International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (3): May-June 2023, page 16-36. ISSN: 2774-0366
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.14456/jsasr.2023.31

Green Business Process Management: The Way to Contribute to Sustainability for Thai Businesses

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Received 24/04/2023 Revised 25/04/2023 Accepted 30/04/2023

Abstracts

Background and Aim: While green business process management takes environmental and sustainability aspects of business processes into account, sustainability, and business management's long-wave theory emphasize environmental issues in technical and economic advances. The objective of this paper is to review the current status of strategic green business process management in light of the heightened emphasis on this topic within academic circles.

Materials and Methods: In order to do this, the approach suggested in this work uses a concept association bank to suggest similar ideas in a domain based on the intended purpose of an inquiry. Through this approach, the authors have the potential to broaden their knowledge beyond their present comprehension. A study was carried out to examine the impact of green business process management and strategic green business process management on the exploration of Thai businesses.

Results: Green business process management (Green BPM) optimises resource use and process architecture. Green BPM and validation improve operational efficiency and meet individual needs. Each process instance has cloud resources. Strategic goals require business process analysis and audits. Sustainability requires eco-friendly logistics and production. Resources affect product, service, and process development. Technical breakthroughs and human resource management require ecological considerations. Outsourcing can improve internal infrastructure.

Conclusion: Green BPM reduces cost, quality, throughput, and adaptability while incorporating ecological, economic, and social goals to reduce environmental impact. Process designers, systems architects, and business engineers collaborate on graphic analysis, visualization, information technology, metrics monitoring, and defect identification. Thai companies are eco-conscious, therefore a trial study optimized data consolidation energy use. Resource reallocation, procurement, eco-friendly marketing, and technical breakthroughs can drastically reduce the environmental footprint.

Keywords: Green Business; Business Process Management; Environmental; Sustainability

Introduction

In February 2023, the Intergovernmental Panel on Climate Change (IPCC) published a report indicating that addressing global climate change requires prioritizing environmental aspects in technical and economic developments (IPCC, 2023). Ensuring the finite nature of numerous raw materials and mitigating the rise of global greenhouse gas emissions is imperative. It is imperative to take measures to tackle these concerns in both private and industrial settings. Porter (1985)'s theory on long waves delineates the economic progress of a nation across centuries, commencing from the advent of steam engine technology and culminating in the emergence of information technology and telecommunications. The statement posits that the attainment of sustained economic growth in the medium and long run necessitates the elimination of bottlenecks that typically emerge towards the conclusion of each developmental stage (Wingwon & Lertpachin, 2018). Subsequent advancements of this theory encompass environmental factors, biotechnology, and healthcare. The optimization of a company's environmental impact can result in entrepreneurial opportunities and positively impact

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fundamental drivers by reducing and overcoming environmental risks (Kamkankaew et al, 2002b). This process can also influence various factors that contribute to environmental impact.

The incorporation of sustainability into the corporate agenda is a crucial aspect, however, the implementation of environmental improvement measures has been limited. Green business process management (Green BPM) is a managerial strategy that encompasses the ecological and sustainable dimensions of corporate processes (Lamptey et al, 2021). The aim is to broaden the scope of business process management by incorporating environmental considerations, expenses, time, quality, and adaptability through the utilization of various methodologies and techniques (Harmon, 2015). The scope of this endeavor encompasses the development and configuration of process models that are ecologically sustainable, the assimilation of these models into the organizational framework, the implementation and supervision of process models through appropriate metrics and benchmarks, and the evaluation and enhancement of business processes to mitigate their adverse ecological effects (Harmon, 2015). The concept of green business process management (Green BPM) acknowledges the significant correlation that exists between the ecological footprint and the utilization of resources, information technology systems, and the IT infrastructure (Couckuyt & Van Looy, 2021).

The proposed approach involves the utilization of either pre-existing business process models or the development of novel, environmentally-friendly models to establish innovative, ecologically sustainable procedures (Ghose et al., 2010). The expansion dimensions encompass various phases of business process management, which aim to ascertain the environmental impact and regulate/optimize the processes (Couckuyt & Van Looy, 2020). The output pertains to various abstract optimization alternatives that necessitate individual definition and specification, contingent upon the particular business process and execution environment (Al-Nuaimi, Al-Mazrouei & Jabeen, 2020).

The fundamental drivers of development are climate change and the increasing environmental demands caused by population growth and industrialization (Sellitto, 2018; Abdallah & Al-Ghwayeen 2020; Couckuyt & Van Looy, 2020). These drivers lead to direct influencing factors such as air, water and land pollution, the finite nature of natural resources and regulatory and public pressure. The different influencing factors can be further broken down into various associated risks: economic risks, regulatory risks, market risks, operational risks and reputational risks. Reducing and overcoming these risks by optimizing a company's environmental impact leads to entrepreneurial opportunities and influences the various influencing factors, which has a positive effect on the fundamental drivers (Abdallah & Al-Ghwayeen 2020; Couckuyt & Van Looy, 2021)

Business process models are used to implement solutions to ecological problems in business design, using the green business process patterns to identify environmental impacts and optimize business processes (Couckuyt & Van Looy, 2020; Sohns et al., 2023). Abstract optimization alternatives are presented with recommendations for action to positively change the environmental impact of one or more business processes, but these recommendations must be individually defined and specified depending on the business process and execution environment.

The objective of this scholarly article is to assess the present state of strategic green business process management, given the increased attention it has received in academic spheres. In this research, a concept association network is used to infer relevant domain-specific suggestions from the context of a viewer's request. This approach could assist the authors learn more than they do currently. Scholars looked into the effects of green business process management and strategic green business process management on Thai businesses' attempts to discover new business alternatives. This paper's follow-up section will expound upon the environmental impact of business processes, the definition of green business process management, the stage of green business process management, and the strategic view of green business process management.

The brief origin of green business

The operations of businesses have caused significant harm to the environment on a worldwide scale, resulting in environmental concerns that affect both individuals and businesses on a global level. Wingwon & Lertpachin (2018), as well as Kamkankaew et al (2002b), argue that a revision of corporate theory is imperative for enterprises to thrive in the intricate and globalized economy of the present time.

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The escalating apprehension of enterprises regarding ecological matters has implications for both the organization and the natural world. Environmental issues that corporations need to consider include climate change, air and water pollution, and excessive resource usage. It is imperative to consider social concerns, including but not limited to working conditions and labor relations. The implementation of environmentally sustainable management practices should be driven by strategic considerations, stakeholder pressure, and market forces.

The investigation of sustainable companies in literature involves an analysis of the narratives surrounding their inception and those communicated to their clientele. This inquiry primarily focuses on the domains of business, management, economics, and environmental science and policy. The values of an organization encompass a dedication to impartiality, righteousness, and parity, alongside integrity, answerability, and adherence to ethical principle (Liu & Zhao, 2020). The individuals hold the view that the notion of sustainability in the corporate world encompasses not only the ecological carrying capacity but also the ethical and moral obligations related to human survival and advancement. Furthermore, they perceive themselves as agents of change at the local level and as integral members of the broader environmental movement.

Green businesses commonly employ one of four prevalent narratives to elucidate their position within the larger green economy: a rejection of tree-hugging stereotypes, a pragmatic approach, the influence of the conventional economy, or a willingness to make compromises or embrace radical transformations (Navarro, Cronemyr & Huge-Brodin, 2018). The narratives surrounding these accounts exhibit subtleties and fluctuations, often exhibiting a binary perspective that is either exclusively focused on commerce or solely concerned with environmental preservation. The absence of a singular narrative that occupies the intermediate space between environmentally conscious companies and conventional businesses is notable. Various businesses may integrate elements of both capitalist and environmental cultures into their unique missions and identities. The aforementioned articles demonstrate the varying interpretations of narratives and personal affiliations contingent upon the reader's perspective.

