Decision Making in Manufacturing and Services
Special Issue • 2024 • pp. 107–116

Leveraging Business Process Management for Sustainable Transformation: Case Study of MECK Decarbonization Strategy

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Abstract. The heating sector is a critical focus for climate-change mitigation, as it accounts for 40–50% of global energy consumption and remains a major source of greenhouse gas (GHG) emissions. Miejska Energetyka Cieplna sp. z o.o. (MECK), a municipal heating company in Poland, faces an urgent need to undergo green transformation in order to comply with the Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS). This study aims to demonstrate how business process management (BPM) can be effectively applied to support MECK's transition toward sustainable practices, ensuring its compliance with CSRD and ESRS requirements while fostering long-term profitability and competitiveness. Through the application of BPM, MECK has successfully embedded sustainability into its operations; key achievements have included developing actionable insights for process improvements, decarbonizing operations, reducing waste, creating new sustainable products, and adhering to CSRD and ESRS reporting standards. These efforts have enhanced MECK's ability to secure long-term profitability while significantly improving its environmental sustainability. This case study highlights the pivotal role of BPM in enabling heating companies to meet regulatory requirements and advance their sustainability agendas. MECK's experience underscores the importance of data quality, transparency, process optimization, and continuous improvement as foundational elements for achieving sustainability goals.

Keywords: business process management (BPM), sustainability, green transformation, heating sector, CSRD, ESRS, decarbonization

Mathematics Subject Classification: 90B99

JEL Classification: O31, Q56

Submitted: October 13, 2024

Revised: December 16, 2024

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1. INTRODUCTION

Over the past decade, business process management (BPM) has been at the forefront of guiding digital transformations across diverse industries and regions. It has enhanced operational efficiency, customer experience, and overall agility. As the world shifts toward sustainability, leveraging BPM to navigate green transformations and promote sustainable developments is imperative. This article aimed to present a case study of the impact of BPM on the green transformation in the heating industry in Poland – particularly in the context of the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS). The presented case study shows how, by adapting the BPM strategy to this regulatory framework, the heating company achieved significant environmental benefits and became a driver of sustainable growth.

This is particularly important because, currently in the EU, more than half of the gross final energy consumption is accounted for by the heating sector – making it the largest consumer in the energy sector. Despite the efforts toward sustainable development, however, three-quarters of European heat is still generated from fossil fuel sources (with almost half coming from natural gas) (Siksnelyte-Butkiene et al., 2021). The importance of embarking on a path of sustainable development for heating companies in Poland is illustrated by the fact that 392 licensed companies provide district heating to more than 40% of households, corresponding to about 6 million families (Jędral, 2024). While there are ongoing discussions in the heating sector that are focused on heat-generation sources and their impacts on climate change, heating companies will soon be obligated (in accordance with the CSRD) to report on their sustainability in accordance with the ESRD standard. In addition to their business results, this involves considering the impacts of the integrated management of carbon and water footprints, the wide range of pollutants that are produced, the resources that are used, the waste that is generated, and the biodiversity that is protected within their business processes.

This research employs an illustrative case-study methodology for investigating the effectiveness of BPM for navigating the green transition within the context of CSRD and ESRS. The choice of a case-study approach aligns with Yin's (2009) assertion that this method is particularly well-suited for exploring complex phenomena in real-life settings – especially when understanding the intricate boundaries between the phenomena and their contexts. This approach ensures that our findings are theoretical and have practical implications for real-world business process management.

2. SITUATION FACED

The case study presents activities at Miejska Energetyka Cieplna in Koszalin (MECK); the company operates based on a concession and specializes in generating, transmitting, and distributing heat. MECK satisfies a significant part of the heat demand of Koszalin as well as neighboring Sianów. The MECK heating infrastructure is 123 kilometers long and has 932 strategically located substations that are capable of providing customers with 1 million GJ of heat energy annually. MECK's commitment to envi-

ronmental management is evident in its laboratory services; the company conducts rigorous chemical and physical tests of its boiler water quality and monitors parameters such as pH levels, hardness, and alkalinity as well as phosphate and sulfite contents. It also analyzes various solid fuels, coal dusts, and biomasses for their chemical compositions, calorific values, and environmental impacts. Gas and dust emissions are also regularly monitored, and the results of these analyses are documented and used to assess the company's compliance with applicable standards. Laboratory staff also examine the contents of flammable parts in the waste that is generated in the technological processes, supporting recycling and safe waste-disposal activities.

