-making analysis.

### Description of the Case Study

A case study was performed in a ETOPBO company based in Norway that offers manufacturing, service, and KW. The company employs about 100 people and specializes in a range of offshore, subsea and defense projects. Previous research has led to the conclusion that poor final project margins were a result of some project types' final budgets—roughly 30% of the projects in the portfolio—being higher than anticipated. The data analysis that was conducted revealed that excessive engineering hours and management activities are the reason for increased project margins.

Further data obtained from the business's internal systems revealed issues that were reported related to product quality and low customer satisfaction. Therefore, in order to achieve the organization's strategic goals, the senior management of the corporation is looking for a solution to support project control and monitoring, and quality assurance.

### Identification of Performance Indicators (PIs)

The list of possible relevant PIs for the organization is indicated in Exhibit 7 below. The suggested PIs were developed using recommendations from the DMs as well as examples from the engineering KW literature (Cruz Villazón et al., 2020; Jordão et al., 2011).

### Step 2. Development of Hierarchy

The authors suggest that the selection of criteria is contingent upon the available alternatives, as the former are chosen in relation to the latter (Munier & Hontoria, 2021). It is possible to decide the criteria only when the alternatives are known; therefore, it can be concluded that the criteria are defined based on alternatives (Munier & Hontoria, 2021; Russo & Camanho, 2015). AHP assumes that the criteria are independent (Munier & Hontoria, 2021). Saaty (1980) advises working with fewer than 9 criteria.

The literature review by Russo and Camanho (2015) states that the process of choosing the foundation of criteria is typically based on the literature; however, a similar number of cases under study indicated that the process was based on choosing the criteria that were deemed pertinent for the organization.

In this case study, the criteria for selecting KPIs were determined based on a combination of factors. Firstly, they were obtained based on a review of relevant literature (McNeeney, 2005; Podgórski, 2015; Shahin & Mahbod, 2007). Secondly, they were selected by suggestions from

DMs. According to the literature review, each KPI considered in the decision-making process had to adhere to the SMART criteria (McNeeney, 2005; Shahin & Mahbod, 2007), which refers for specific, measurable, achievable, relevant, and time-bound. Specifically, each indicator needed to meet the following criteria:

- Specific: The indicator should exactly outline the phenomenon under research and be understandable to stakeholders (Podgórski, 2015).
- Measurable: Indicators should be directly obtainable from the company’s systems or easily calculable based on available data using existing software or stored data.