According to Ghose et al. (2010) definition, green enterprises demonstrate a commitment to preserving both ecological and societal contexts by exercising meticulous oversight, regulation, and administration of their activities. The global trend towards sustainability has led to an increase in pressure from stakeholders within the business community for companies to adopt more environmentally conscious practices. Couckuyt & Van Looy (2020) posited that sustainability encompasses a range of environmental concerns, including but not limited to social justice, environmental safeguards, and economic growth. Based on the global sustainability trend, the authors infer that green business are subject to oversight and regulation in order to maintain ecological and social environments. Additionally, stakeholders are seeking greater implementation of ecologically friendly practices, which encompass social justice, environmental protection, and economic growth.

Certain environmentally conscious enterprises must develop compelling narratives to effectively market themselves within the prevailing capitalist cultural context. To attain this objective, it is imperative that they construct narratives that portray them as conventional participants while upholding their environmental principles. Hence, it is imperative for environmentally conscious enterprises to navigate the fine line between moderate and extreme approaches to sustainable consumerism. Challenges to establishing legitimacy are ubiquitous across various strata of society and are moulded by dominant ideologies and prominent agents.

Contemporary businesses are required to assume increased obligations towards the welfare of the ecological and societal domains. Therefore, it is crucial for them to contemplate the potential impact of their actions on these spheres. In order to achieve a positive impact on both the natural and social environments in which they operate, businesses must strive to maintain equilibrium among the social, environmental, and economic sectors with the aim of benefiting future generations (Allam et al, 2021). Adopting environmentally conscious practices can be a strategic decision aimed at achieving economic benefits. If an organization aims to achieve its long-term objectives, it is advisable to implement green management practices.

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To conclude, green businesses are required to utilize four narratives to elucidate their stance in the broader green economy, namely environmental concerns, social considerations, and sustainability. In order to attain a favorable outcome in the ecological and societal milieu, enterprises must endeavor to uphold a state of balance amidst the economic, environmental, and social domains. Incorporating eco-friendly practices into business operations can be a deliberate and calculated move with the goal of attaining financial advantages. In order for enterprises to prosper in the globalized economy, it is imperative that a revision of corporate theory be undertaken.

Environmental impact of business processes

The conventional approach to managing business processes centers on the optimization of cost, quality, throughput, and adaptability (Bhatti & Danilovic, 2018). Nevertheless, there is an increasing awareness of environmental issues. The environmental efforts of a company are driven by influencing variables. Various factors have differential impacts on companies (Qin, 2019; Allam et al, 2021; Sohns et al., 2023): (1) the potential depletion of resources should not pose a threat to the long-term viability of the organization. The mitigation of pollution is imperative in order to provide forthcoming generations with a favorable environment, thereby ensuring the stability of the company. The level of public awareness regarding environmental issues is increasing. Organizations frequently conduct image campaigns as a means of demonstrating their commitment to sustainability. The aforementioned campaigns are centered on enhancing the internal environmental conditions. The optimization programmed of enterprises are being subjected to legislative pressure and new regulations, which require them to improve the environmental impact of their business processes.

The aforementioned influences indicate that it is imperative for organizations to comprehend their environmental impact in order to alleviate commercial risks and generate novel prospects (Navarro, Cronemyr & Huge-Brodin, 2018). The ultimate outcome often dictates a corporation's ability to achieve cost reductions. Therefore, the optimization of both the industrial process and the final product is increasingly significant. The adherence to legal regulations incurs significant expenses for corporations. The provision of a monetary reward serves to enhance individuals' consciousness towards environmental concerns. Organizations are required to establish a methodology for documenting the ecological ramifications of their operational procedures, establish long-term objectives, and implement tools to track, evaluate, and scrutinize current workflows, software, and amenities to acquire all pertinent environmental data (Shahid & Sheikh, 2022).

The optimization of company operations necessitates the identification of environmentally significant data. The discipline of business process management utilizes data analysis as a means to comprehend and enhance organizational processes (Abdallah & Al-Ghwayeen 2020). In order to effectively manage operations and attain organizational objectives, it is imperative to possess a comprehensive comprehension of business procedures. The increasing intricacy of procedures and data raises the inquiry of how to effectively communicate targeted, lucid, and comprehensible information to facilitate decision-making for optimization projects (Shahid & Sheikh, 2022).

By utilizing Key Ecological Indicators (KEIs), discern the pertinent information for decision-making purposes (Zhou, Ou & Li, 2016). The aforementioned data has the potential to be associated with the operational procedures of the enterprise. Activity-based costing is a management technique that involves the collection of data from various source systems, its consolidation, and its allocation to a specific process or process instance (Mohibullah et al, 2020). This process involves the implementation of various methods and strategies. The methods for obtaining environmental information are currently in their early stages of development (Sun, Cheshmehzangi & Wang, 2020). This is due to the infrequent occurrence of a direct environmental impact resulting from the business process. The energy consumption of an automated process activity is determined indirectly by the hardware and systems utilized. It is imperative for a company to devise a strategy to incorporate crucial environmental data, including the aforementioned, into its operational procedures to facilitate informed decision-making. The second subfield involves the examination and interpretation of data (Pekmez, 2016). Providing application-specific information is essential for enhancing comprehension, knowledge acquisition, and the ability to derive alternative actions. According to recent studies conducted in 2021

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to 2023 (Feng, Sheng & Li, 2021; Lamptey et al, 2021; Tuphila, Ruangchoengchum & Chetchotsak, 2022; Sohns et al., 2023), graphic visualizations have been found to outperform textual information in certain domains. The aforementioned specifications result in the creation of a personalized, visual representation of the commercial procedure and its ecological consequences, rendering data easily comprehensible and adaptable to evolving demands. The amalgamation of the two sub-disciplines pertains to the identification of requisite data for assessing environmental ramifications, its origin, its correlation with commercial procedures, and the provision of distinct analytical prerequisites for a personalized interpretation of such data.

The primary objective of business process management is to enhance efficiency in terms of time, cost, quality, and flexibility to enable prompt and adaptable responses to market demands (Lamptey et al, 2021). The phenomenon of globalized marketplaces has demonstrated that these four criteria frequently prove insufficient. Corporate management that is focused on achieving specific objectives must take into account various factors such as modifications in the legislative framework, scarcities of raw materials, changes in the standard of living, and evolving customer demands when making adjustments to business operations (Tuphila, Ruangchoengchum & Chetchotsak, 2022). The study of sustainable business process management involves the incorporation of diverse concepts.

The concept of entrepreneurial sustainability is characterized by the integration of a company's ecological, economic, and social objectives (Prasetyo & Setyadharma, 2022). The comprehension of frequently and infrequently utilized terminology necessitates the provision of definitions. The present study differentiates the concept of sustainability from that of green. The concept of sustainability encompasses the economic, social, and environmental dimensions. However, the term "green" specifically pertains to the ecological aspect of sustainability (Garzella & Fiorentino, 2014). The present endeavor centers on green business process management, which aims to enhance ecological sustainability (Gallotta et al, 2016). Nevertheless, it is imperative to acknowledge a corporation's economic objectives. The aforementioned aspects are predominantly addressed by business process management and economic activity, and are therefore regarded as established within the scope of the current inquiry. The contributions of the investigation only provide a brief discussion of social objectives as a component of a comprehensive sustainability strategy.

To summaries, conventional business process management prioritizes cost minimization, enhancement of quality, acceleration of throughput, and flexibility. However, there is an increasing emphasis on environmental considerations. It is imperative for corporations to document the ecological ramifications of their operational procedures, establish long-term objectives, and employ Key Environmental Indicators (KEIs) to pinpoint pertinent data for informed decision-making. The integration of ecological, economic, and social objectives is a fundamental aspect of sustainable business process management.

