

## RESEARCH ARTICLE

# A Review on Business Process Management System Design: The Role of Virtualization and Work Design

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**ABSTRACT** Business Process Management (BPM) has emerged as a fundamental aspect of modern business, revolutionizing task execution and operational efficiency. This study explored the integration of BPM, virtualization, and work design to enhance organizational performance and productivity. The objective is to contribute to the ongoing dialogue on the combined impact of these elements on BPM systems and their applicability in contemporary office settings. Through a systematic literature review, 136 journal articles were examined and selected from 2,248 articles matching the search criteria. This review reveals major gaps in the current literature and identifies opportunities for further research and investigation. These findings underscore the potential significance of integrating virtualization and work design in BPM systems to enhance flexibility, scalability, and agility. Organizations can effectively respond to dynamic business needs and market conditions by leveraging virtual resources, thus eliminating the constraints of physical proximity. We provide a reflective discussion linking theoretical understanding with empirical evidence from literature. Our analysis revealed promising avenues for future research, emphasizing the role of usability in BPM system design and its impact on task accomplishment. This systematic literature review underscores the role of virtualization and work design in BPM system design. We found that both components not only enhanced the performance and effectiveness of BPM systems, but also improved flexibility, scalability, and user experience. A holistic approach to BPM system design has emerged as crucial, encompassing process modelling, automation, workflow management, integration, analytics, reporting, governance, and continuous improvement. Despite the evident benefits, our review identified distinct challenges such as managing system complexity, ensuring security, navigating resistance to change, and harmonizing technology with human elements. Our analysis underscores avenues for research that have not yet been thoroughly explored and opportunities to further extend knowledge in this field.

**INDEX TERMS** Business process management (BPM), virtualization, work design, integration, workflow automation, organizations, modern office environment.

## I. INTRODUCTION

Business Process Management (BPM) has emerged as a fundamental aspect of business, transforming how tasks are streamlined and executed [1]. Researchers, remote designers, and logistics personnel have found notable success in cooperative work structures, often supported by basic tools,

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such as calendars, emails, or business social networks [2]. However, the rapid advancement of technology is driving the transition from these traditional platforms to more robust BPM software that offers features such as workflow chains, deadline tracking, and audit capabilities.

Operational efficiency and work quality, which are the prime determinants of business success, are significantly enhanced by a well-implemented BPM system [3]. It streamlines processes, reduces errors, and mitigates wastage.

Furthermore, BPM has been recognized for fostering regulatory compliance, supporting the digital revolution, promoting agility, and enabling improved delivery of goods and services to consumers [4]. Thus, businesses may gain competitive advantage by implementing customer-centric software interfaces.

Data management, which is the bedrock of many business operations, has also been greatly affected by digital advancements [5]. Efficient organization and management of voluminous data is now achievable, with larger companies often leveraging SQL Server databases and smaller entities using applications such as Microsoft Access [3]. These tools are essential for companies of all sizes because they facilitate data collection and storage for future decision-making purposes. For instance, databases enable businesses to operate e-commerce websites and manage user-login information. Such technological infrastructure, which is an integral component of BPM, can significantly transform a company's operations.

The pivotal role of technology in business has been increasingly evident since the technological revolution, which has had an even more profound impact than the preceding industrial revolution [3]. Almost every aspect of business operations, from manufacturing and finance to security and human resources, has been reshaped significantly by technological advancements.

Computing technology has long served as a crucial productivity tool for businesses, with advancements continuously altering the work processes to enhance productivity [6]. For instance, the transition from typewriters to word processors necessitated new skills and workflows but resulted in substantial productivity gains [7]. This symbiotic relationship between work design and productivity improvement was particularly evident in the BPM domain [8].

With the advent of BPM systems, businesses can automate many manual tasks, improving workflow organization, integration, and optimization [9]. This transformation allows business processes to be driven by the BPM system rather than solely by human operators.

Virtualization, which involves dividing resources into multiple execution environments, has also gained prominence in the business world [10]. Combined with the BPMS, it provides the resources and instructions necessary to complete the workflows. Advances in virtual reality (VR), mixed reality (MR), and collaborative virtual environments (CVEs) offer new ways of viewing and interacting with the physical environment [11].

Figure 1 offers a visual representation of these foundational elements of the data-management process and their interplay in a typical business setting.

Modern BPM system design, deeply rooted in computer and management science [12], significantly impacts daily work, leading to considerations of work design as a function of business process automation. The usability of a system also plays a vital role in ensuring effective and efficient task completion [13].

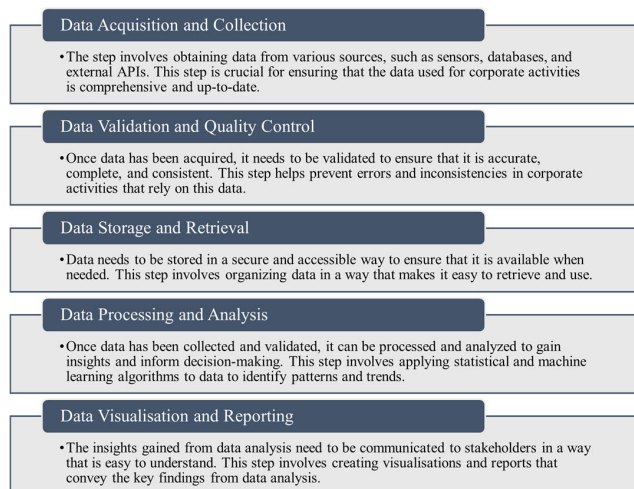


FIGURE 1. Foundations of data management process.

The concept of usability also has relevance in the context of BPM, with the potential to positively influence task accomplishment [13]. The amalgamation of BPM, virtual resources, and work design raises pertinent questions regarding their combined impact on BPM systems and applicability in contemporary office settings.

While some systematic literature reviews related to business process management exist [14], [15], [16], these reviews have focused on other issues such as sustainability, the state of digital transformation in business processes, and business management processes in specific industries. Reference [14] conducted a systematic review of digital transformation in business process management, focusing on the current state of digital transformation to inform the basis of transforming business processes. However, this study emphasized Big Data, the Internet of Things, and Blockchain technologies, leaving out aspects of virtualization and impacts on modern business environments. Reference [16] focused on integrating sustainability into business process management by exploring the design and evaluation of visualization to encourage sustainable practices. Another systematic review [15] focused on business process management systems in port processes, exploring the analysis, modelling, implementation, execution, control, and optimization of business processes in port environments. In contrast to these existing reviews, this review investigates the incorporation of system design and visualization in business process management across different industries, clearly outlining how beneficial systems design and visualization are to improve business process management.

The objective of this paper is to critically examine the current body of knowledge concerning the integration of BPM, virtualization, and work design, identify gaps and limitations in the existing literature, and address pertinent research questions, such as how these elements interrelate and collectively impact BPM system design.

Our analysis focuses on the benefits and challenges of combining these three elements within BPM systems, which may influence a system's adaptability, usability, and response to business needs and market changes. A total of 129 journal articles were reviewed from a larger pool of 2,248 articles that matched the search criteria. This review identified major gaps in the current literature in relation to BPM, virtualization, and work design. The findings show that there is room for better understanding of the relationship between BPM, virtualization, and work design. In our discussion, we highlight the impact of usability on the BPM system design as a promising area for further research. The goal is to highlight areas for further exploration and provide valuable insights for researchers and academics.