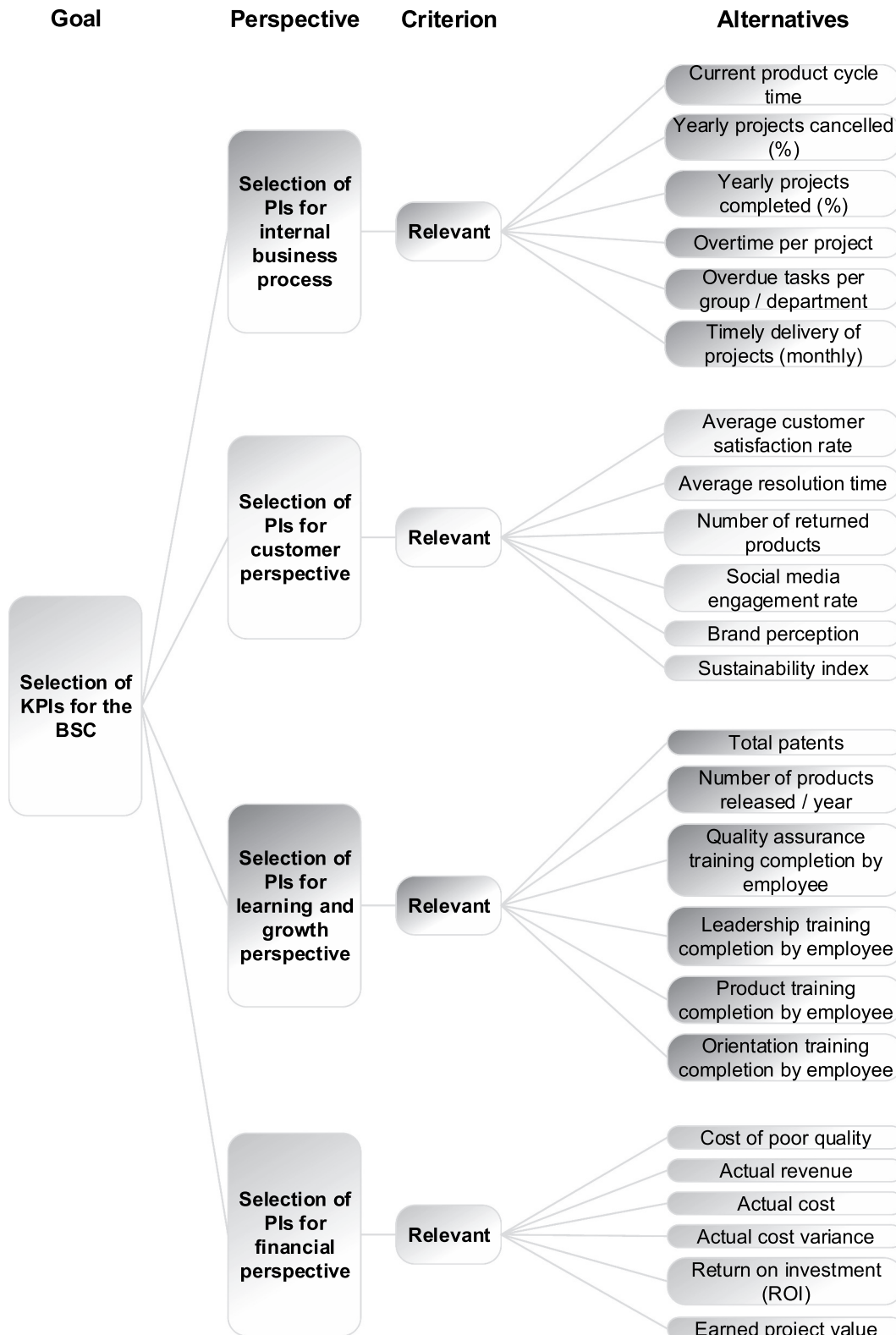


Exhibit 6. Overall Hierarchical Structure for the Case Study

**Exhibit 7.** Performance Indicators (PIs) for ETOPBO

Financial perspective	<ul style="list-style-type: none"> <li>● Alt. 1: Earned project value(average for all ongoing projects; calculated monthly)</li> <li>● Alt. 2: Return on investment(ROI) (average for all ongoing projects; calculated monthly)</li> <li>● Alt. 3: Actual cost variance(for all ongoing projects; calculated monthly)</li> <li>● Alt. 4: Actual cost (for all ongoing projects; calculated monthly)</li> <li>● Alt. 5: Actual revenue (for all ongoing projects; calculated monthly)</li> <li>● Alt. 6: Cost of poor quality(calculated monthly)</li> </ul>
Customer	<ul style="list-style-type: none"> <li>● Alt. 1: Customer satisfaction rate (average)</li> <li>● Alt. 2: Average resolution time</li> <li>● Alt. 3: Number of returned products</li> <li>● Alt. 4: Social media engagement rate</li> <li>● Alt. 5: Brand perception</li> <li>● Alt. 6: Sustainability index</li> </ul>
Internal business process	<ul style="list-style-type: none"> <li>● Alt. 1: Timely delivery of projects (monthly)</li> <li>● Alt. 2: Overdue tasks per group/department</li> <li>● Alt. 3: Overtime per project</li> <li>● Alt. 4: Yearly projects completed (%)</li> <li>● Alt. 5: Yearly projects cancelled (%)</li> <li>● Alt. 6: Current product cycle time</li> </ul>
Learning and growth	<ul style="list-style-type: none"> <li>● Alt. 1: Orientation training completion by employee</li> <li>● Alt. 2: Product training completion by employee</li> <li>● Alt. 3: Leadership training completion by employee</li> <li>● Alt. 4: Quality assurance training completion by employee</li> <li>● Alt. 5: Number of products released/year</li> <li>● Alt. 6: Total patents</li> </ul>

- Attainable: Indicator principles should be achievable, with sufficient human and technical resources for data collection (Podgórski, 2015).
- Relevant: Indicators should align with the specific perspective of the BSC and be pertinent to the goals and targets established by the organization.
- Time-bound: It should be possible to define the time-frame within which a given measure of the indicator may be accomplished (Podgórski, 2015).

Moreover, the DMs collectively determined that all proposed PIs should meet the criteria of being specific, measurable, attainable, and time-bound.

While compiling the list of PIs, only those meeting the criteria of being specific, measurable, attainable, and time-bound were included, as shown in Exhibit 7. To streamline the complex comparison process, the DMs requested the use of a single criterion. Consequently, it was agreed that PIs would be evaluated solely based on their relevance criterion. Therefore, each PI was evaluated by the DM through a single guiding question: “How relevant is this PI to the organisation?” Using this single question significantly reduced the time required to compare the 24 PIs.

While the suitability of using AHP for a single criterion may be debatable, the authors of this manuscript believe it was appropriate in this context. The primary goal was to compare alternatives efficiently, and the remaining criteria were deemed to have a negligible impact on the final decision. Moreover, leveraging software to calculate weights and rank alternatives based on pairwise comparisons for the single criterion proved beneficial, streamlining the decision-making process.

Applying AHP with a single criterion—such as *relevance*—can streamline the decision-making process by concentrating on the most critical factor. This simplified approach is particularly effective in contexts where clarity is essential, stakes are high, or resources are constrained. Several studies have successfully employed a single-criterion AHP model, including

environmental decision-making (Sadiq & Tesfamariam, 2007), healthcare prioritization (Schmidt et al., 2015), and supply chain management (Salomon et al., 2016). Focusing on one key criterion ensures that the most important aspect is given priority, thereby enhancing the efficiency and impact of the decision-making process (Salomon et al., 2016).

A hierarchical structure is required to depict a problem when utilizing the AHP model (Farkas, 2010). Therefore, a hierarchical structure will be created for each perspective of the BSC once all of the PIs and criteria are defined and stated. The decision problem, which in this case is the choice of KPIs for every BSC perspective, can be broken down into a hierarchy of smaller issues that can be examined separately. It is assumed that each perspective of the BSC is equally important. The decision issue decomposition from the BSC’s perspectives is shown in Exhibit 6.

### Step 3. Pairwise Comparison of Alternatives

Once the hierarchy is defined (Exhibit 6), it is possible to assess the alternatives in pairs and ascertain their respective relative relevance. Two methods of evaluating the alternatives through AHP are described in the literature (Russo & Camanho, 2015; Wallenius et al., 2008): pairwise (or relative judgment) and rating (also known as absolute judgment).

When there are many of options, the rating approach may be thought to be more effective; however, it does necessitate a pre-established and verified rated scale. Although the pairwise technique is more accurate, the rating can also make the AHP application faster and easier to use (Russo & Camanho, 2015). The approaches yield comparable outcomes despite their differences (Russo & Camanho, 2015).

The AHP uses paired comparison judgments for pairs of homogenous items (Farkas, 2010). Exhibit 8 (Saaty & Vargas, 1994) depicts the fundamental value scale used to describe judgment intensity.