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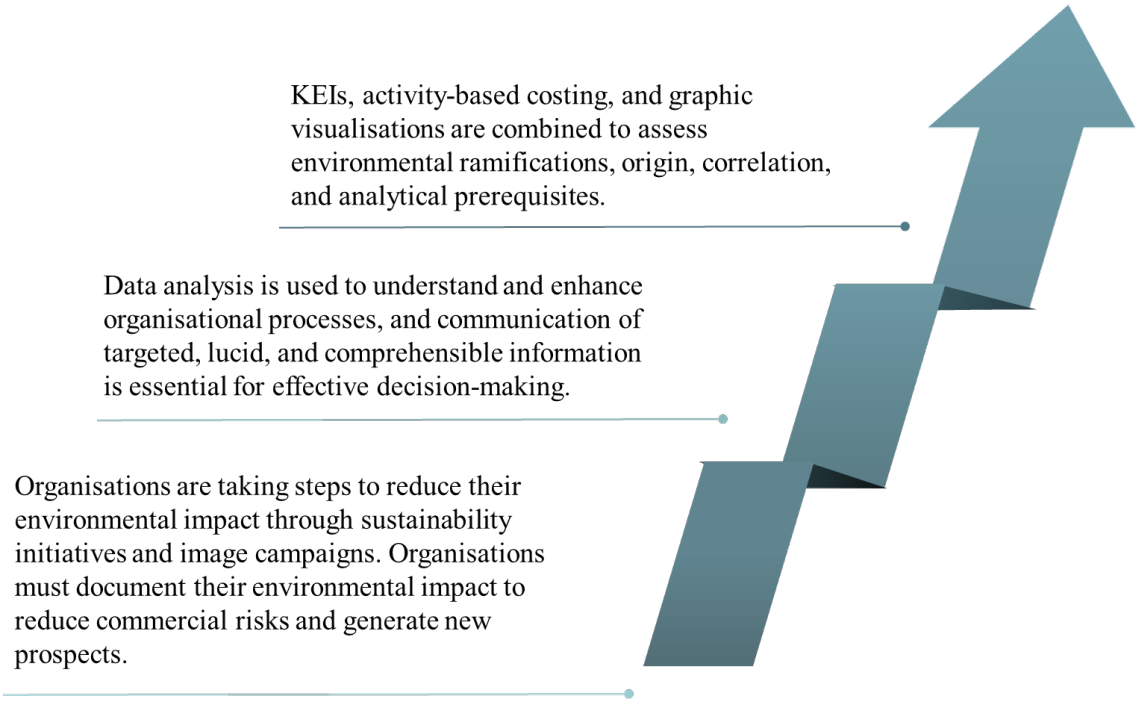

Figure 1: Environmental impact of business processes

Definition of Green Business Process Management

The concept of Green Business Process Management (BPM) involves the consideration of the environmental impact of business processes during their definition and optimization (Gallotta et al, 2016). The incorporation of an ecological dimension amplifies the conflicting goals among the pre-existing facets. Sustainable products may possess a higher cost but exhibit superior quality (Garzella & Fiorentino, 2014).

The expansion of optimization, the conversion of a traditional enterprise into a business process management structure, and the advancement of corporate objectives and regulations have an impact on the input and output of business processes (Gohar & Indulska, 2015). The analysis of material and energy flow provides Tree branch with a comprehensive understanding of the input and output factors that have a significant impact on the environment (Alsolamy & Taha, 2021). The vertical axis is utilized in the transformation of raw materials into products through various processes. Primary resources refer to the essential inputs necessary for the production of a product or service. The material that provides additional evidence or information is oriented in a horizontal direction. Information technology (IT) systems and energy can be considered as supplementary resources that are required for a particular process, but do not constitute the final product (Kamkankaew et al, 2002b).

Green Business Process Management (Green BPM) aims to enhance environmental factors by optimizing the utilization of primary and secondary resources (Dumas et al, 2018). Primary resources are defined by research and development, as well as product and service design (Sellitto, 2018). However, secondary resources can be enhanced through effective task design and execution. The terms Green IT and Green IS had been introduced to enhance the efficiency of the underlying IT infrastructure (Liu & Zhao, 2020). The field of Green IT pertains to the implementation of techniques and strategies that promote energy efficiency and optimal utilization of hardware resources. Green Information Systems (Green IS) are developed and executed with the objective of rendering organizational operations ecologically sustainable (Zhang, Sang & Yao, 2018).

Nevertheless, the utilization of effective resources and implementation of Green Information Systems (IS) may not necessarily result in a significant improvement in a firm's ecological footprint (Zhang, Sang & Yao, 2018). A comprehensive optimization strategy can only be fully utilized by incorporating a company-wide process perspective and implementing structural changes to the

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company's operations. Optimization initiatives center on enhancing the utilization of resources, typically guided by commercial procedures (Shahid & Sheikh, 2022). The holistic optimization of entrepreneurial activity for ecological purposes, as achieved through business process management, can result in the transformation of a company into a green enterprise. The present paper employs the methodology of business process management to enhance the efficiency of resource utilization and process architecture, thereby ensuring a holistic approach.

In conclusion, Green BPM is a method that focuses on minimizing the environmental impact of business activities by converting them into a business process management framework. The approach considers expanded facets of optimization, such as material and energy flow analysis, and incorporates methodologies for enhancing energy efficiency and hardware resource utilization. The utilization of efficient resources and Green Information Systems (IS) may not necessarily result in a significant improvement in a company's environmental impact. It is imperative to incorporate a company-wide process perspective and implement structural changes to the company's operations to ensure the effective utilization of a comprehensive optimization strategy.

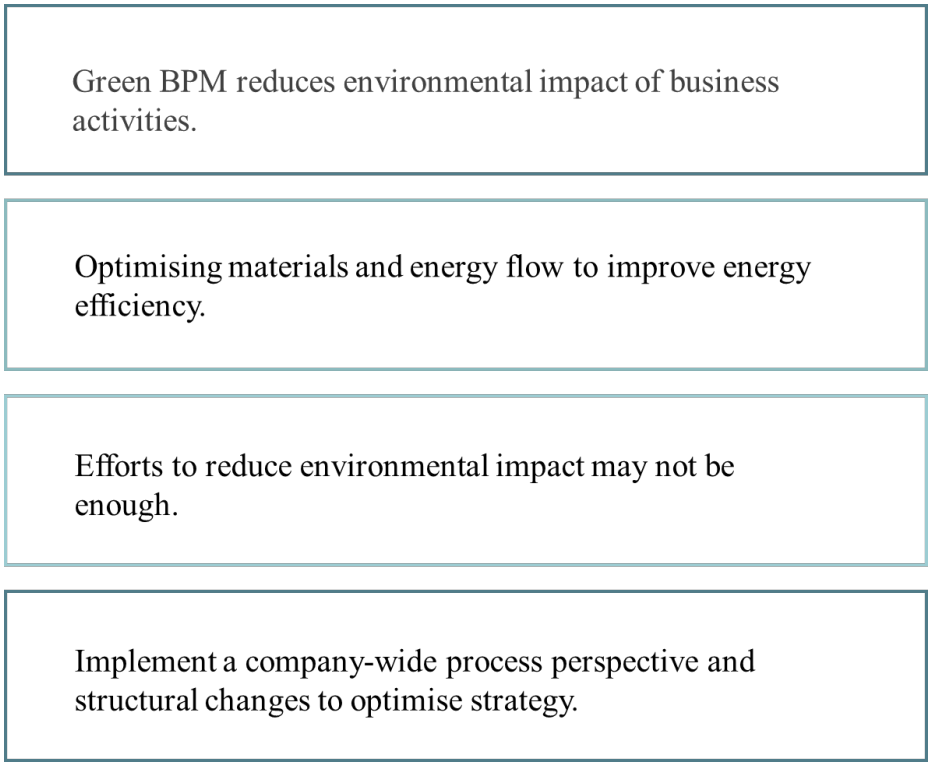

Figure 2: Definition of Green Business Process Management

Extension of conventional business process management

The consideration of ecological factors by business process management has been limited in scope. There is a limited number of scholarly methodologies available that specifically target business practices aimed at enhancing a company's environmental impact (Abdallah & Al-Ghwayeen 2020). There exist a limited number of techniques that exclusively focus on sub-areas of business process management. As an illustration, the authors measure all notable environmental ramifications and assess the energy efficiency of the hardware system (Jakobi et al, 2016). Currently, there is a lack of ability to develop a comprehensive business process management system that incorporates environmental impact as a factor alongside optimization components (Liu & Zhao, 2020).