The remainder of this paper is organized as follows. Section II outlines the methodologies used to conduct this systematic literature review. Section III discusses our findings and key themes in detail. Section IV provides a reflective discussion linking theoretical understanding with empirical evidence obtained from the literature, identifies literature gaps, and proposes directions for future research. Finally, Section V summarizes the key findings and their implications for the field, and reinforces the future directions suggested in the discussion.

## II. METHODOLOGY

The current research employed a systematic review of the relevant literature to enhance the understanding of virtualization and work design concepts in the context of BPM system design. This encompasses an examination of the benefits and limitations associated with the integration of these concepts. The research additionally examined the correlation between virtualization and work design, and their influence on the design of business process management systems. The decision to conduct a systematic review instead of a meta-analysis or narrative review is based on two primary justifications. First, it was intended to ensure methodological rigor in mapping the extant academic literature on virtualization and work design in the context of BPM system design. Second, as portrayed in empirical studies, this study aimed to establish a basis for clarifying the association between virtualization and work design, and their effects on BPM system design [4]. This systematic literature review follows a fundamental approach to establish an evidence base by comprehensively identifying, assessing, and interpreting all pertinent research related to a specific research inquiry, subject matter, or phenomenon of significance [17]. This systematic review adheres to explicit procedures and principles to ensure transparency and reproducibility [17] and to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) [18].

### A. RESEARCH PROCESS

The systematic review procedure was divided into three distinct stages to ensure its successful and efficient imple-

mentation. These stages encompass the process of planning, executing the review, and finally reporting the findings of the review [18]. During the first phase of the study, a set of research questions was developed that were deemed crucial in achieving the objective of the study. Consequently, these questions were used to identify the most suitable search terms and keywords, and the databases that would subsequently be utilized for conducting the literature search. The Google Scholar, Scopus, and Science Direct databases were used in the search process to identify relevant studies for this review. The review entailed identifying relevant studies from these databases using the selection criteria. The data obtained from studies that met the inclusion criteria were subsequently extracted for analysis. Finally, an in-depth analysis of the results was performed to address the research questions in the current study. The findings were subsequently organized and presented based on themes, followed by a brief discussion and suggestions for future research.

### B. RESEARCH QUESTIONS AND SEARCH STRATEGY

To facilitate the search for eligible articles, it was essential to identify and define the research questions that this systematic review would focus on. As a result, the present study formulated the following questions to facilitate attaining the systematic review objective.

1. How does the relationship between BPM, virtual resources, and work design impact the practical application of BPM systems in the modern office environment?
2. What are virtualization and work design roles in BPM system design, including the advantages and limitations of incorporating these concepts?

These research questions aim to determine the influence of virtualization and work design on business process management (BPM) and their consequential effects on these systems. Additionally, the review aimed to identify areas of research that have yet to be explored to inform future advancements in business process management and encourage additional empirical investigations in this area. This study aims to consolidate the fragmented literature on virtualization and work design in Business Process Management (BPM) by gathering a comprehensive collection of articles that address the topic. The review adhered to established management practices by exclusively incorporating peer-reviewed scholarly journals into the analysis [19]. The search strategy encompassed a comprehensive exploration of pertinent scholarly databases, which included, but were not restricted to, the online platforms of educational establishments that host peer-reviewed literature. The search was executed utilizing a blend of key terms encompassing "Business Process Management System Design," "virtualization," and "work design." The retrieved outcomes were screened for relevance to the research subject matter and the inclusion criteria. Table 1 provides a detailed description of the five distinct search stages and terms used in this process.

**TABLE 1.** Search terms.

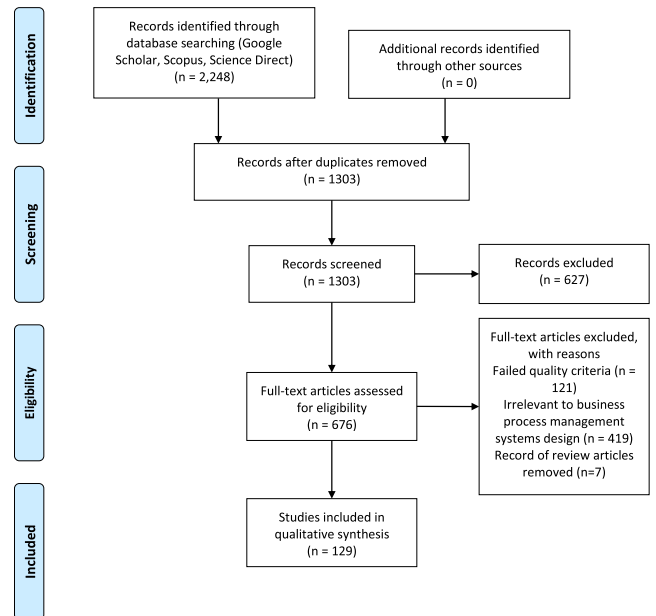
Phase	Search terms
First Phase	("Business process management system design" OR "business process management development") AND ("workflow automation" OR "workflow management" OR "process execution") AND ("industry use" OR "adoption" OR "modern work environment")
Second Phase	("virtualization" OR "virtual resources") AND ("innovation" OR "technological advances") AND ("development" OR "modern work environment OR industry use")
Third Phase	("Work design") AND ("business process management system" OR "systems design") AND ("technological advances" OR "artificial intelligence" OR "adoption" OR "modern work environment")
Fourth Phase	("Business process management" OR "systems design" OR "workflow automation" OR "work design") AND ("virtualization OR virtual resources") AND ("integration" OR "relationship" OR "influence")
Fifth Phase	("Business process management" OR "virtualization" OR "work design" OR "systems design") AND ("attitudes" OR "experiences" OR "adoption") AND ("organizational culture" OR "dimensions of work design")

### C. SELECTION CRITERIA

This systematic literature review aimed to present pertinent data, conduct comparisons, and perform statistical analyses. Therefore, only pertinent information was considered. The present investigation utilized precisely defined eligibility criteria to identify the pertinent literature. The present study used scholarly articles from the Google Scholar, Scopus, and Science Direct databases, representing a large subset of available databases to be meaningful. The inclusion criteria for articles were limited to those published in English between 2000 and 2023. The study will employ inclusion criteria based on the occurrence of the terms "Business Process Management System Design," "virtualization," and "work design" in the title, abstract, or keywords of the article. The exclusion criteria will encompass non-inclusion of the terms above in the title, abstract, or keywords, coupled with the presence of extraneous information. The selection process for peer-reviewed articles involved the assessment of their adherence to the inclusion criteria. Articles that satisfied these criteria were evaluated based on the presence of an abstract, a minimum length of four pages, and a focus on the impact of virtualization and work design on business process management systems. No papers that discussed the topic areas investigated in this review but did not concentrate on the same outcomes were considered [18]. The flow chart in the figure below shows how the articles were selected for analysis in this systematic literature review.