**Exhibit 8.** Saaty's fundamental scale (adapted from Saaty & Vargas, 1994)

Numerical scale	Description
1	Equally importance
2	Slight importance
3	Moderate significance
4	Strong moderate significance
5	Significant importance
6	Strong importance
7	Demonstrated importance
8	Very, very strong importance
9	Extreme significance

ExpertChoice software was used to analyze the created hierarchy through a sequences of pairwise judgments. The DMs were requested to weigh each factor in relation to every other component in its own subcategory. Aragonés-Beltrán et al. (2009) state that the procedure requires an objective prioritization, which is achieved by taking into account the viewpoints of multiple specialists. The opinions of specialists with extensive expertise and understanding in the industry area provided the information used in this case study. Four specialists were selected:

- Expert 1 has over 25 years of industry experience, specializing in sales and finance. Throughout his career, he has held a leading managerial position, making strategic decisions that shaped the company's direction. His expertise in sales includes driving revenue growth, developing innovative strategies, and building strong client relationships.
- Expert 2 is a professional with extensive understanding of company procedures and a background in industry businesses. This expert has a bachelor's in engineering and master's in economics and holds a high-level managerial position. With a strong foundation in both technical and economic disciplines, Expert 2 is adept at optimizing operational efficiency and driving strategic initiatives. His role involves overseeing daily operations, ensuring smooth workflow, and implementing policies that align with the company's goals. Expert 2's comprehensive knowledge and leadership skills contribute significantly to the company's success and growth.
- Expert 3: a professional with long experience and deep knowledge of performance measures for the engineering and manufacturing sectors. Expert 3 is a seasoned professional with extensive experience in supply chain management and health, safety and environment. Currently serving as the high-level manager. He has been instrumental in achieving the company's goals and managing risks effectively.

- Expert 4 is a project management specialist with 20 years of experience. Expert 4 is responsible for overseeing and driving key initiatives, ensuring that projects are completed successfully and align with the company's strategic goals.

Every alternative is contrasted with the others within a certain criterion ("Relevant"). The software uses Saaty's (Saaty, 1980) measure of relative importance to transform the DMs' preferences to numerical values. There are nine levels of importance as presented in Exhibit 8.

Furthermore, the program enables the DMs to assess the consistency ratio (CR) to gauge how consistently they make decisions (Exhibit 9). The same program, ExpertChoice, automatically determined the CR using the values selected for the pairwise comparison. The CR cannot be more than 10% in order to be considered acceptable. The software needed to be corrected in the event that the CR was higher in order to proceed to the next step.

#### Step 4. Evaluation of Alternatives' Global Weight

Next, each alternative's global weight is determined using the AHP approach. The global weights of each choice in relation to each criterion are determined using the values acquired in the preceding phase. The ExpertChoice program was used to determine the global weight of each choice as the last step. The options with the maximum weights were chosen by the DMs to be applied in the case study company based on the calculated global weights of all alternatives.

#### Step 5. Ranking of PIs and Selection of KPIs

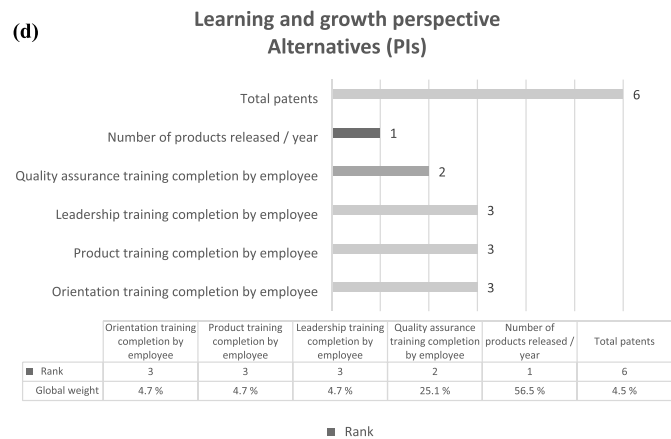
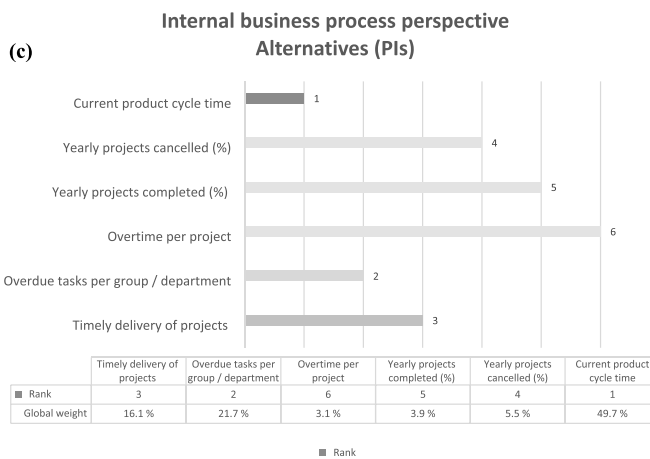
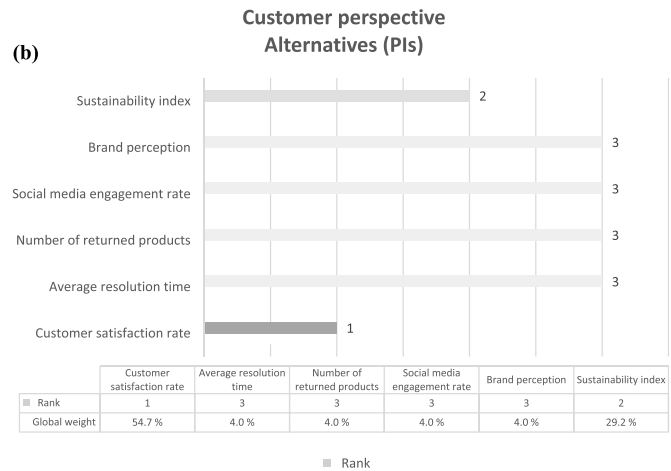
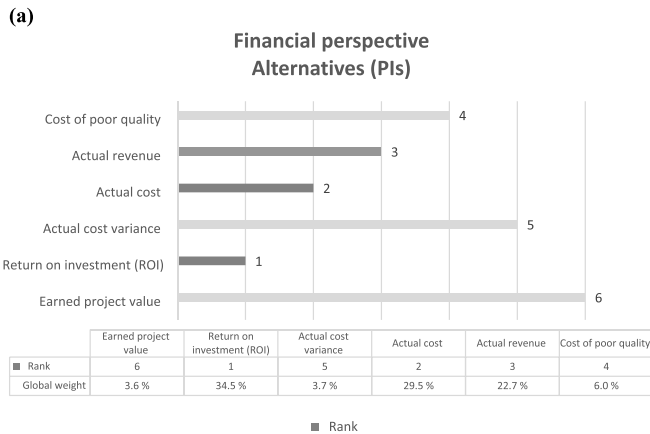
The selected PIs were prioritized and incorporated into the BSC based on their global weights, determined by DMs. PIs with stronger global weights, reflected in the figures below, were included in the BSC as KPIs. At least two KPIs were chosen for each group (the top two in the ranking), in some instances, three KPIs were selected, particularly when there was a significant percentage difference between the rankings of the third and fourth indicators (Exhibit 10).