The subsequent section illustrates the impact of ecological factors on the management of business processes. This phrase is commonly used in academic writing to prompt a discussion of similarities and

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differences between two or more subjects or concepts. It is a way to analyses and evaluate the relationships and distinctions between them. This paper examines various sub-areas of business process management (BPM) to facilitate comparison and extension identification. Specifically, the analysis focuses (Recker et al, 2009) on (1) the life cycle of a business process, (2) key performance indicators for quantifying process performance, (3) service-oriented BPM architectures for execution and support, and (4) strategic factors in company direction. The selection of these domains was made with the intention of comprehensively encompassing all fundamental aspects of business process management. The life cycle of business processes encompasses three stages: creation, execution, and optimization. Indicators are utilized to oversee and regulate commercial procedures. The implementation of BPM technology is evident in the architecture. The strategic aspect of Business Process Management (BPM) encompasses the essential role of management.

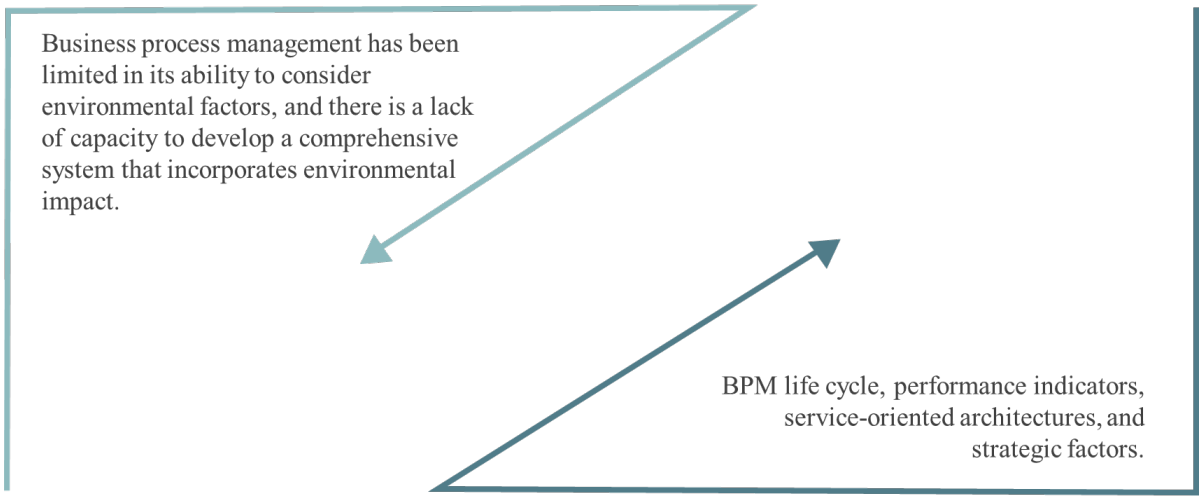

Figure 3: Extension of conventional business process management

The present analysis concludes that ecological factors have been only partially acknowledged in the domain of business process management, and a limited number of methodologies exclusively address specific sub-areas of business process management. The present chapter showcases the impact of ecological factors on business process management (BPM) through an analysis of various aspects such as the life cycle, key performance indicators, service-oriented BPM architectures, and strategic factors governing the direction of a company.

The Stage of Green Business Process Management

Ecological factors have only been partially understood in the realm of business process management (). There is a limited number of scholarly methodologies that focus on enhancing a company's environmental impact through business procedures. A limited number of techniques focus exclusively on sub-areas within the realm of business process management. As an illustration, the authors measure all notable ecological ramifications and the energy efficiency of the hardware system. Currently, there is a lack of ability to develop a comprehensive business process management system that incorporates environmental impact as a parameter alongside optimization components.

The subsequent section illustrates the impact of ecological factors on the management of business processes. Analyze the similarities and differences between two or more subjects. The present study undertakes an analysis of various sub-areas of business process management (BPM) in order to facilitate comparison and extension identification. The selection of these domains was made with the aim of comprehensively addressing all fundamental aspects of business process management. The several

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studies (Sellitto, 2018; Qin, 2019; Abdallah & Al-Ghwayeen 2020; Al-Nuaimi, Al-Mazrouei & Jabeen, 2020; Couckuyt & Van Looy, 2020; Allam et al, 2021; Couckuyt & Van Looy, 2021; ; Sohns et al., 2023) have been synthesized by the authors and the stage of green business processes encompasses six stages, namely strategy and administration, modeling design, configuration, execution, monitoring, analysis, and certification

Stage I: strategy and administration

During the strategy and administration phase, strategic goals and processes are identified and defined. Additionally, quantitative techniques are employed to check targets, and administrative activities are established for life cycle phases. The traditional approach to business process management entails the establishment of strategic objectives by management and the identification of corresponding business processes to attain them. The specified targets also encompass the environmental impact of the processes. The planning phase should encompass the necessary infrastructure required to accomplish the specified procedures in order to address the novel objectives. Information Technology, human resources, transportation, and other related areas. The initial phase involves monitoring the ecological footprint of all procedural resources.

Key Performance Indicators (KPIs) such as sales and customer complaints are frequently utilized by companies. The Key Performance Indicators (KPIs) serve to optimize procedures aimed at achieving targets. The implementation of sustainable business process management necessitates the utilization of ecological key performance indicators (KPIs) and indicators. The present investigation designates the ecological indicators as Key Ecological Indicators (KEI).

Business process activities are determined by environmental and economic factors. The process involves the selection of various activities, resources, and a control flow structure. As a result of ecological considerations, activities may be carried out in a modified manner. As an example, multiple process instances are concurrently performing operations at a specific moment. Therefore, it is possible to allocate resources specific to a task based on time-dependency, rather than maintaining their availability.

Assisting a corporate entity in delineating its business procedures necessitates addressing all of its administrative requirements. The primary necessities of the BPM life cycle encompass the assimilation of novel information sources, the customization and reconfiguration of business processes and activities, and a more intimate ecological integration of business process activities with the infrastructure that carries them out. This study incorporates the Ecological Officer into the roster of business process management stakeholders in order to fulfil their overarching duties. This occupation involves integrating ecological factors into the management of business processes and developing them independently in collaboration with process designers, systems architects, and business engineers. The Ecological Officer is responsible for determining pertinent Key Ecological Indicators in alignment with the organization's strategic objectives. This involves identifying and establishing appropriate measurement and monitoring techniques, integrating environmental data with existing business processes, facilitating process modelling and adaptation through the use of suitable process models, and implementing appropriate procedures. The maintenance of data persistence and accreditation of business processes and resources are additional administrative tasks. The assurance of compliance and certification is achieved through the retention of all economic and ecological data pertaining to business processes.

To summaries this stage, the business process management's strategy and administration phase encompasses the establishment of strategic objectives and processes, utilization of quantitative methods to evaluate targets, and implementation of administrative tasks to manage life cycle phases. Organizations utilize Key Performance Indicators (KPIs) such as sales and customer complaints to enhance operational efficiency. The determination of activities is influenced by both environmental and economic factors, and may be subject to modification based on ecological considerations. The role of the Ecological Officer entails the incorporation of ecological considerations into the administration of commercial operations, as well as the independent development of such considerations in partnership with process designers, systems architects, and business engineers. The individuals in question bear the

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responsibility of identifying relevant Key Ecological Indicators, incorporating environmental data into pre-existing business operations, facilitating the modelling and adjustment of processes, and executing suitable protocols.