MECK is at a critical juncture where it must rapidly prepare for green transformation in order to meet the EU "Fit for 55" package, related climate-neutrality plans, and the CSRD and ESRS requirements. The heating sector's decarbonization is essential for achieving climate-change-mitigation goals, as it accounts for 40–50% of global energy consumption and remains a primary source of GHG emissions. With heating and cooling representing a significant portion of energy use in the European Union (and most of this energy currently being derived from fossil fuels), MECK's transition to sustainable practices is both a regulatory and environmental imperative. MECK must integrate sustainability into its core business processes in order to navigate this transformation quickly and efficiently.

3. ACTION TAKEN

MECK has embarked on a comprehensive decarbonization strategy that aligns with the European Union's and Poland's policies and regulations. This strategic shift aims to meet regulatory requirements, reduce greenhouse-gas emissions, and enhance the company's market competitiveness and resilience. Meeting the needs of its stakeholders and leveraging green financing options such as government funds, green loans, and bonds for lowering capital costs is also significant. MECK's decarbonization strategy involves several key initiatives, such as the construction of new heat sources at the FUB site (including two gas-powered cogeneration units – 2.685 MWe and 2.525 MWt each), air and water heat pumps (13.4 MWt), the decommissioning of the K-7 coal boiler at DPM, and the construction of a new biomass boiler (10.0 MWt).

It is important to emphasize that using biomasses and heat pumps as renewable energy sources (RES) and introducing CHP cogeneration units as low-emission energy sources are key elements of this strategy. Implementing these projects will bring numerous benefits to both the environment and the residents of Koszalin. Transitioning to more-efficient cogeneration technologies and utilizing biomasses and heat pumps as renewable energy sources (RES) will significantly reduce the release of carbon dioxide and other harmful emissions into the atmosphere. This will result in cleaner air in the region, positively impacting the residents' health and quality of life. The diversified energy sources will also stabilize heating prices, as independence from a single fuel source will minimize the impact of raw material price fluctuations on heating costs, and the heating system will become more resilient to potential supply disruptions and global market price changes. Investments in new technologies

and infrastructure modernization will also significantly improve the overall energy efficiency of the heating system. Thanks to these actions, MECK will be able to maintain the status of an efficient heating system through 2034. Modernizing the infrastructure and adopting new technologies will enhance MECK's market position, attract new customers and investors, and ensure long-term sustainability and resistance. Spurred on by its ambitious decarbonization strategy, MECK's green transformation has been profoundly reliant on the strategic application of BPM. Traditional BPM initiatives measure performance in terms of time, quality, cost, and flexibility (Dumas et al., 2018). Traditional BPM initiatives measure performance in terms of time, quality, cost, and flexibility (Szelągowski & Berniak-Woźny, 2024). In the case of MECK, it was essential to leverage the Green BPM concept that emerged as an integration of BPM and business sustainability, emphasizing environmental impacts alongside traditional performance measures (Ghose et al., 2010). By adopting Green BPM practices, organizations like MECK can focus on the sustainability of their processes – not merely on its end products and services (Rozman et al., 2015). For example, tracking its resource consumption and collecting data on its use of capital goods can help inform decisions about end-of-life management (Blengini et al., 2012).

Integrating sustainability with BPM has required MECK to take a new look at the business and new data structures that encompass sustainability parameters and new assessment capabilities in order to generate actionable insights and link these insights to process actions. This required adapting to the previously known business requirements, addressing applicable regulations, taking actions such as decarbonization and waste reduction, and creating new sustainable products, services, and business models (Bhatnagar et al., 2022). This required the company to analyze and improve its business processes by identifying and reducing its resource consumption, minimizing its waste, and promoting its sustainable practices. These practices include analyzing its current processes in order to assess their environmental impacts, using process mining to discover inefficiencies, optimize its processes, and use process simulation to test changes before being implemented. MECK aims to reduce the consumption of fossil fuels, energy, water, materials, and other resources by switching to more efficient and less environmentally burdensome energy sources or heat-transfer technologies and finding ways to reuse or recycle materials. According to the Green BPM concept, improved processes can reduce the amount of waste that is generated by improving the quality of the packaging, reducing any damage during transport, and implementing better logistics management (Sohns et al., 2023).