Although the result of the AHP is to select the best alternatives for a company, the stakeholders remain accountable for its acceptance or rejection (Munier & Hontoria, 2021). In this case study, the DMs were evaluating the KPIs obtained and the final decision was to keep them in the current form.

Exhibit 11 presents the comparative sensitivity analysis chart that visually represents the global weights of KPIs across four perspectives of the BSC. The chart illustrates which KPIs

**Exhibit 9.** Consistency Ratios for various Perspectives. The Customer Perspective CR (5.1%) Demonstrates the Highest Consistency in Judgments, While the Internal Business Process Perspective CR (8.1%) has the Lowest Consistency

Criteria	Consistency Ratio (CR)			
	Financial perspective	Customer	Internal business process	Learning and growth
Relevant	5,6 %	5,1%	8,1%	7,5%



**Exhibit 10.** Performance Scores for PIs Regarding Following Perspectives: (a) Financial,(b) Customer, (c) Internal Business Process, (d) Learning and Growth.Each Perspective of the BSC is Considered Equally Important; only, the Alternatives within each Perspective are Ranked Based on the DMs Judgment

have the most significant impact within each perspective, helping to identify areas that are most sensitive to changes.

**Step 6. Selection of KPIs and a Strategy Map**

The developed BSC framework is presented in Exhibit 12 in the form of a strategy map, and in Exhibit 13 in the form of a digital dashboard. The strategy map has been developed in order to describe in a graphical way how a company can create strategic value. While the information in the “Targets” and “Initiatives” columns was derived from the case study organization’s top management, the “Measures (KPIs)” column was derived from the AHP analysis, and the DMs used the ranking to determine which PIs were most significant.

The targets and initiatives were developed through interviews with key decision-makers, who were responsible for identifying and selecting the relevant PIs. This approach ensured that the metrics were closely aligned with organizational priorities and reflected the strategic objectives defined by leadership.

**Findings and Implementation**

**KPI Dashboard Deployment**

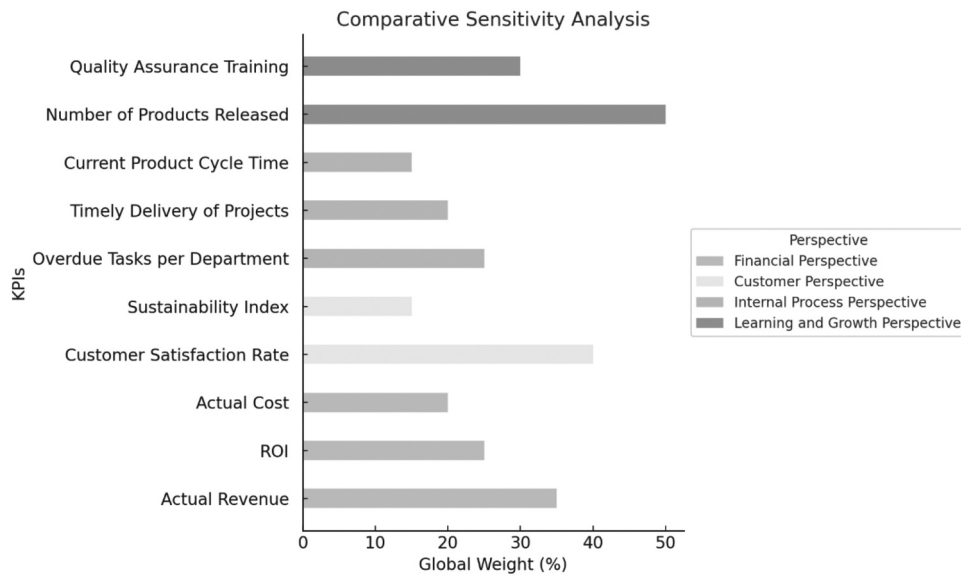
The KPIs acquired were utilized to generate a KPI dashboard and to build a comprehensive BSC. The dashboard is shown

below (Exhibit 13). The board’s goal is simply to highlight the key areas of the company that DMs believes should be prioritized. The board will be made public to all firm personnel by deploying it on an online platform.

The majority of the data used in this analysis is real, though certain KPIs, such as the *sustainability index* and *overdue documents*, are not currently measured in the case study company. However, these metrics can be retrieved from the system when necessary. None of the proposed KPIs are unattainable, though some, such as tracking *new product releases* or *quality assurance training per employee*, may require manual data collection. The dashboard presented reflects an ideal model, which will require additional resources for full implementation. In the context of an agile organization, this dashboard should be updated daily to maintain its relevance and utility in decision-making.