### D. DATA EXTRACTION AND SYNTHESIS

The objective of the literature review was to investigate and amalgamate prior research on the subject matter, ascertain

**FIGURE 2.** PRISMA flow chart demonstrating the article selection process.

deficiencies in knowledge, and formulate suggestions for prospective research. Furthermore, this research aims to offer a thorough and evaluative examination of the extant literature concerning the function of virtualization and work design in advancing a business process management (BPM) system. The study used a methodological literature search and analysis approach, as outlined in Figure 2. The chosen documents were assessed using thematic analysis. Subsequently, the analysis phase identified and categorized the principal themes, concepts, and theories derived from relevant literature [19]. This involved inferring the relevance of the derived concepts to the research questions and objectives. This literature review aims to critically analyze current research on incorporating virtualization and work design in developing Business Process Management Systems (BPMSs). This research endeavor aims to identify the principal themes, concepts, and theories that arise from existing literature, which will serve as a foundation for constructing a conceptual framework.

The criteria for determining eligible publications were established according to the review question. Consulting scholarly articles on systematic literature reviews facilitated the identification of the procedural steps involved in conducting systematic reviews [18]. The present investigation involved multiple phases, and the delineation of each of the research stages facilitated the acquisition and analysis of data. The procedures were partitioned into distinct categories: information sources, search methodology, selection procedure, data-gathering procedure, and data analysis.

### E. RISK OF BIASNESS

Several potential sources of bias were identified in this study. The search for studies in scientific repositories was subject

to bias owing to the idiosyncratic nature of each repository, with some databases not permitting the application of pre-established criteria. Additionally, there is a potential risk of receiving documentation outside the scope of Business Process Management. Furthermore, there was an uneven distribution of documents across years and scientific repositories. The data selection process exhibited bias after the application of the established criteria. Exclusion criteria were applied to ensure that only publications meeting the minimum page requirements were included in the review, thereby maintaining a high level of quality. The use of diverse criteria resulted in the exclusion of several publications. Had these publications been incorporated, it could have facilitated a more equitable distribution and reduced the likelihood of bias among all items under investigation [19].

Furthermore, this review identified bias in data reporting. Nevertheless, utilizing a unified methodology in research is crucial in mitigating this potential hazard. Potential bias during the research process, including data collection and publication selection, was assessed. The pertinent aspects of the methodology were discussed, and various techniques were revised until they could be integrated effectively. The potential for bias was mitigated, as the data were collected across nearly all categories of the study [17]. Furthermore, the established eligibility criteria ensured high rigour and certainty in the collected data. The criteria and methodologies were revised as required to establish a cohesive approach for implementation. The consistent approach employed in the review process facilitated the acquisition of the most pertinent data, thus mitigating the potential for bias. An iterative review and data analysis were required to ensure the consistency and reliability of the information obtained. The present investigation employed rigorous systematic research and data collection techniques, and thoroughly examined and evaluated all relevant publications. Persistent practice of conducting methodological examinations and evaluating the acquired data was consistently ensured. The analyses aimed to minimize existing biases. Examining reference publications in literary reviews facilitated the comprehension of the appropriate methods for organizing, processing, and presenting acquired data and information [19].

### III. FINDINGS

#### A. BPM SYSTEM DESIGN

BPM has become essential for modern organizations to improve efficiency and optimize their workflows. The framework of BPM system design involves several key components and considerations that are critical for designing a successful BPM system [20]. The first step in the framework of BPM system design is process modelling. The process involves identifying, defining, and modelling business processes using process modelling notations, such as BPMN. The goal clearly and precisely represents each process including its inputs, outputs, activities, and decision points. By defining processes in this way, organizations can understand how their oper-

ations work and identify areas for improvement. The next step is the process automation. Another study established that this process entails automating the methods defined in the previous step [21]. This requires the selection of an appropriate BPM software tool that enables process execution, monitoring, and management [1]. Process automation can significantly improve efficiency by eliminating manual tasks, reducing errors, and enabling processes to be executed quickly and accurately. Workflow management is another critical component of BPM system design [22]. This step involves assigning user tasks, tracking progress, and routing between different process steps.

Workflow management allows organizations to coordinate work across teams and ensure that processes are executed promptly and efficiently [22]. Integration with other systems is also crucial for the BPM System Design. Organizations must integrate their BPM systems with other systems to enable data exchange, communication, and coordination between systems. This could include integration with legacy systems, enterprise resource planning (ERP) systems, or third-party applications [6]. Integration enables data to flow between systems, ensuring that all procedures can access the information they need to operate efficiently. Analytics and reporting are critical components of BPM system design. Organizations must monitor process performance and identify areas for improvement [23]. BPM systems provide analytics and reporting capabilities that allow process owners to monitor process performance, identify bottlenecks, and make data-driven decisions for process improvements. Governance and compliance are critical components of BPM system design. BPM systems must provide features for governance and compliance, including security and access control, audit trails, and regulatory compliance checks [24].

In addition, organizations can avoid legal and financial risks by promptly executing processes. Finally, the design of the BPM system should support continuous improvements. It involves providing tools for process analysis, simulation, and optimization [25]. These tools enable organizations to identify improvement areas and simulate the impact of process changes before implementation [26]. Generally, the framework of BPM system design provides a structured approach for designing and implementing BPM systems. By following this framework, the study noted that public administrators and organizations could improve process efficiency, agility, and overall business performance [26]. Process modelling, process automation, workflow management, integration with other systems, analytics and reporting, governance and compliance, and continuous process improvement are critical components of BPM system design. Consequently, organizations adopting a BPM system can improve their operations, reduce costs, and increase customer satisfaction [27]. With the rapid pace of technological advancement and changing customer expectations, the importance of the BPM system design will continue to grow [24]. Hence, organizations that invest in designing and implementing effective

BPM systems are better positioned to compete and thrive in the modern business landscape.

### 1) DEVELOPMENT OF BPM

BPM has been developed as a catalyst for optimizing activities and operations at the workplace by providing a systematic approach to identifying, analyzing, designing, implementing, monitoring, and controlling business processes. BPM started as a quality management initiative in the 1980s with the introduction of Total Quality Management (TQM), Six Sigma, and Continuous Improvement (CI) methodologies [28]. These approaches emphasize the importance of process improvement in improving business performance. The study noted that in the 1990s, a new generation of BPM tools emerged that combined workflow management capabilities with process modelling, simulation, and analysis tools. These tools enable organizations to visualize their business processes and identify opportunities for improvement. A range of factors have driven the development of BPM [29]. These factors include the increasing complexity of business operations and need for greater efficiency and cost-effectiveness. In addition, these factors rely on growing demand for agility and flexibility in response to changing market conditions [30]. Consequently, BPM provides a systematic framework for identifying and addressing bottlenecks, inefficiencies, and other issues that affect business performance.

In a changing business environment with dynamic demands, BPM must be flexible for an effective response [26]. Linking the BPM theory to the business process by assessing non-traditional methods in work design allows for its practical application [31]. However, the definition of business management and Information Technology (IT) terminology often needs to be more broadly agreed upon within academic or corporate spheres. Hence, explaining various concepts, such as BPM, becomes challenging. BPM entails the methods, tools, technologies, management, analysis, and automation of processes by entities to achieve competitive and strategic advantages [32]. Thus, BPM adoption is integral to upgrading a firm’s business operations, and its successful execution is vital. The process of implementing BPM systems and practices within an organization involves a systematic approach to identifying, designing, executing, monitoring, and optimizing business processes to achieve business objectives [33]. The study noted that BPM adoption is a critical component of digital transformation for organizations, enabling them to streamline operations, reduce costs, and increase customer satisfaction.