To investigate how to implement sustainability using Green BPM, a case study was conducted; this included the following:

– Document analysis (internal and external) – this process started with an external documentation analysis, covering CSRD, ESRS, and international publications with the best practices, metrics, and reports on the Polish heating sector. A further examination of organizational documents such as process manuals, procedural documents, and previous assessments of business processes was thoroughly conducted. This analysis provided an understanding of the business processes within the organization and its external context.

– Semi-structured interviews – these were conducted with key stakeholders of BPM, including managers (who oversee the implementations of business processes and environmental issues), process owners (who are responsible for the day-to-day execution of business processes), and IT personnel (who support the technological aspects of business processes). These interviews elicited nuanced insights into the stakeholders' perceptions of the sustainability of their companies' business processes, the challenges that they encountered, and their expectations from the assessment frameworks.

The data-collection steps explicitly aimed to align business processes with environmental sustainability goals:

1. Development of the ESRS-Readiness Questionnaire – this questionnaire was based on CSRD, ESRS, and international publications with the best practices, metrics, and reports on the Polish heating sector. Furthermore, it was adjusted to the company's specifics based on the internal document analysis. The questionnaire aimed to assess MECK's readiness for CSRD/ESRS compliance and identify key areas for improvement.
2. ESRS-Readiness Workshop with MECK staff – the MECK staff participated in a workshop that was designed to collect data and understand current activities, plans, and potential projects based on the ESRS Readiness Questionnaire. The outcome of this workshop was a report that presented the current level of environmental sustainability and outlined actions that were to be taken shortly.
3. Business Process-Analysis Workshops – a thorough analysis of current business processes (As-Is processes) was conducted in order to evaluate their integration with environmental sustainability goals. This step involved assessing how well the existing processes supported the organization's sustainability objectives as well as identifying any gaps.
4. Business Process-Improvement Workshops – following the analysis, the business processes were improved by integrating them with environmental goals and metrics. This involved modifying the processes in order to better align with the MECK decarbonization strategy objectives as well as ensuring continuous monitoring and improvement.

4. KEY OUTCOMES

BPM facilitated the systematic analysis and continuous improvement of MECK's processes, thus ensuring that they met the stringent environmental standards and regulatory requirements. The journey toward implementation began with a readiness assessment based on ESRS, which encompassed critical criteria such as climate-change mitigation, pollution control, water and marine resource management, biodiversity conservation, and circular economy practices. In the initial stage, the company undertook a comprehensive review of its documentation and engaged in semi-structured interviews with key employees in order to evaluate the current

practices and identify any existing gaps. This foundational step was essential for defining the specific goals and key performance indicators (KPIs) based on the ESRS criteria, which are focused on reducing greenhouse gas emissions, enhancing resource efficiency, and undertaking pro-environmental activities (like the initiative to transform its coal storage facilities into green and recreational areas that serve Koszalin's residents).

Subsequently, the business processes were meticulously reviewed in order to incorporate environmental criteria that were crucial for decarbonization and more generally – sustainable development. The analysis revealed that such environmental criteria as environmental-impact assessments were only considered to the extent that was required by law. As the work advanced, the business processes were improved to integrate green criteria at each stage using BPMN; this is illustrated by the investment process that is presented in Figure 1.