The long-term objective is to automate the retrieval of dashboard data from cloud-based storage systems, utilizing BI tools such as Power BI. Currently, the majority of data is manually managed and stored in Excel files. Transitioning to a cloud-based infrastructure will enhance data accessibility, enable real-time updates, and improve the overall efficiency of the performance management system.

The primary contribution of this manuscript lies in the post-design process of the BSC, as illustrated in Exhibit 14. This process is grounded in contemporary literature and responds to the growing demand for performance



**Exhibit 11.** Comparative Sensitivity Analysis for KPIs Chosen by DMs

measurement systems that are agile and capable of adapting to rapidly evolving external conditions, such as technological innovation and competitive dynamics (Govindarajan & Ananthanpillai, 2024; Kumar et al., 2024; Sahoo et al., 2023; Sharma et al., 2024; Van de Ven et al., 2023; Wiraeus & Creelman, 2019). To operationalize this responsiveness, the proposed framework incorporates daily updates of selected KPIs, regular trend reviews by leadership (e.g., on a weekly basis), and timely adjustments based on data-driven insights. Business intelligence (BI) systems and robust data storage infrastructures are integral to the effectiveness of this approach.

Wiraeus and Creelman (2019) emphasized the necessity for BSCs to be agile and adaptive, critiquing traditional implementations for becoming overly complex and rigid due to an excessive number of poorly designed KPIs. Such implementations often reduce the BSC to a bureaucratic reporting mechanism rather than a dynamic strategic management tool. In response, they advocated for a streamlined model characterized by a limited set of high-impact KPIs and initiatives, enabling more frequent data utilization and strategic responsiveness. This agility empowers organizations to reposition swiftly in response to emerging opportunities or threats, thereby enhancing the BSC's strategic utility.

Building on this foundation, the BI-enabled BSC proposed in this manuscript represents a significant advancement over traditional models. It facilitates real-time data integration and dynamic performance monitoring, allowing organizations to adapt rapidly to changing conditions. By consolidating diverse data sources, the system offers a holistic view of organizational performance, thereby supporting proactive management and continuous improvement. Automated processes further enhance efficiency by minimizing manual input and reducing the risk of errors, while also fostering cross-functional collaboration. In contrast, traditional BSC models typically rely on periodic updates, manual data handling, and fragmented information systems, which can result in outdated insights, limited interactivity, and delayed decision-making. The static

nature of such models often constrains scalability and responsiveness, ultimately impeding strategic agility.

## 5.2. Practical, Theoretical and Managerial Implications

The research provides practical guidance for ETOPBOs, specifically in the electrical industry, on how to effectively select and KPIs using a BSC integrated with AHP and digital dashboards. By implementing the agile BSC framework, managers can improve decision-making processes and asset monitoring, ensuring that their KPIs are aligned with strategic goals. This methodology also enhances the ability of knowledge workers to access real-time performance data, improving operational efficiency.

The study makes a theoretical contribution by introducing an agile BSC framework that incorporates contemporary elements such as sustainability, digitalization, and BI. This extension of the traditional BSC fills a gap in existing performance measurement research, particularly in how organizations can remain agile while addressing modern challenges. It builds on foundational theories such as the BSC by Kaplan and Norton (2000) and AHP by Saaty (2005), offering a novel application of these methods in the context of complex engineering projects.

For managers and decision-makers in similar industrial organizations, this study provides a roadmap for selecting the most relevant KPIs through a structured and prioritized approach. The agile BSC framework offers a flexible, future-focused tool for aligning performance metrics with broader organizational strategies, including sustainability and digital transformation. Unlike traditional frameworks that often follow a linear approach, agile embraces change and encourages teams to respond quickly to evolving requirements and feedback. By adopting this framework, managers can ensure more effective performance tracking, better alignment of team efforts with business goals, and improved organizational agility. The digital dashboards further support managerial oversight by providing real-time feedback on performance.