Technological advancements have played a significant role in the development of the BPM [34]. The availability of process modelling tools, workflow engines, and integration platforms provided organizations with the necessary infrastructure to manage their processes more efficiently and automatically [35]. Additionally, the growing demand for organizational agility and responsiveness to changing cus-

**TABLE 2. Studies on the impact of virtualization and work design on the development of BPM system design.**

Author(s), (Year)	Aim/Purpose	Main Contribution(s)
AlShathry (2016) [43]	To investigate the current state of BPM maturity in Saudi Arabian organizations	<p>This study provides a framework for assessing BPM maturity in organizations that can be used to identify strengths and weaknesses in their BPM practices.</p> <p>The study reveals that most organizations in Saudi Arabia are still in the early stages of BPM maturity, indicating a need for further development and investment in BPM.</p> <p>The study identifies critical success factors for achieving BPM maturity in organizations, including executive support, process measurement, and employee involvement.</p> <p>The study's findings can guide organizations to improve BPM practices and achieve better operational performance and business outcomes.</p>
Aureli et al. (2019) [27]	To investigate the key factors that enhance knowledge-intensive business processes and fill the gap in the literature, which ultimately leads to competitive advantage for organizations	<p>The study's main contribution is identifying five key factors that improve knowledge-intensive business processes, which lead to competitive advantage. These factors are:</p> <ul style="list-style-type: none"> <li>Leadership and management support</li> <li>An organizational culture that promotes knowledge-sharing and collaboration</li> <li>Use of appropriate technology and tools</li> <li>Human capital management practices that attract, retain, and develop knowledge workers</li> <li>Effective measurement and evaluation of knowledge-intensive processes.</li> </ul>
		It established a comprehensive literature review of research articles on Agile BPM to identify

**TABLE 2. (Continued.) Studies on the impact of virtualization and work design on the development of BPM system design.**

Badakhshan et al. (2020) [30]	To provide a systematic literature review and explore the potential benefits of adopting Agile principles in BPM	the key themes, challenges, and opportunities.  An integrated framework for Agile BPM that combines Agile principles, BPM activities, and practices.
Butt (2020) [4]	To propose a conceptual framework to support digital transformation in manufacturing using an integrated BPM approach	It developed a conceptual framework that aligns the critical components of digital transformation with BPM concepts, highlighting the importance of a strategic approach to digital transformation.  It establishes a holistic approach to digital transformation, focusing on technology, people, processes, and culture.
Del Giudice (2016) [44]	To identify the potential benefits and challenges of integrating IoT into BPM and to provide an overview of the current state of research in this area	Identifying potential benefits of integrating IoT and BPM include increased efficiency, real-time data monitoring, and enhanced customer experience.  It established the challenges of this integration, such as security and privacy concerns and the need for new standards and protocols.
Houy, Fettke and Loos (2010) [3]	To provide an overview of empirical research in the field of BPM	Providing a comprehensive analysis of the emerging field of empirical research in BPM.  Identified gaps in the existing research and provided suggestions for future research directions in the field of BPM.
Ivančić et al. (2019) [45]	To provide a systematic literature review of Robotic Process Automation (RPA) to identify the state-of-the-art,	The comprehensive review of existing literature on RPA covers the history and development of RPA, its potential benefits and challenges, and the current state of research in this field.  Highlights the current state of research in RPA and

**TABLE 2. (Continued.) Studies on the impact of virtualization and work design on the development of BPM system design.**

	potential benefits, challenges, and research opportunities in this field	identifies potential research opportunities, such as integrating RPA with other technologies, developing RPA governance frameworks, and investigating RPA's impact on job roles and work design.
Mahmoodzadeh, Jalalinia and Nekui (2009) [46]	To propose a framework for business process outsourcing based on the integration of BPM and Knowledge Management (KM)	It entails the development of an outsourcing framework that aims to bridge the gap between the client organization and the outsourcing vendor by managing and sharing knowledge during the outsourcing process.  The study proposed a model consisting of five stages: (1) planning, (2) design, (3) execution, (4) control, and (5) improvement. The framework aimed to ensure a smooth knowledge transition between the client and vendor organization during outsourcing.
Margherita (2014) [47]	To develop an operational body of knowledge by proposing two integrative definitions of BPM systems and activities	It provided two integrated definitions of BPM that can be used to develop a shared understanding of the subject, create a common language for BPM professionals, and enhance BPM practices.
Münstermann, Eckhardt and Weitzel (2010) [48]	To examine whether the recruitment process can benefit from standardization and if there is a correlation between standardization	It provided empirical evidence of the impact of business process standardization on the performance of the recruitment process.  Established the process's effectiveness and provided insight into the potential benefits of business process standardization for organizations.
Neubauer (2009) [49]	To investigate the status of BPM by exploring its adoption, tools being used, and the associated benefits	It provided an overview of BPM adoption and implementation across various industries and countries.  Identifies the main drivers and barriers to BPM implementation and

**TABLE 2. (Continued.) Studies on the impact of virtualization and work design on the development of BPM system design.**

	and challenges	provides insights into the factors that contribute to the success of BPM initiatives.
Pradabwong (2017) [50]	To investigate the impact of BPM on supply chain collaboration and how this collaboration affects organizational performance and competitiveness	It provided empirical evidence on the relationship between BPM, supply chain collaboration, and their impact on organizational performance and competitiveness.  It highlighted the importance of BPM in creating an environment that fosters collaboration and communication between supply chain partners.
Röglinger, Pöppelbuß, and Becker (2012) [51]	To analyze the existing maturity models in the field of BPM and provide a structured overview of the use and development of these models	It provided a systematic review and comparison of BPM maturity models from different domains, such as IT service management, project management, and quality management.  It developed a classification scheme to categorize the BPM maturity models according to their characteristics, such as focus, scope, and level of detail.  It identified common elements and differences among BPM maturity models, which provides insights for developing new models or improving  It discussed the limitations and challenges of BPM maturity models and the potential future directions for their development.
Shaw et al. (2007) [52]	To provide a theoretical and practical understanding of the elements of a BPM system	The study identified six key elements of a BPM system: process modelling, process execution, process monitoring, process analysis, process optimization, and process reengineering. By understanding these elements, organizations can develop a comprehensive approach to BPM.