Stage II: Modeling Design

During the modelling phase, BPM is utilized to model business processes. Validation of the process model is necessary to ensure that the syntactic and semantic implementation of the requirements is achieved, and that the intended process and objectives have been satisfactorily accomplished. The integration of environmental indicators necessitates more than mere functional process modelling. The initial step of the process model involves verifying that resources are both functionally appropriate and utilized with efficiency, while considering the established Key Efficiency Indicators (KEIs). This entails the expansion of selection criteria for resources and services, as well as the mapping of control flow components as required. In order to attain these objectives, it is imperative that feasible techniques and methodologies provide insights into the designated Key Evaluation Indicators (KEIs) during the process model design phase. The phase of design time involves the establishment of novel processes and the enhancement of existing process models. According to the functional needs model, it is imperative for the Ecological Officer to provide comprehensive environmental information pertaining to various activities and services, sourced from multiple data repositories. Examples of data that can be utilized include sensor data pertaining to energy and water consumption, as well as third-party agreements for Ecological Service Level Agreements (eSLAs). The analysis of pre-existing services is a critical step in identifying those that are functionally relevant.

The acquisition of environmental knowledge has the potential to modify existing process models or introduce novel iterations. Raw materials possessing diverse Service Level Agreements (SLAs) can be utilized. Consumers have the option to select between conventional or environmentally-friendly methods of implementation. The constellations in question can be associated with monetary compensation. The significance of supporting business process modelling with relevant approaches is particularly crucial, as there is a lack of sufficient dissemination of expertise in environmentally friendly design and optimization. The Green Business Process Patterns utilize established use cases and domains such as cloud computing and enterprise application architecture to propose solutions for enhancing process efficiency in a sustainable manner.

This stage delineates and furnishes methodologies for the analysis and evaluation of process model. According to recent studies conducted in 2021 and 2022, graphic analysis has demonstrated superior performance compared to textual representation in various domains. Therefore, it is imperative that the techniques mentioned accurately align with the specified Key Effectiveness Indicators (KEIs), specifically in terms of speed and accessibility.

Various visualization components can exhibit environmental data of business processes, contingent on the KEI category, drawing from loosely associated visualization templates. This stage of the lifecycle pertains to the creation of templates for modelling, excluding process models. Visualization templates can be reused in process models.

As it sums up for this stage, business Process Modelling (BPM) is employed for the purpose of representing business processes, and the process of validation is indispensable to guarantee successful implementation. The process model incorporates environmental indicators, while Green Business Process Patterns offer remedies to optimize process efficacy. The utilization of graphic analysis and visualization components is feasible.

Stage III: Configuration

Activities and their organizational structure are defined by the process model from the previous phase. The phase of configuration involves all procedures related to running the model. The field of Information Technology involves the establishment of a functional process model and the selection of appropriate systems and services. The implementation of activities and the technology utilized are determined by systems and services. This choice is often determined by economic, security, or regulatory goals in order to fulfil service level agreements and achieve objectives. The customization

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of requirements is necessary to align with the specific ecological systems and services under consideration. Information Technology systems have the capability to perform tasks with speed and efficiency. Hiring an individual results in a decrease in energy consumption and a reduction in environmental footprint. Therefore, it is imperative that selection decisions take into account any potential conflicts in objectives and fulfil all strategic objectives.

The aforementioned instance suggests that the implementation of environmentally sustainable business process management necessitates the consideration of the structure of business processes, the execution environment, and the implementation process. Therefore, it is imperative to take into account both the top-down and bottom-up approaches to implementation. The bottom-up approach is a strategic framework that aims to optimize the utilization of business infrastructure by modelling business operations. It is possible to create a model of an automated business process that involves the aggregation of queries from various data sources. Reduces expenses associated with communication. The top-down methodology involves the allocation of process activities to distinct resources or resource categories that are capable of effectively executing the task. Information technology systems have the ability to utilize resources that can be scaled up or down in order to accommodate varying process workloads. Deactivate components of resources that are not fully utilized. Additional resources have the capability to be incorporated in a dynamic manner.

During the configuration phase, it is imperative to identify, define, and integrate data sources to conduct a comprehensive analysis of business processes. This phase also involves selecting alternative systems and services or automatic service selection, which may include runtime considerations. Key performance indicators (KEIs) should encompass techniques and strategies for tracking and evaluating metrics. The monitoring phase utilizes various sources of information.

In order to sum up of this stage, the information technology domain encompasses the development of an operational process model and the identification of suitable systems and services. Customizing requirements is a crucial step in ensuring alignment with the unique ecological systems and services being evaluated. The achievement of ecologically sustainable business process management requires the contemplation of the configuration of business processes, the execution milieu, and the implementation procedure. In order to ensure effective implementation, it is crucial to consider both the top-down and bottom-up approaches. The inclusion of methodologies and approaches for monitoring and assessing metrics is imperative in the development of key performance indicators (KPIs). The phase of monitoring employs diverse sources of information.

Stage IV: Execution

During the execution phase, there is an active management of the flow of individual process instances. This phase executes supplementary tasks to optimize resource allocation and execution, contingent upon the specified configuration. An important consideration in this context pertains to the effective utilization of resources in order to minimize any adverse environmental consequences. Cloud computing exemplifies the provision of resources in accordance with the specific requirements of process instances that are to be executed. Another aspect pertains to the effective execution of process instances. The present emphasis lies not solely on the allocation of resources based on necessity, but also on the identification of effective resources. The conventional approach to business process management provides techniques that enable the dynamic linking of services during runtime. By broadening the selection criteria to encompass ecological considerations, these techniques can also facilitate the identification of resources and services that are ecologically efficient.

To summaries for this stage, it is imperative to engage in active management of individual process instances during the execution phase to enhance resource allocation and execution. Cloud computing provisions resources based on the specific needs of process instances. The primary objective is to discern efficacious resources, and the traditional methodology of managing business processes offers methodologies that facilitate the dynamic interconnection of services at runtime. This aids in the identification of resources and services that exhibit ecological efficiency.

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Phase V: Monitoring

During monitoring, every process instance's data is viewed. This document typically contains comprehensive data on the execution of a business process, including key performance indicators (KPIs), and serves as a valuable resource for analyzing and monitoring progress towards strategic objectives. The previous rounds of analysis have indicated that achieving ecological objectives necessitates obtaining additional environmental data from novel sources. This is particularly relevant in the context of KEI values. The documentation of a process across all regions and its transparency for ecological study necessitates the incorporation of supplementary monitoring and sensor functions.

The integration of information systems is imperative for effective monitoring, as it enables the utilization of data in analytical processes. An integration of the diverse measuring systems for Key Performance Indicators (KEIs) necessitates the implementation of a monitoring model. This model offers Key Environmental Indicators (KEI) assessments and establishes correlations between environmental metrics and operational efficiency. The significance of the second stage lies in the fact that the sources of information are typically autonomous. The permanent storage of runtime and environmental data is imperative for the purposes of business process analysis and auditing. It may be necessary to further develop or enhance strategies for maintaining persistence. The extent of expansion is contingent upon the operational procedures (whether human or automated), extraneous variables, and the tenacity of the resolution. It is imperative to conduct an individual assessment.

To conclude for this stage, the act of monitoring is imperative in order to analyses and track progress towards strategic objectives. In order to attain ecological goals, it is imperative to acquire supplementary environmental information from innovative sources. The integration of information systems is a crucial aspect of efficient monitoring, as it facilitates the utilization of data in analytical procedures. In order to establish a correlation between energy consumption and the utilization of IT systems, it is imperative to take into account the process activities involved. The preservation of runtime and environmental data in a lasting manner is a crucial aspect for the purposes of business process analysis and auditing.