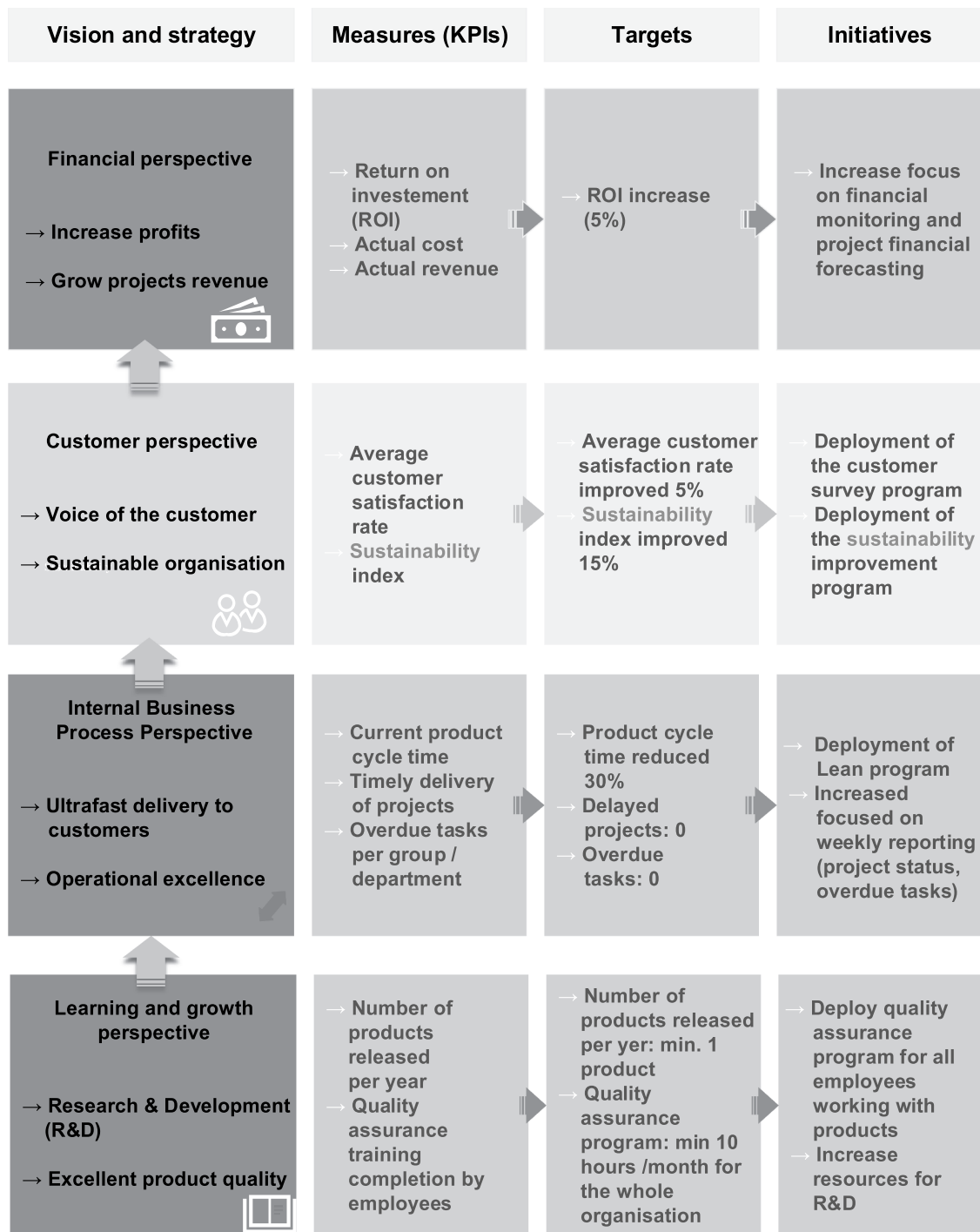


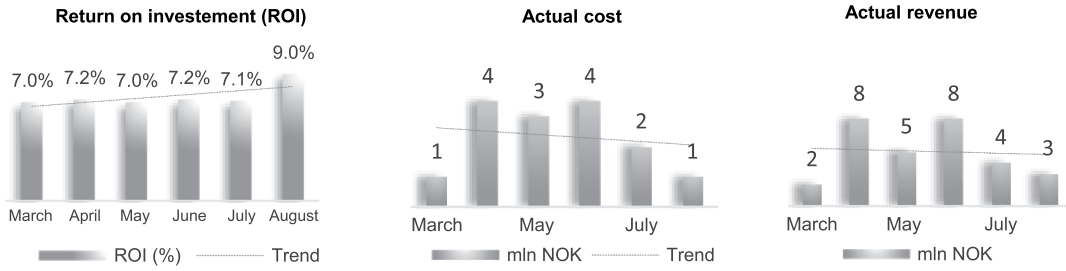
Exhibit 12. The Developed BSC Framework in the form of a Strategy Map

### Discussion

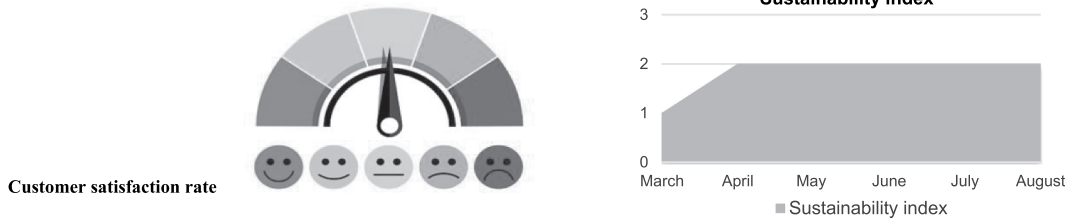
This study explores the potential for performance improvement in engineering project-oriented companies through an enhanced version of the BSC. It aligns with the findings of Bshayreh et al. (2024), who argue that the BSC should be employed as a strategic tool due to its positive impact on firm performance. The authors also concur with Alloghani et al. (2018), who suggest that BSC can improve the quality of organizational operations by identifying areas for improvement and supporting decision-making processes in response to dynamic changes.

Moreover, this work supports Beaver's (2007) assertion that engineering teams benefit from a simplified scorecard, providing daily visibility into drivers and outcomes to ensure the delivery of business value to clients. Although Beaver's article, focused on software organizations, was written over a decade ago, the authors of this study contend that the agile BSC is now universally applicable to all engineering project organizations. Beaver further emphasizes that the BSC should prioritize business value over project deliverables, encouraging teams to focus on tasks that create the most value for clients—a perspective reflected in the dashboard created for this case study.

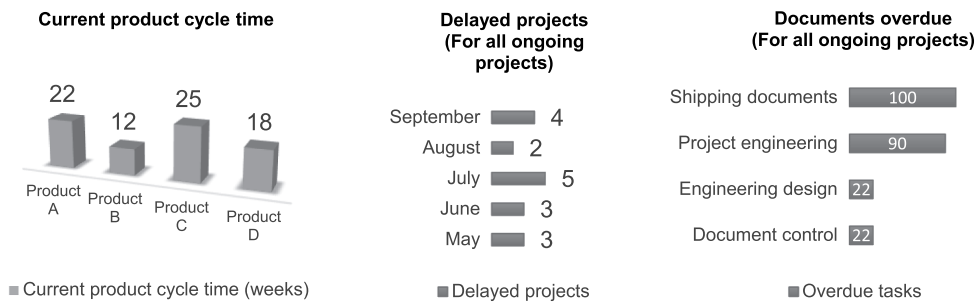
**Digital BSC dashboard**  
**Financial perspective**