**TABLE 2. (Continued.) Studies on the impact of virtualization and work design on the development of BPM system design.**

		It provided a balanced view of the theoretical and practical aspects of BPM. It discusses the concepts and theories behind BPM and the practical issues that arise during BPM implementation.  Evaluated various BPM tools available in the market and provided recommendations on the selection of BPM tools based on their features and functionalities.
Wamba and Mishra (2017) [53]	To conduct a comprehensive literature review of the integration of big data with business processes	It identified key factors affecting extensive data integration with business processes, including data quality, security, privacy, governance, and analytics.  It provided insights into the benefits and challenges of extensive data integration for organizations like improved operational efficiency, better decision-making, and enhanced customer experience.
Zelt et al. (2019) [54]	To develop a theory of Contingent BPM (CBPM) that highlights how BPM can adapt to different contexts and situations	The research developed a theoretical framework combining contingency theory and BPM to explain how organizations can optimize their practices.  The study contributed to the BPM literature by highlighting the importance of contingency factors, like the size and complexity of an organization, in BPM practice design.

tomers needs and market conditions has led to the adoption of BPM. A management framework is a critical enabler of strategic alignment and operational excellence [36]. It gives organizations a holistic view of their processes, allowing them to identify improvement opportunities and make data-driven decisions [37]. Generally, BPM is developed as a catalyst for optimizing activities and operations in the workplace. It achieves this by providing organizations with a structured and systematic approach to process improvement



[36]. The process is supported by technology and is driven by the need for agility and customer centricity. The following section discusses the modern BPM systems.

## 2) MODERN BPM SYSTEMS

BPM has undergone significant changes in evolution from traditional systems to modern BPM system designs. Conventional BPM systems, such as those used by Romanian industrial service companies, focus on optimizing processes and using technology to manage and streamline workflow [38]. These systems are primarily aimed at increasing efficiency and reducing costs. However, with the advancement of technology, the need for modern BPM system design has emerged [34]. Modern BPM systems have evolved to incorporate additional features and capabilities beyond traditional workflow management. These systems are designed to help organizations become more agile, flexible, and responsive to environmental changes. Technological advances and changes in entities' economic, social, and political environments have impacted BPM practices. Traditional BPM systems focus on process optimization and automation, whereas modern systems focus on digital transformation. Modern BPM systems aim to leverage the latest digital technology. These include Artificial Intelligence (AI), Robotic Process Automation (RPA), and Machine Learning (ML). These technologies enable entities to leverage their capabilities, drive innovation, enhance customer experiences, and streamline operations [39]. Hence, modern BPM systems are customer centric. They aim to create a seamless experience for customers and provide personalized services. Modern BPM systems are designed to facilitate customer interaction across multiple channels and provide a unified view of customer data.

The advent and ready availability of virtual resources change how a company looks at resourcing processes [40]. Modern BPM systems are cloud based and provide greater flexibility and scalability. These systems are designed to operate on a subscription-based model, and can be accessed anywhere and anytime. Hence, modern BPM systems are agile and adaptable, designed to respond to changes in the environment, and quickly adapt to new business requirements. These advancements affect how work is designed, the employee's role as a process is automated, and resources are virtualized. Therefore, BPM theory must expand beyond automation to include work design and virtual resources for architectural considerations. In addition, the BPM systems built according to these theories must be adapted to expand the approach. The study notes that many firms need help with the BPM because of the limited understanding of this system design [41]. Hence, they must still undertake BPM initiatives. It concludes that BPM is a term that describes the process-oriented philosophy in managing organizational activities as well as the business-IT functions of the organization.

Progress in modern BPM systems is used to improve the efficiency and reliability of processes, as virtual resources can

be used to simulate real-world scenarios. Modern BPM systems can also support work design, which involves designing and arranging work activities to optimize performance and efficiency [42]. These systems can also provide a centralized platform for process management and monitoring, allowing businesses to monitor and analyze the performance of their processes in real time. Such information can be used to identify areas for improvement and implement changes that can enhance process performance [25]. Moreover, modern BPM systems are designed to be seamlessly integrated with other systems and applications. This integration ensures that data are shared across the organization, leading to more informed decision-making. Hence, modern BPM systems have evolved from traditional process optimization and automation methods to digital transformation, customer-centric, cloud-based, agile, and integration. These systems are designed to give organizations the tools to become more agile, flexible, and responsive to environmental changes.

Generally, modern BPM systems improve process management to improve efficiency and performance, and remain competitive in today's fast-paced business environment [27]. Over the years, BPM systems have undergone significant development and improvement, leading to modern techniques designed to meet the current dynamic and rapidly changing business environment. Table 2 presents some recent studies on the development of BPM, focusing on virtualization and work design. This provides valuable insight into the impact of practical integration. Moreover, these studies support the need for further research for broad contributions to the development of BPM system design.

Modern BPM systems provide a holistic view of business processes. Thus, it enables area identification for improvements and changes to increase efficiency and reduce costs. Another essential aspect is their ability to automate business processes, reduce the need for manual intervention, and free employees to focus on more important tasks. Another critical feature of modern BPM systems is their ability to be integrated with other technologies. These technologies include customer relationship management (CRM) systems, ERP systems, and supply chain management (SCM) systems [23]. Integration allows organizations to manage their operations effectively (see Table 3). Thus, the risk of data silos was reduced. Simultaneously, the information shared between different departments in real time is enhanced with higher efficiency.

## 3) KEY STEPS IN ADOPTING BPM SYSTEM DESIGN

The adoption of BPM is a complex process that involves several key steps. The first step in BPM adoption is to identify the business processes that need improvement. It involves understanding the organization's goals and objectives as well as the methods that are currently in place. Organizations can use process-mapping tools to map their existing processes and identify areas for improvement. Once the organization has identified the techniques that need improvement, the

**TABLE 3. Technology with the capacity to integrate into BPM systems.**

Technology	Definition	Virtualization	Work Design
CRM Systems	CRM systems help businesses manage and analyze customer interactions and data throughout the customer lifecycle to improve customer relationships and business-customer interactions.	Virtual CRM systems allow businesses to centralize customer data and provide a single view of the customer across all departments and channels. Thus, it can improve data accuracy, increase collaboration, and reduce costs.	Work design in CRM systems involves creating processes and workflows that align with customer journeys and needs. Thus, it can help businesses to provide more personalized and efficient customer experiences.
ERP Systems	Enterprise resource planning systems are integrated software systems that help businesses manage and automate core business processes, such as financials, human resources, and supply chain management.	Virtual ERP systems can improve scalability, accessibility, and data management. Thus, this can increase efficiency and cost savings and improve data accuracy.	Work design in ERP systems involves creating processes and workflows that align with business goals and strategies. Hence, it can help businesses to streamline operations and reduce waste.
SCM Systems	Supply chain management systems help businesses manage the flow of goods, information, and financial transactions throughout the supply chain. It	Virtual SCM systems can improve the supply chain's visibility, collaboration, and efficiency. Thus, it can lead to increased customer satisfaction, reduced costs, and improved data accuracy.	Work design in SCM systems involves creating processes and workflows that align with supply chain goals and strategies. Hence, it

**TABLE 3. (Continued.) Technology with the capacity to integrate into BPM systems.**

	includes the processes of procurement, production, and distribution.		Hence, it can help businesses to streamline operations and reduce waste.
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next step is to define the process objectives [55]. Process objectives are specific, measurable, and achievable goals that an organization wants to achieve through BPM adoption. These objectives should be aligned with the organization's overall goals and objectives. The third step in BPM adoption is to design new processes to help the organization achieve its objectives. This entails identifying process improvements, streamlining processes, and eliminating redundant tasks. Process modelling tools can create new techniques and simulate their impact on organizations [38]. Once the new processes have been designed, the organization must implement them. It encompasses training employees on the latest procedures, updating existing systems, and integrating new functions into the organization's operations. Organizations may need to modify their operational structures to support new processes.