Phase VI: Analysis

The analysis phase is concerned with the examination of business process execution through the utilization of monitoring data. This stage involves the evaluation of objectives and identification of weaknesses. In order to effectively display and analyses process monitoring data, it is necessary to include information regarding the execution environment. The aforementioned add-on is capable of discerning the ecological footprint of a given business process, as well as establishing interdependencies among activities and process models. The methodologies employed for evaluation should be conducive to the measurement of Key Performance Indicators (KPIs) and Key Evaluation Indicators (KEIs).

The utilization of business dashboards or analytical techniques that effectively exhibit pertinent metrics can be employed for the purpose of scrutinizing and assessing process models. This enables decision-makers to identify innovative process-specific optimization patterns or utilize existing patterns and best practices to mitigate the environmental impact of processes. The utilization of process views is a valuable tool for the visualization and analysis of processes that are established on predetermined Key Efficiency Indicators (KEIs), owing to the valuable insights that they provide. Apart from conducting analysis, these designated perspectives enable decision-makers to evaluate the economic and environmental consequences of process alternatives.

The configurations for analyzing process models may be contingent upon the analysis methodologies employed during the modelling phase. The aforementioned configurations facilitate the correlation of amalgamated data origins with constituent components of process models. The model of monitoring allocates the energy consumption of an IT service to the activities of the process model.
In conclusion for this stage, the analysis phase entails looking at how business processes are carried out using monitoring data. The process entails the assessment of goals and detection of deficiencies, and encompasses details pertaining to the operational context. The assessment techniques employed ought to be suitable for gauging Key Performance Indicators (KPIs) and Key Efficiency Indicators (KEIs). The utilization of process views is a significant technique in the visualization and examination of

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processes. The examination of process models may be subject to the analysis methodologies employed during the modelling phase, and configurations for such analysis may be dependent on this.

Phase VII: Certification

As evidence of conformance with and fulfilment of a stated quality standard, certification of goods, services, or management systems is provided. Instances of this phenomenon include the certification of management systems and processes in accordance with ISO 9001, as well as the certification of information security in accordance with ISO 27001. Similar to the existing certifications, an appropriate certification can be utilized provided that ecological sustainability factors are considered. This document serves as evidence of adherence to environmental regulations, encompassing both ethical corporate responsibility towards the environment and legal obligations to provide substantiating proof.

Certifications, such as ISO 14001, enable corporations to exhibit adherence to environmental and social standards, thereby providing them with greater prospects to showcase their sustainable manufacturing of products. It is important to acknowledge that varying certifications and environmental labels may not possess equivalent standing. Marketing strategies are frequently employed to enhance customer impact and the competitive advantage of a company. These strategies aim to portray products, services, objectives, and corporate policies in a manner that emphasizes their environmentally friendly nature. The phenomenon of greenwashing, referring to marketing campaigns that falsely claim environmentally friendly practices, has been a topic of discussion in both media and academic literature since the 1980s. The allegation levelled against this methodology, which is solely aimed at enhancing the public perception of the organization, is that the pursuit of profit is prioritized over the amelioration of the ecological condition. The modifications are not subsequently manifested in the hierarchical arrangements of the organization.

To summaries for this stage, the act of certifying goods, services, or management systems serves as proof of adherence to a specified quality standard and fulfilment thereof. The utilization of this tool may also serve as a means to showcase ecological sustainability considerations. Marketing tactics, such as the practice of greenwashing, are employed to augment the influence on customers and the competitive edge of a corporation. The accusation of greenwashing posits that the prioritization of profit takes precedence over the improvement of ecological conditions.

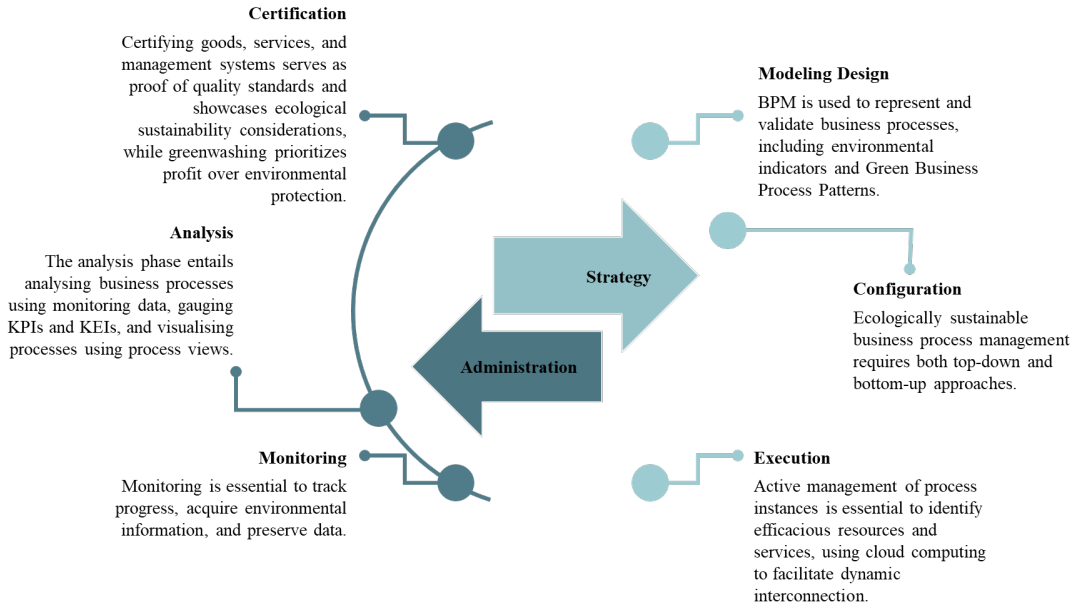

Figure 4: The Stage of Green Business Process Management

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In summaries this section, it can be stated that the incorporation of business process modelling (BPM) and validation is imperative for the achievement of effective implementation. Key Performance Indicators (KPIs) are utilized to optimize operational efficiency and tailor specific needs. Cloud computing offers resources that are tailored to the requirements of individual process instances. Conducting an analysis and audit of business processes is a crucial component in attaining strategic goals. Marketing strategies, such as the use of greenwashing, are utilized to augment customer persuasion and gain a competitive advantage.

Strategic view of Green Business process management

Business process management is a comprehensive approach to managing a firm (Sellitto, 2018). The impact of strategic goals on process design, implementation, management, and optimization is significant (Porter, 1985). The design and optimization of processes for cost leaders are primarily influenced by costs. Effective leadership necessitates the implementation of process design that prioritizes the quality of customer service. Therefore, it is imperative for a corporation to take into account their environmental impact while establishing strategic objectives. This measure safeguards the organization against alterations in the environment. Furthermore, it provides the opportunity for early decision-makers in business process management (BPM) to modify their initial selections (Farid, 2022). The value chain model introduced by Porter (1985) is employed as a means of demonstrating the prerequisites and outcomes of green business process management (BPM). This comprehensive framework encompasses all domains of a company and categorizes conventional business operations into primary and ancillary activities (Dumas et al, 2018). The activities within the value chain pertain to the transformation of products or services, rather than being classified as business processes. The operational processes of the organization carry out every task. This section brings together the stage of green business process management with the perspectives of various scholars (Porter, 1985; Jakobi et al, 2016; Dumas et al, 2018; Sellitto, 2018; Qin, 2019; Abdallah & Al-Ghwayeen 2020; Al-Nuaimi, Al-Mazrouei & Jabeen, 2020; Couckuyt & Van Looy, 2020; Allam et al, 2021; Couckuyt & Van Looy, 2021; Sohns et al., 2023) to demonstrate the impact of green business process management on strategic green business process management across various domains, including logistics and production, marketing and sales, procurement, technology development, human resources management, and company infrastructure. The following information is provided in detail:

Strategic green business process management expansion of logistics and production

The fundamental components of product and service provision are comprised of inbound logistics, production, and outbound logistics. Consequently, it is their duty to develop the fundamental procedures of an organization. The strategic significance of these regions renders them crucial in the determination of ecologically sustainable procedures. Ecologically speaking, the emphasis lies on the processes and operational settings employed, as well as the utilization of infrastructure resources.
The objective of defining strategic decisions is to effectively address potential goal conflicts among cost, time, quality, flexibility, and environmental dimensions. In the context of process design, it is imperative to possess preliminary data pertaining to the environmental ramifications of the proposed or pre-existing infrastructure. The selection of process steps or infrastructure components may vary depending on the defined Key Performance Indicators (KPIs) and Key Efficiency Indicators (KEIs).