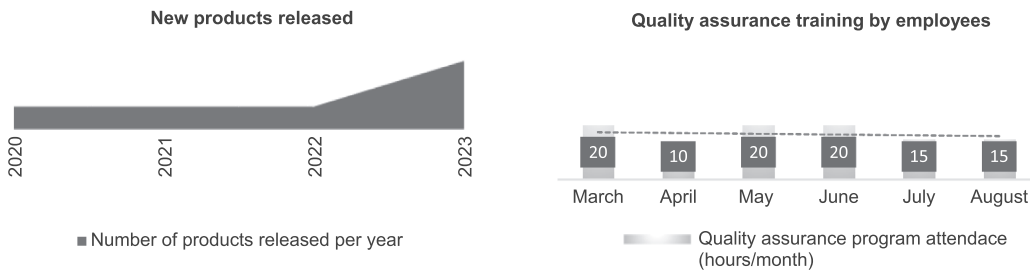
**Customer perspective**



**Internal business perspective**



**Learning and growth perspective**



**Exhibit 13.** The Developed BSC in the form of a Digital Dashboard

In the current study, sustainability is integrated into the existing BSC pillars, rather than creating a separate pillar, which partially aligns with Jones (2011). Jones advocated for integrating sustainability into all aspects of the organization to ensure environmental concerns are addressed holistically. However, Jones also suggested creating a distinct environmental perspective by capturing environmental impact through the “Process” and “Learning and Growth” pillars. The authors of this manuscript take a flexible stance, suggesting that companies should decide how best to incorporate sustainability based on their individual needs.

The approach employed in this paper to integrate sustainability and digital dashboards into the agile BSC can be contrasted with the work of Chalmeta and Ferrer-Estévez (2023), who demonstrated the development of a sustainable BSC supported by BI. A notable distinction between their study and the current manuscript lies in the fact that this case study does not aim to create a “sustainable BSC,” as sustainability is not the primary focus. Instead, sustainability is embedded within the traditional BSC framework, following the premise that such integration should be a natural practice for companies. Nevertheless, the principal objective of the BSC remains unchanged: to provide a performance measurement system

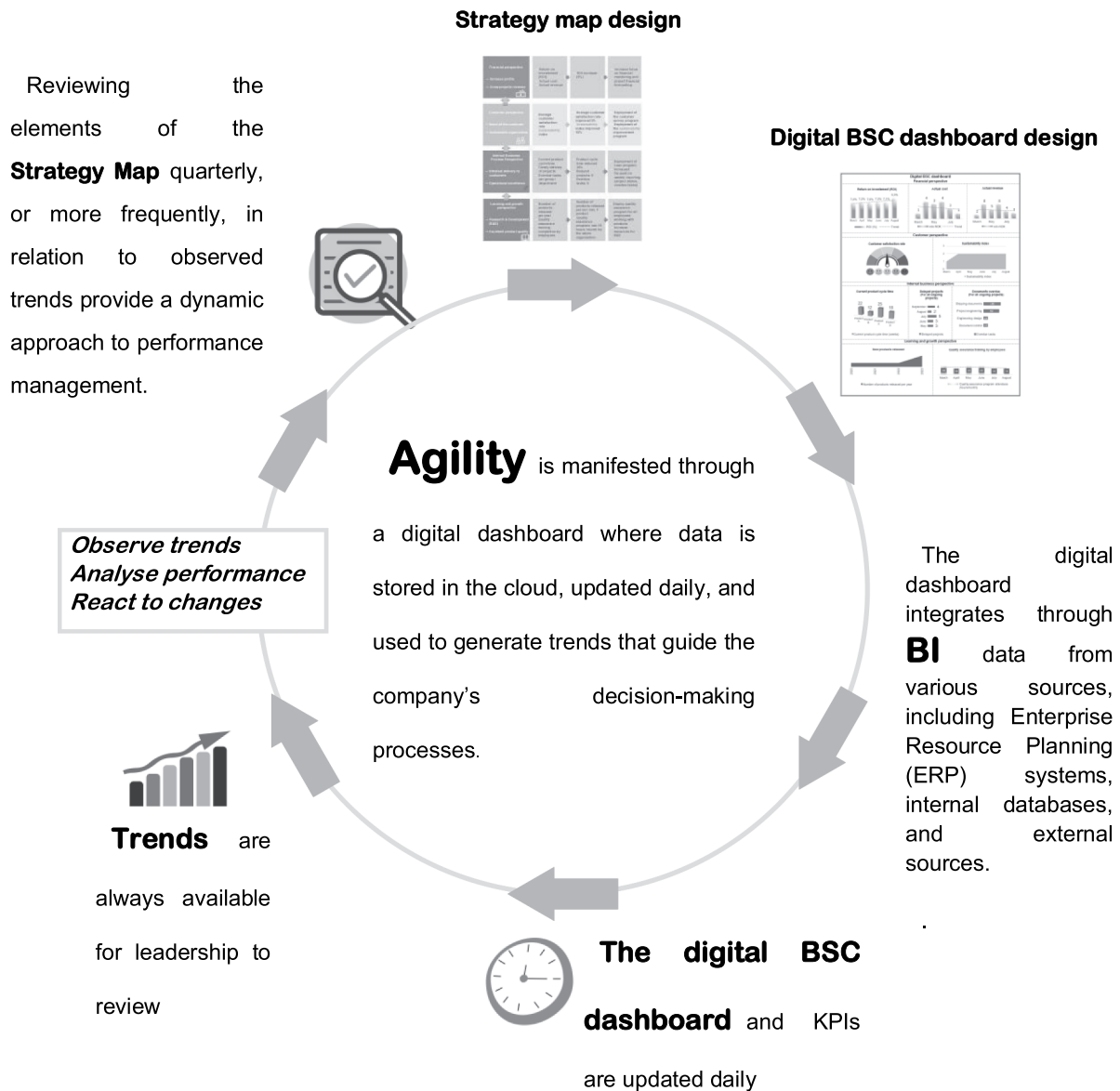


Exhibit 14. BSC Review Process

aligned with corporate strategies. The focus of this study is on enhancing the agility of the BSC, emphasizing that KPIs should be monitored and updated on a daily basis.