The fifth step in BPM adoption involves monitoring and measuring the performance of the new processes. It includes tracking key performance indicators (KPIs) such as cycle time, process defects, and customer satisfaction. Organizations can use dashboards and other monitoring tools to track KPIs and identify areas for improvement. The final step in BPM adoption is to analyze and optimize the new processes. It uses the data collected from the monitoring and measurement stages to identify areas for improvement and make changes to the new methods. Organizations can use process improvement tools to identify areas for optimization and implement process changes. Generally, BPM adoption is a complex process involving several key steps, including identifying business processes and defining process objectives. The process entails designing new strategies, implementing new procedures, monitoring and measuring performance, and analyzing and optimizing processes [55]. Consequently, organizations adopting BPM can achieve improved efficiency, increased agility, cost savings, enhanced customer satisfaction, and many other benefits. By following these key steps, organizations can successfully implement BPM and achieve operational excellence.

#### 4) APPLICATION OF BPM SYSTEM DESIGN ACROSS INDUSTRIES

BPM systems continue to evolve, incorporating new technologies, such as AI and ML. Consequently, BPM systems became more integrated with the ability to interact with

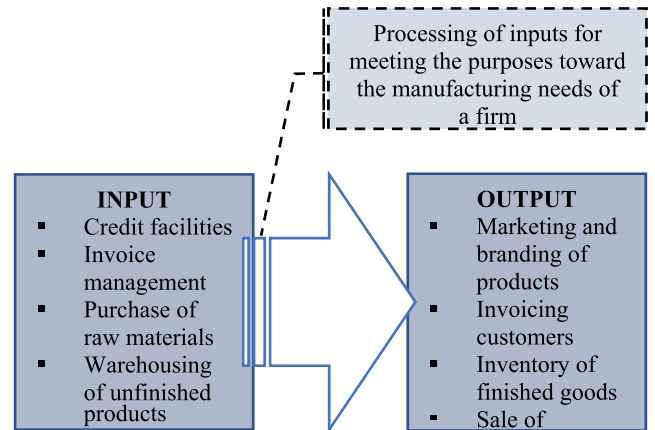
other methods, such as customer relationship management (CRM) and enterprise resource planning (ERP) systems [56]. This integration allowed organizations to streamline their operations and processes, reduce manual intervention, and improve efficiency. Currently, BPM systems are widely used across various industries, including manufacturing, finance, healthcare, and government. These systems have become critical components of organizations' operations, helping them manage complex processes, improve efficiency, and achieve operational excellence. BPM systems are also increasingly focusing on customer experience, with integrated features such as process analytics and customer feedback. The history and evolution of BPM system design across industries have been marked by steady technological advancements, increased integration with other systems, and a focus on improving customer experience [38]. Consequently, BPM systems have become essential to organizations' operations and processes, helping them achieve operational excellence and goals. As technology evolves, BPM systems are likely to play a key role in organizations' operations and processes for many years [55]. Although BPM system design has common principles, each industry's specific challenges and needs result in differences in creating BPM systems.

#### *a: APPLICATION OF BPM SYSTEM DESIGN IN THE MANUFACTURING INDUSTRY*

The use of the BPM system design in the manufacturing industry has evolved significantly over the past several decades [57]. In the early days of BPM systems, manufacturing organizations primarily focused on automating individual processes, such as order fulfilment and production schedules. These early BPM systems were limited in scope and functionality and were often implemented using manual methods and spreadsheets. However, the emergence of the Internet and an unprecedented surge in technological applications have revolutionized the industry. Consequently, BPM significantly impacts a company's supply chain management (SCM) by improving operational efficiency, positive productivity, and manageable costs [58]. One example of the impact of BPM on SCM is order fulfilment (see Figure 3). BPM systems automate the receiving, processing, and fulfilling of customer orders. As a result, it helps organizations reduce manual intervention, minimize errors, and improve order accuracy. BPM systems also provide real-time visibility into order-fulfilment processes, allowing organizations to identify and resolve any issues that may arise quickly.

#### *b: APPLICATION OF BPM SYSTEM DESIGN IN THE IT INDUSTRY*

The IT industry has come a long way since its inception as a disorganized emerging sector. Over the years, the industry has transformed into a modern integral part of the global economy through proper BPM practices [59]. BPM systems enable organizations to automate and streamline their operations and processes, reduce manual intervention, and improve efficiency. These systems also allow organizations to better



**FIGURE 3.** Common input and output processes of manufacturing.

manage their resources and optimize their processes, which helps improve competitiveness. As the IT industry continued to evolve, BPM systems became increasingly integrated with other systems such as CRM and ERP [56]. The IT industry is one of the most significant and integral parts of the global economy, contributing significantly to economic growth and employment. This transformation has been driven by the widespread adoption of BPM systems, allowing organizations to achieve operational excellence and goals. The significant ways in which BPM has been integrated into the industry include automating IT processes, streamlining workflows, enhancing communication, improving decision-making, enhancing compliance, improving customer satisfaction, and managing change. BPM solutions in the IT industry typically offer features such as process modelling and design, process execution, process monitoring and optimization, and process collaboration and communication [34]. These tools help organizations gain visibility into their processes, identify bottlenecks and inefficiencies, and make real-time improvements.

#### *c: APPLICATION OF BPM SYSTEM DESIGN IN THE MEDICAL INDUSTRY*

In this industry, BPM can be used to improve the efficiency, accuracy, and effectiveness of patient care and administrative processes [60]. The healthcare industry uses unique processes that require high precision, speed, and efficiency. Therefore, BPM principles are applied in the healthcare industry to improve patient care quality, reduce costs, and increase efficiency. Another way that BPM principles are involved in the medical sector is through clinical decision support systems (CDSSs) [61]. CDSSs use algorithms and data analysis to help healthcare providers make informed decisions regarding patient care. BPM principles help optimize these systems, ensuring that they provide relevant and accurate information in real time. As a result, it helps healthcare providers make informed decisions quickly and confidently, improving the quality of patient care in emergency cases, such as the COVID-19 pandemic [62]. The medical industry also applies BPM principles to enhance supply chain management. BPM

principles help optimize the flow of drugs and medical supplies from manufacturers to healthcare providers. As a result, it helps reduce waste, improve inventory management, and reduce healthcare costs. By using BPM principles to optimize the supply chain, the healthcare industry can ensure that patients have access to the medications and supplies they need when they need them. Hence, the healthcare industry can ensure that patients receive high-quality care, while reducing costs and improving efficiency [60].

BPM principles have led to significant innovation, which has improved practice in the industry. These steps include the following.