Strategic green business process management expansion of marketing and sales

The functions of marketing and sales in an organization are to influence the perception of the general public, strategically position the products and services in the market, and provide assistance to customers. The implementation of an ecologically-focused marketing strategy can effectively communicate a company's ecological values and objectives to meet market demands, ultimately impacting the company's reputation. This phenomenon may result in various outcomes, such as the acquisition of novel clientele, expansion into untapped markets, or implementation of innovative business strategies. The design of marketing strategies is a multifaceted process that necessitates a bespoke approach, contingent upon the organization and its strategic objectives. Instances of this

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phenomenon include the implementation of alternative ecological services or the introduction of novel ecological product lines. Effective marketing strategies can enhance the visibility of ecologically-oriented restructuring initiatives undertaken in logistics and production, thereby improving their overall publicity.

Strategic green business process management expansion of procurement

The acquisition of all resources required to help a corporation achieve its commercial objectives is the focus of this topic. Consequently, this region exerts a noteworthy influence on the ecosystem, as it is externally sourced and not internally generated within the organization. The decisions made regarding resource procurement have a significant influence on the products, services, and processes of a company. By procuring goods and services that have been certified for their ecological standards, a company can potentially enhance its environmental footprint while also bolstering its public image. The implementation of ecological procurement necessitates the establishment of guidelines that incorporate the environmental impact of products and services as an integral component of the selection process, in addition to price considerations.

Strategic green business process management expansion of technology development

The field of technology development encompasses, among other things, research and development, process automation and optimization, as well as new technologies for the realization of the value chain and the related business processes. It is imperative that the development process incorporates ecologically relevant requirements in a robust manner. Expanding the life cycle of business processes can facilitate anchoring in the realm of continuous improvement and ecological reengineering. In the realm of product and service development, it is imperative to take into account individual requirements that may vary depending on the specific application. An illustration of resources in product development includes the utilization of sustainable or recycled raw materials and renewable energies.

Strategic green business process management expansion of human resources management

The employees of an organization constitute a crucial variable that warrants careful consideration in gauging the ecological footprint of the company, specifically in relation to the consumption of resources during routine operations. Organizational policies and initiatives have the potential to foster a culture of innovation among employees, leading to the generation of novel ideas aimed at enhancing resource utilization in a positive manner. The identification of CO2 emissions from employees has been documented in both academic literature and practical applications. This text outlines various strategies for enhancing organizational performance, such as evaluating the relative merits of business travel versus video conferencing, establishing protocols for meetings and training sessions, and implementing measures to promote energy efficiency in the workplace.

Strategic green business process management expansion of the company infrastructure

The corporate facilities encompass all the necessary components of infrastructure that are essential for the attainment of business objectives. Regarding business processes, this refers specifically to the operational context in which the processes and services are carried out. The involvement of the IT infrastructure, building infrastructure, machine infrastructure, or logistics infrastructure may vary depending on the business process. Various forms of infrastructure have the potential to facilitate the reduction of a company's environmental footprint on an individual basis. When formulating infrastructure definitions, the inclusion of ecological factors may prompt the consideration of outsourcing strategies as a viable option for supplementing or replacing internal infrastructure components. Enterprises that specialize in rendering specific services typically attain economies of scale that are unattainable by singular firms. Consequently, it is imperative that the prerequisites for the formulation of outsourcing tactics encompass environmental factors that are derived from a company's strategic objectives.

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In conclusion for this section, it is crucial to incorporate ecologically comprehensive strategies in logistics and production operations to guarantee ecological sustainability. The strategic roles of marketing and sales are of utmost importance in the positioning of products and services in the market. The procurement of resources has a significant influence on the advancement of products, services, and processes. Incorporating ecologically significant criteria into technological advancements and acknowledging the ecological impact in the management of human resources are essential. The adoption of outsourcing tactics has the potential to serve as a viable option for enhancing or replacing internal infrastructure elements.

Conclusion

The Business Process Management (BPM) methodology is centered on the optimization of cost reduction, quality enhancement, acceleration of throughput, and adaptability. The approach incorporates ecological, economic, and social objectives with the aim of mitigating environmental impact. The integration of ecological factors is a crucial aspect of commercial operations, which involves the collaboration of process designers, systems architects, and business engineers. The utilization of graphic analysis and visualization techniques is a crucial aspect of promoting ecologically sustainable business process management. Additionally, the incorporation of information technology, metrics monitoring, and defect discovery methods is also imperative. The practice of greenwashing is employed to enhance a company's customer outreach and competitive edge, while also necessitating ecologically sustainable logistics and industrial procedures. The integration of technology advancement and human resource management necessitates the consideration of ecological impact, while the utilization of outsourcing may serve as a viable alternative or complement to internal infrastructure elements.

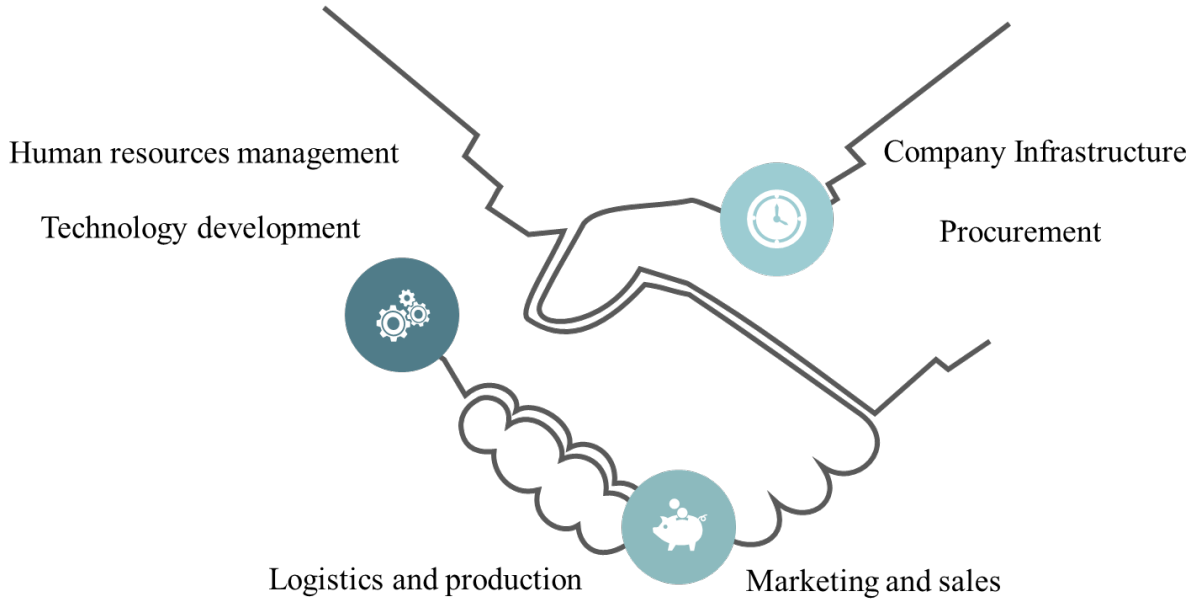

Figure 5: Strategic green business process management expansion

Implementation

Thai businesses provide a diverse range of commodities via digital platforms. The individual has conveyed a willingness to engage in environmental initiatives at a later point in time. The firm's management is currently endeavoring to integrate ecologically sustainable practices into its business process management. A pilot project was carried out to optimize the energy consumption of the company's data consolidation process. Monthly, the consolidation of online sales data into a centralized data repository occurs. The procedure of extracting data encompasses the retrieval of sales information