Similarly, to the work in this manuscript, Tonchia and Quagini (2010) discussed the integration of BSC and BI, highlighting how visual tools help managers quickly identify areas needing attention. More recently, Gonçalves et al. (2023) emphasized the importance of KPI selection, data visualization, and the role of BI in data transfer. While Gonçalves et al. (2023) focus on data transfer and its processes, this paper highlights the critical role of the BSC in providing a structured framework that balances leading and lagging KPIs, ensuring alignment with strategic objectives beyond merely gathering and displaying data through dashboards. The authors of this paper believe that any company can or will be able to adapt BI tools to create integrated dashboards for the necessary data. However, the data shall be properly structured, and in this regard, the BSC remains the preferred solution compared to other methods.

#### 5.4. Limitations

The findings from this case study reveal several issues that present challenges related to the development and deployment of the BSC in engineering. Firstly, the chosen decision-making AHP method supporting selection of the KPI process has numerous limitations. According to some authors, AHP is recommended in cases where it is allowed to make a choice based on the subjective opinions of the DM. In the case of a private company, the choice of KPIs impacts the entire organization, therefore project stakeholders may not support the use of AHP due to the independent nature of the decision. Secondly, some of the DMs from the case study said that the AHP method was time-consuming, and the pairwise comparison did not seem to be needed from their perspective, as the decision could be made by e.g. “ranking” or “voting.” The most difficult aspect of this case study was finding relevant literature detailing PIs for engineering knowledge work, particularly in an office environment.

Other challenges presented during the case study were implementation of the KPIs to be used in the organization, deployment of the digital dashboards and sharing the data. As concluded by the top management, the measurement of data in order to present the updated KPIs on a weekly or monthly basis would require a full-time position, which would require the company to hire a new person. This is due to the fact that the company does not have integrated systems that would be able to generate the necessary data to share with the whole organization. Gathering and handling data manually on a weekly and monthly basis would require an additional position. Another concern was expressed related to the software required to present the data and share it within the organization. That software would need to be chosen and purchased, which would be an additional cost.

## Conclusions

This paper proposed an agile BSC framework for engineering private sector based on an example of an ETOPBO, through a case study. This research primary goal was the integration of agility, sustainability, BI, and interactive dashboards into the BSC to better serve engineering organizations, particularly project-oriented ones that have demonstrated challenges with strategy integration. The newly created BSC framework aims to enhanced decision-making, strategic alignment, and operational efficiency by utilizing real-time data. By incorporating these elements, the research aims to improve organizations' ability to respond to dynamic environments and better align strategic objectives with day-to-day operations. The proposed BSC design demonstrates the potential for the BSC framework to be both agile and sustainable. Agility is evidenced through the implementation of a digital dashboard, where data is stored in the cloud, updated on a daily basis, and leveraged to generate real-time trends. Sustainability is embodied in the inclusion of the "Sustainability Index" as a KPI. This index, calculated based on the company's operational data, will be utilized to communicate the organization's sustainability performance to customers, thereby enhancing transparency and accountability.

The secondary goal of this paper's case study is to demonstrate how to use prioritization methods to determine KPIs for engineering knowledge work that will be deployed in the BSC. As a result, the most important PIs for an engineering organization that provides knowledge work have been identified. The literature research reveals multiple examples of PI selection using MCDM for various organizations in the fields of asset integrity management, maintenance, supply chain and manufacturing. However, research focused on engineering enterprises that provide knowledge work is rare. In this study, AHP was employed as the MCDM method for selecting KPIs. The AHP breaks down a decision problem into components and creates hierarchies of criteria, making the value of each criterion plain and understood to the DM. The procedure is straightforward, and discrepancies are immediately detected. The comparison of criteria is simple and convenient.

By implementing KPIs in the BSC, the organization can provide managers with a reliable view of the organization's

performance, and this would allow them to respond promptly and efficiently to irregularities. By using the BSC together with the KPI dashboards suggested in this article, it is possible to measure the overall performance in an organization in relation to experts' awareness, enabling the organization to achieve the right balance between the lagging and leading indicators.

Based on the case study, it could be observed that for the engineering knowledge work organization, the BSC cannot be a pattern taken from any other company, but should be customized to fit the organization's strategy. The proposed BSC attempts to enhance the case study company's overall performance, with an emphasis on final project margins, product quality and operational excellence. It will benefit the office atmosphere by outlining attainable targets. In addition, a KPI dashboard will show the employee's current status of organizational performance, as well as future goals.

However, it is vital to recognize the study's shortcomings. Primarily, the perspectives captured are from a limited number of experts/practitioners in Norway, potentially limiting the generalizability of the findings across diverse business, cultural, or environmental contexts. Nonetheless, these findings might provide important insight for businesses that do knowledge work and want to improve performance by selecting relevant KPIs. Future study will look at the outcomes of deploying the established BSC and digital KPI dashboard in comparable cases studies. This broader scope will enable a deeper understanding of the efficacy and adaptability of these tools in various organizational contexts, thereby facilitating broader applications of the findings in knowledge work management and performance improvement strategies worldwide.

The findings from this Norwegian case study have broader implications beyond the electrical industry and geographical context. The agile BSC framework, integrated with AHP and digital dashboards, can be adapted to various industries facing similar challenges in performance measurement and strategic alignment. By providing real-time performance data and enhancing decision-making processes, this methodology can improve operational efficiency in diverse organizational settings. Furthermore, the integration of sustainability, digitalization, and BI elements within the BSC framework offers valuable insights for organizations globally, enabling them to remain agile and responsive to modern challenges.

## Disclosure Statement

No potential conflict of interest was reported by the author(s).

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