1. **Clinical Process Improvement:** BPM can streamline and standardize clinical processes such as patient diagnosis, treatment, and follow-up care. It helps to ensure that patients receive consistent, high-quality care and reduces the risk of errors and adverse events.
2. **Electronic Health Record (EHR) Management:** The BPM can optimize EHR systems commonly used in healthcare organizations to manage patient information. By automating and streamlining the process of collecting, storing, and retrieving patient data, BPM can improve healthcare delivery efficiency and accuracy. As a result, EHR ensure that healthcare providers have access to accurate and up-to-date information about their patients, thereby improving patient outcomes.
3. **Complaint Handling System:** A complaint handling system is essential for quality management and patient satisfaction in the medical industry [63]. A complaint handling system aims to allow patients, families, and healthcare providers to express their concerns and receive prompt and effective responses. BPM affects the effectiveness and efficiency of the usability of such a system. It enables complaint registration, assessment, resolution, feedback, and intervention success, monitoring, and evaluation.
4. **Supply Chain Management:** BPM can manage the supply chain of medical goods and services by procuring raw materials to deliver finished products to customers. This includes managing the flow of materials, information, and payments between suppliers, manufacturers, distributors, and healthcare providers.
5. **Patient Scheduling and Appointments:** BPM can automate and streamline scheduling patient appointments and managing waiting lists. This can help improve patient satisfaction, reduce wait times, and increase operational efficiency.
6. **Regulatory Compliance:** BPM can be used to ensure that healthcare organizations comply with various regulations, such as the HIPAA and the Affordable Care Act [64]. By automating and streamlining data privacy and security processes, the BPM can help reduce the risk of regulatory violations and protect patients' personal information.

#### *d: APPLICATION OF BPM SYSTEM DESIGN IN THE FINANCE INDUSTRY*

The financial industry is highly regulated and complex [59]. Therefore, efficient operational processes are required. BPM systems are designed to help organizations optimize their operations and improve their efficiency. In the finance industry, BPM systems can be designed to address a range of processes including loan processing, risk management, and compliance management [28]. Loan processing is a critical process that can benefit from BPM systems. A BPM system can be designed to automate the loan-processing workflow, reduce the need for manual intervention, and minimize the risk of errors [65]. This system can be designed to capture customer data, assess loan eligibility, and manage the loan approval process. It helps improve the speed and accuracy of loan processing and reduces the time required to complete loan applications. Risk management is another process that can benefit from the BPM system in the finance industry. BPM systems can be designed to monitor and manage risk, ensuring that the finance organization operates within acceptable risk parameters [28]. This includes monitoring market risk, credit risk, and operational risk. BPM systems can be designed to track and manage risk metrics, and alert risk managers when a potential risk event occurs. It helps reduce the risk of financial loss and ensures that the organization operates within regulatory compliance requirements.

Compliance management is another critical process that can benefit from the BPM system in the finance industry. BPM systems can be designed to automate compliance management, ensuring that the organization adheres to regulatory requirements [66]. This study noted that this includes monitoring and managing regulatory compliance, such as anti-money laundering (AML) regulations and the Foreign Account Tax Compliance Act (FATCA). BPM systems can be designed to capture and analyze data and alert compliance managers when a potential compliance issue arises. As a result, it helps reduce the risk of non-compliance and ensures that the organization operates within the law [66]. Moreover, automation of back-end processes enables accounts payable, accounts receivable, and payment processing. The BPM system design helps to streamline these processes by automating routine tasks, reducing errors, and improving the speed and accuracy of transactions [67]. As a result, it enables finance organizations to process transactions faster, reducing the time required to complete back-end processes and improving customer experience. Generally, the finance industry benefits significantly from the use of BPM systems. BPM systems can be designed to improve efficiency, reduce costs, and minimize the risk of errors. By automating key processes, BPM systems can help finance organizations operate more effectively and efficiently [1]. The study notes that areas with the opportunity to implement such automation include loan processing, risk management, and compliance management.

#### *e: APPLICATION OF BPM SYSTEM DESIGN IN THE RETAIL INDUSTRY*

The retail industry constantly changes, and retailers continuously seek ways to improve their operations and customer experiences. The BPM system design is one way to achieve this goal [68]. An example of the unique use of the BPM system design in the retail industry is the implementation of omni-channel retailing. Omni-channel retailing is a customer-focused approach that integrates all customer touchpoints, including online and offline channels [69]. The BPM system design helps optimize these channels, ensuring that customers have a seamless shopping experience, regardless of their medium. Consequently, it helps retailers improve customer satisfaction and increase sales. Another example of a unique application of the BPM system design in the retail industry is the implementation of predictive analytics [68]. Predictive analytics uses data analysis to predict future trends and customer behavior. Retailers use the BPM system design to optimize predictive analytics systems, ensuring that they provide relevant and accurate information to staff. This helps retailers make informed decisions about inventory management, marketing strategies, and customer engagement [70]. The BPM is also used to improve in-store operations. Retailers use the BPM system to automate cash management, inventory management, and customer service processes.

Walmart is a leading global chain store that leverages the BPM system design to optimize its supply chain processes [71]. The BPM system design helps Walmart manage the flow of goods from suppliers to stores, ensuring that products are available to customers when needed [72]. Walmart's use of the BPM system design has enabled the company to reduce waste, improve inventory management, and increase efficiency. Consequently, it has helped Walmart remain a market leader in the retail industry. Another pioneer in BPM system design in the retail industry is Amazon. Amazon uses a BPM system design to automate the order-fulfilment processes. The BPM system design helps Amazon to manage the flow of orders from customers to fulfilment centers, reducing the time required to complete orders and improving customer experience [72]. Amazon's use of the BPM system design has enabled the company to remain a market leader in the retail industry. Hence, they deliver products to customers quickly and efficiently [73]. The BPM system design helps to optimize these processes, reduce errors, and improve the speed and accuracy of transactions. Consequently, it allows retailers to reduce costs, improve customer satisfaction, and increase sales.

#### *f: APPLICATION OF BPM SYSTEM DESIGN BY THE GOVERNMENT*

The government faces unique challenges and needs that require innovative and tailored BPM system designs. For example, one unique way the government uses the BPM system design is by automating the procurement processes [74]. Procurement processes can be complex and time con-

suming. Such complexities can be solved using the BPM system design, which can streamline these processes, reduce errors, and improve the speed and accuracy of transactions. Consequently, it enables the government to purchase goods and services more efficiently, reduce costs, and improve the quality of public services. Another unique way in which the government uses the BPM system design is by implementing case management systems [75]. Case-management systems are designed to track and manage complex cases related to benefits, immigration, and criminal justice. The BPM system design helps optimize these systems, ensuring that they provide relevant and accurate information to citizens and staff. Consequently, it allows the government to improve case resolution times, reduce costs, and improve the quality of public services. This system helps governments to ensure that procurement processes are transparent, efficient, and compliant with government regulations [74]. By using the BPM system design, governments can reduce the risk of fraud and corruption, improve the quality of public procurement, and reduce the costs of public goods and services [66].

By using the BPM system design, the government can improve efficiency, reduce costs, and improve the quality of public services [76]. In addition, the government uniquely uses the BPM system design to enhance the quality of its public delivery foundation and framework. The BPM system design manages public health programs, public works projects, and general procurement processes. Governments can use BPM system design to enhance the efficiency, transparency, and compliance of public services [66]. This improves public health outcomes, the delivery of public works projects, and the quality of public procurement.