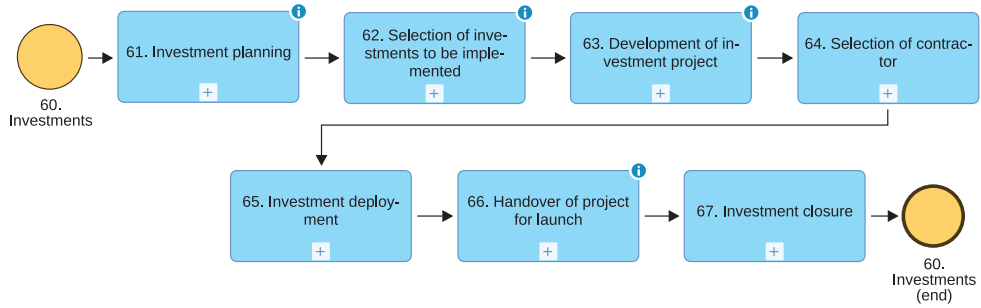

Fig. 1. *Investment process in MECK in BPMN*

Most of the investment plans are now focused on implementing the MECK decarbonization strategy. In the **Investment planning** stage, reducing the environmental footprint (especially the carbon footprint) has become a key objective, and the impact on the energy mix and carbon footprint across the Scopes 1, 2, and 3 emissions is being thoroughly evaluated.

During the **Selection of investments to be implemented** stage, the impact of the investment on the company's environmental goals (as are outlined in the company's strategy) is being meticulously assessed. This involves specific criteria such as the impact on the energy mix, the greenhouse gas emissions during the pre- and post-investment stages (measured in CO_2 equivalents), the changes in the intensity of the emissions (CO_2/revenue), and the energy consumption and its sources (pre- and post-investment). Other considerations include air, water, soil pollution, and light- and noise-pollution levels as well as the changes in these emissions due to the investment. Additionally, water usage during the investment implementation and changes in the organizational water usage post-investment are examined, alongside the impact on biodiversity and investments in biodiversity enhancement (such as converting areas into green/water-absorbing spaces). The resource usage during the

investment as well as its impact on resource efficiency (including using waste heat for higher efficiency) are also critical factors.

In the **Development of an investment project** stage, the environmental footprint (esp. carbon) and its impact on water management, pollution control, biodiversity, and resource efficiency are carefully considered. These are also essential criteria when selecting business partners.

In the **Investment deployment** stage, an environmental report that documents the investment's impact is prepared. The report covers the impact of the investment process and the ecological impact change that results from it (in the short- and long-term perspectives).

Finally, in the **Investment closure** stage, the environmental-impact report is communicated to stakeholders through various channels, including the company's website, newsletters, and social media.

Amid MEC's green transformation, implementing an enterprise resource planning (ERP) system plays a significant role. The implemented ERP system will collect and structure environmental data on heat consumption, water/heat flows, energy consumption, CO_2-emission levels, and key performance indicators (KPI) from the heat meters and sensors that will be installed on the energy sources as well as the transmission network. By integrating this information with the data that is collected from external sources regarding weather or energy prices, for example, the system will enable the following:

- monitoring compliance with national and EU regulations;
- ongoing monitoring of implementation of MECK decarbonization strategy and green transformation at every stage of implemented processes (and not only resulting KPIs);
- informed operational decisions during process implementation and selection of directions and priorities for process optimization and automation due to multilateral contextual forecasts regarding energy demand.

The collected data (including detailed data on the heat production and distribution processes) will be used in the next step by the artificial intelligence (AI) that is planned for implementation. The goal is to further deepen MEC's green transformation through more-precise forecasting and indicating any possible directions for improving the process, optimizing the utilization of production capacity, and identifying the sources of losses more quickly. Artificial intelligence capabilities will enable the identification of patterns and anomalies in the data, thus supporting operational activities and forecasting future energy-consumption levels and actions in order to reduce the carbon footprint (and overall environmental footprint) of the heat production and supply.

5. CONCLUSION AND LESSONS LEARNED

The case study of MECK's employment of BPM for navigating its green transformation offers valuable insights into industry trends, management practices, and relevant

academic concepts. MECK's decarbonization strategy is a robust plan that ensures compliance with EU regulations, reduces emissions, and improves market competitiveness. By investing in advanced technologies and diversifying its energy sources, MECK aims to secure a sustainable and prosperous future while meeting the evolving needs of stakeholders and mitigating potential risks.