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from databases of online portals. The procedure of data cleansing encompasses the amalgamation of data from heterogeneous systems. Redundant customer information is eliminated. In the third phase of the process, sanitized data is loaded into the organization's data warehouse system for further analysis. The subsequent contribution focused on the incorporation and dissemination of environmental effects associated with Thai corporate procedures within the context of business process management approaches. The research centered on the analysis and augmentation of four discrete geographical areas. The Key Ecological Indicators (KEIs) are a collection of environmental metrics that function as crucial indicators of ecological health and function. The aforementioned indicators have been specifically crafted to offer valuable understanding regarding crucial environmental variables and their associated target operations. The KEIs concept pertains to the integration of environmental indicators that depict the current state of the environment and key performance indicators (KPIs) that establish performance benchmarks and objectives. The utilization of key performance indicators (KPIs) was implemented in the expansion of the phase of environmentally sustainable business process management. The previously mentioned extensions incorporate a new role referred to as the Ecology Officer, a certification process, and all the essential elements necessary for the establishment of an operational framework, its execution, monitoring, and environmental assessment. The expansion of architectures for business process management is imperative to facilitate the propagation of information across the diverse stages of the extended life cycle. The available extensions encompass the assimilation of sensors and environmental databases, processing services, and focused analysis. The discourse revolved around the technical and strategic facets of business process management. This study has demonstrated that the implementation of strategic decisions, such as resource reallocation, procurement policies, eco-friendly marketing tactics, and technological advancements, can result in a significant decrease in the environmental footprint of a company based in Thailand.

The second research contribution involved the analysis of business processes through the identification of decision-relevant information. This was achieved by utilizing the identified Key Evaluation Indicators (KEIs) and subsequently analyzing and interpreting the information obtained. The procedural model for implementation comprises several steps, including KEI definition, resource model creation, monitoring model creation, process analysis implementation, and optimization alternative selection. The initial stage pertains to the first research contribution, while the final stage pertains to the third research contribution. A resource model was utilized to map KEIs to business process and activity resources. The utilization of mapping regulations can facilitate the identification of the dispersion of environmental influences. A sound monitoring framework necessitates the inclusion of this data. The monitoring model outlines a suitable measurement framework that specifies the necessary data to be collected and disseminated by the relevant resources for the purpose of conducting a meaningful analysis of the process model. The present study introduces a modifiable and graphical representation of commercial procedures for the purpose of data examination. The separation of distinct areas of responsibility, namely the development of a visualization template, the selection of analysis data, the configuration of visualization, and the actual visualization process, facilitates the prompt and adaptable adjustment of analyses in response to evolving business processes and analysis demands. The study employed a comprehensive approach to establish the resource model, monitoring model, and process analysis protocols. Illustrative presentations were also exhibited.

The following contribution of this scholarly article pertained to the examination of commercial procedures by means of recognizing pertinent information for decision-making purposes. The accomplishment was attained through the utilization of the identified key evaluation indicators (KEIs) and subsequent analysis and interpretation of the acquired information. The implementation procedural model involves a series of steps, namely the definition of Knowledge, Experience, and Intelligence (KEI), the creation of a resource model, the creation of a monitoring model, the implementation of process analysis, and the selection of alternative optimization strategies. The first stage is related to the most recent contribution, whereas the last stage is associated with the third research contribution. The study employed a resource model to establish a correlation between Key Economic Indicators (KEIs) and the resources associated with business processes and activities in Thailand. The implementation of mapping regulations can aid in the recognition of the distribution of environmental factors. The

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DOI: https://doi.org/10.14456/jsasr.2023.31

incorporation of this data is imperative in the establishment of a comprehensive sound monitoring framework. The monitoring model presents a measurement framework that delineates the requisite data to be gathered and disseminated by pertinent resources to facilitate a comprehensive analysis of the process model. The current study presents a customizable and visual depiction of business processes aimed at facilitating data analysis. The division of specific areas of accountability, such as the creation of a visual representation model, the curation of analytical data, the setup of visualization, and the implementation of the visualization procedure, enables the expeditious and flexible modification of analyses to meet the changing requirements of Thai business processes and analytical needs. The study suggests that Thai enterprises should adopt a comprehensive strategy to develop a resource model, monitoring model, and process analysis protocols. Exhibitions of illustrative presentations were also showcased.

Next contribution focused on utilizing analytical results to identify and select optimization opportunities. The current manuscript is organized according to patterns. Thai traditional businesses are characterized by patterns, which are abstract solutions to recurring problems that can be applied universally across diverse organizations by defining conditions and prerequisites. This study examined several Green Business Process Patterns by conducting a literature review of ecological solution approaches in the field of business. The solutions comprise of those that are specifically aimed at mitigating the environmental impact of a business process, as well as those that were originally intended for other domains but can be utilized to ameliorate the deleterious environmental consequences. The development of a framework for pattern support was undertaken to aid users in the identification of patterns for the purpose of optimization projects. It is recommended that Thai businesses implement an identification method that follows a structured process consisting of various stages. These stages should take into account the necessary adjustments required, such as those related to process, service, or infrastructure. Additionally, the identification method should consider the thematic emphasis of a given pattern and the patterns utilized in previous optimization efforts.

The final contribution pertains to the assessment and authentication of methodologies and concepts. A framework for green business process management (Green BPM) was established at the outset. Furthermore, a prototype was created. Thai businesses have the potential to incorporate the principles and advancements of green business process management. The software enables clients to establish and execute environmentally sustainable process monitoring, evaluate commercial procedures, and determine the most effective optimization tactics. Furthermore, Thai scholars may incorporate this concept in order to verify the effectiveness of the approach through future research.

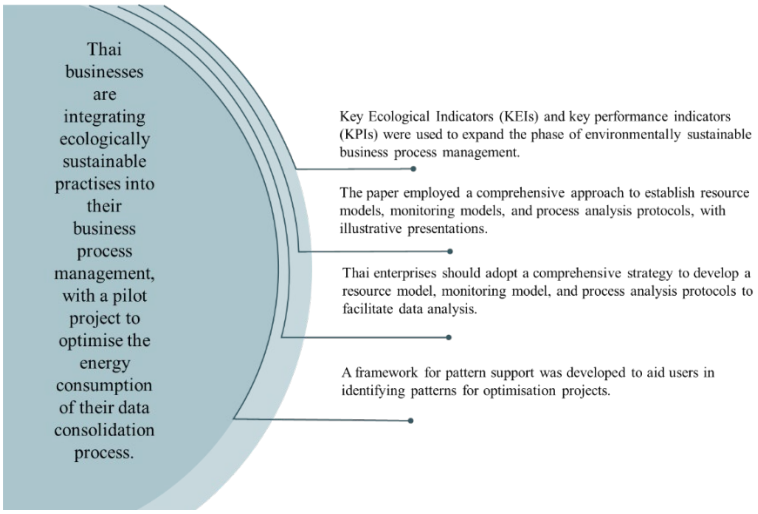

Figure 6: Implementation of strategic green business process management

Citation: Kamkankaew, P., Phattarowas, V., Thanin, P., Jeesorn, W., & Phungjitpraphai, P., (2023). Green Business Process Management: The Way to Contribute to Sustainability for Thai Businesses. International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (3), 17-36; DOI: https://doi.org/10.14456/jsasr.2023.31

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (3): May-June 2023, page 16-36. ISSN: 2774-0366
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.14456/jsasr.2023.31

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International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (3): May-June 2023, page 16-36. ISSN: 2774-0366
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