Using BPM in MECK's green transformation has enabled the company to systematically embed environmental criteria into its business processes – particularly, its investments. This structured approach ensures enhanced sustainability, increased stakeholder satisfaction, and improved market competitiveness. The case of MECK illustrates just how BPM could be a powerful tool in driving organizational change toward sustainability, thus serving as a model for other companies in the heating sector and beyond. The impact of this transformation cannot be overstated, as failing to implement a decarbonization strategy could result in significant financial, regulatory, and reputational risks – particularly, the following:

- continued reliance on coal could lead to unmanageable CO_2 emissions and escalating heat prices for Koszalin's residents;
- stricter environmental regulations could increase operational costs and legal liabilities, while lacking access to external capital (no coal-related credits) would hamper financial sustainability;
- growing climate awareness among Koszalin's residents could lead to heightened pressure from customers, local communities, and investors, thus damaging MECK's reputation.

BPM systematically manages and optimizes its business processes, thus ensuring that they align with sustainability/decarbonization objectives. By integrating sustainability and BPM, MECK gains access to a wide range of internal and external data that allows for continuous monitoring and verifications of the process's implementation and its results. This enables corrective operational actions, long-term planning, and the execution of sustainable development and business process-improvement initiatives.

Future actions and investments in diversified energy sources will present challenges that are related to the effective management, planning, and development of the heating infrastructure; thus, implementing a decarbonization strategy at MECK requires supporting managers with advanced IT solutions. Analyses and interviews with the management board and key employees of MECK indicate that the effective implementation of the Green BPM concept necessitates a modern integrated information system (such as ERP or BPMS) along with AI. These technologies will be crucial in executing changes and supporting ongoing sustainable development. By using IT tools that support BPM (such as ERP systems, AI, and IoT devices that monitor energy production and distribution in real-time), MECK can effectively control and optimize its operational processes while also planning investment processes based on accurate data. This capability is crucial in a climate of rapid regulatory changes and market pressures such as increasing energy prices and CO_2-emission fees. Integrating IT technology that is supported by BPM will enable MECK to achieve long-term environmental and economic benefits.

5.1. Industry implications

MECK's integration of BPM for sustainability offers significant implications for the heating sector and beyond. This transformation highlights BPM's capability to drive environmental improvements in traditionally high-emission industries, thus setting a precedent for others. MECK's case demonstrates how BPM can align operational processes with global low-carbon energy transition efforts, thus contributing to climate-change mitigation. With the advent of CSRD and ESRS, the pressure on companies to enhance sustainability reporting has intensified. MECK's experience illustrates how BPM can facilitate compliance with stringent regulations, thus providing a roadmap for other firms to meet similar demands efficiently. Embedding sustainability metrics into core business processes is crucial for managing ESG responsibilities, supporting strategic goals, and improving market competitiveness. Furthermore, modern integrated information systems like ERP and AI are vital for executing changes and fostering sustainable development. Implementing BPM for sustainability involves overcoming significant challenges, including stakeholder engagement and change management; however, it offers substantial benefits.

5.2. Research implications

MEC's integration of BPM with sustainability suggests several research opportunities. Researchers can expand BPM frameworks in order to incorporate comprehensive sustainability metrics, thus creating robust models for evaluating and enhancing business processes across all industries. Further research is needed on integrating ERP and AI technologies within BPM systems in order to assess their effectiveness in identifying patterns, forecasting energy consumption, and optimizing resource usage. Long-term studies on the impact of BPM-driven-sustainability initiatives can provide deeper insights into their effectiveness and broader implications for organizational performance and environmental impact.

5.3. Lessons learned

MECK's green transformation using BPM offers several key lessons:

1) **Comprehensive approach**. Effective BPM in sustainability requires integrating environmental criteria into all business processes. This holistic strategy ensures long-term profitability, competitiveness, and regulatory compliance while meeting stakeholder expectations.
2) **Utilization of real-time data**. Real-time data collection and analysis are essential for monitoring and optimizing sustainable practices. Technologies like ERP and AI provide the data that is necessary for informed decision-making and continuous improvement.
3) **Strategic sustainability of investment planning**. Achieving sustainability goals and reducing environmental footprints require strategic investment-planning. MECK's experience highlights the importance of evaluating investments based on their impact on its energy mix, emissions, and overall environmental performance.

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