#### 5) GLOBAL ATTITUDES TOWARD BPM SYSTEM DESIGN

Although BPM system design has gained widespread acceptance globally, there are varying attitudes toward its implementation and use [77]. The first attitude toward the BPM system design is that it is necessary for organizational success. BPM systems enable businesses to streamline processes, reduce errors, and increase their productivity [78]. BPM systems are widely embraced in countries such as the United States with a strong focus on productivity and efficiency. Entities can perceive BPM as a way to reduce costs and improve their operational efficiency [57]. The use of BPM systems is prevalent in industries, such as healthcare, finance, and manufacturing. Another attitude toward the BPM system design is that it is a tool for driving innovation [79]. BPM systems enable organizations to automate processes and focus on more innovative tasks. Attitudes are particularly prevalent in countries with a strong focus on technology and innovation. These countries see the BPM systems as a way to improve their global competitiveness.

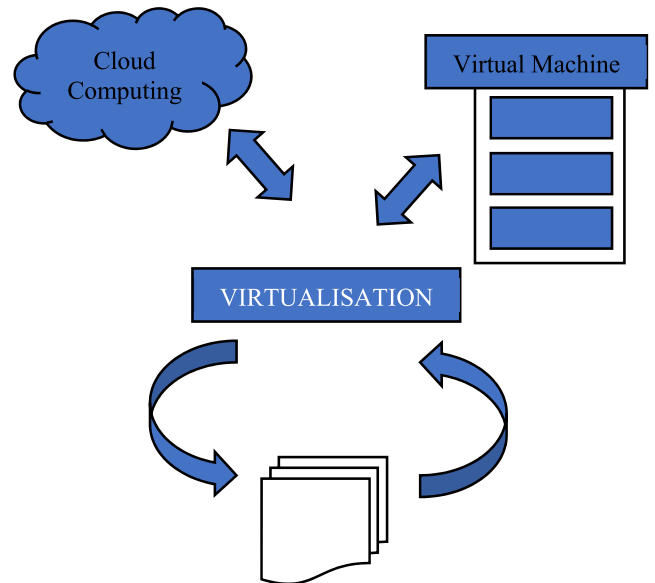
The third attitude toward the BPM system design is that it is a tool for compliance [63]. BPM systems are considered a way to ensure regulatory compliance. Organizations observe regulations by BPM systems, enabling them to comply with

legal requirements, while improving operational efficiency [57]. This attitude is particularly prevalent in banking, insurance, and healthcare industries. Another attitude toward the BPM system design is that it is a tool for customer experience [78]. BPM systems are seen as a way to improve customer experience, as entities enhance their focus on customer service. These systems enable organizations to provide more efficient and personalized services. This attitude is particularly prevalent in retail and hospitality industries. Generally, while there are varying attitudes toward the BPM system design, it is widely accepted as a critical tool for organizational success [36]. BPM systems are essential for businesses to compete in global markets. It is necessary to improve operational efficiency, drive innovation, ensure regulatory compliance, and enhance customer experience. As such, organizations must embrace BPM system design as a critical component of their digital transformation strategy [4].

### B. CONCEPT OF VIRTUALISATION

Virtualization refers to the creation of a virtual version of a physical device or resource, such as a computer, network, or storage. Several pioneers, such as IBM, VMware, and Microsoft, have broadly expanded this innovation. These companies first introduced the concept of virtualization in the 1960s [80]. IBM developed the first virtualization software in the late 1960s: mainframe computers. Another critical innovation was VMware, which revolutionized the industry in the late 1990s with its x86 virtualization technology [81]. The study notes that Microsoft followed suit with its Hyper-V virtualization technology in 2008. It also notes that the history of virtualization has seen several advancements, with the development of virtual machine technology in the late 1990s being a key milestone. The adoption of virtualization in business drives the efficiency and flexibility of IT systems and reduces costs. Companies have widely adopted virtualization technology for several reasons. First, virtualization allows entities to manage and automate their IT systems more efficiently and flexibly, reducing downtime and improving response time [82]. In addition, such capabilities reduce costs by enabling firms to run multiple virtual machines on a single physical server, thereby reducing the need for multiple physical servers [83]. Finally, virtual machines can be isolated from the underlying physical infrastructure to enhance security and privacy (Figure 4).

Over time, virtualization technology has advanced, allowing organizations to create virtual versions of a broader range of resources and use them innovatively. In addition, it has led to the development of related concepts, such as cloud computing and containerization. Cloud computing has enabled virtualization technology to create virtualized computing resources that can be delivered over the internet [84]. For containerization, virtualization technology has been allowed to create isolated settings for applications and services, improving efficiency and flexibility. Critical technologies in virtualization include [85] the following.



**FIGURE 4.** Illustration of virtualization by files interacting with cloud computing and virtual machine for storage purposes.

1. Hypervisor: This is the core technology behind virtualization. The hypervisor, a virtual machine monitor, creates virtual machines and manages their interactions with underlying physical hardware.
2. Virtual Machine (VM): A virtual machine is a software-based version of a computer that functions as a physical machine. VMs allow multiple operating systems to run on a single physical device, making it possible to run various applications and procedures simultaneously.
3. Network virtualization: This technology creates virtualized networks that allow multiple virtual machines to share the same physical network infrastructure. It reduces hardware costs, increases scalability, and improves the network performance.
4. Storage virtualization: This technology abstracts physical storage devices into a pool of virtual storage devices, making it possible to allocate and manage storage resources dynamically. It enables organizations to optimize storage utilization and improve data protection and availability.
5. Management Tools: Organizations require specialized management tools to manage and monitor virtualized systems and applications. These tools provide a single control point for managing the virtual infrastructure, including provisioning, monitoring, and reporting.

#### 1) DEVELOPMENT OF VIRTUALISATION

Virtualization has played a significant role in the development of modern BPM systems. Innovation has existed for many years, but its use in BPM systems is relatively recent [86]. This study notes that it has become an essential IT infrastructure component and has transformed how businesses operate

and manage their systems. Virtualization allows businesses to create a virtual environment in which multiple operating systems can run on a single physical device [85]. It provides a more flexible, scalable, and cost-effective approach for managing IT resources than traditional computing models. The introduction of virtualization in BPM systems has been driven by the need for organizations to improve their business processes [86]. Hence, they can remain competitive in an increasingly challenging business environment. Thus, it has played a significant role in developing modern BPM systems, providing organizations with a powerful tool for improving the efficiency and reliability of their business processes. With the continued growth of virtualization technology, its use in BPM systems is likely to continue growing [11]. Creating virtual environments for process execution has several benefits. This allows the simulation of real-world scenarios and testing process designs before implementation [83]. Thus, it increases the efficiency and reliability of the assessment process at reduced costs associated with the testing and implementation tasks.

Many business functions are outsourced as it becomes more common to integrate remote staff into core work functions. The step of bringing geographically distributed groups of workers together for collaboration through technology-mediated communication is called a global virtual team [77]. These Global Virtual Teams have unique needs in terms of employee engagement and work design. Another study found that virtual teams performed less effectively than face-to-face teams when performing complex tasks [87]. In these tests, work design was not considered a factor. Several studies have investigated the impact of BPM and workflow automation [88]. Their preliminary results from an investigation into 16 business processes from six different organizations showed several improvements. They asserted that business process improvement is measured in terms of lead time, service time, wait time, and resource utilization. Based on preliminary results, they predicted that significant improvements in these parameters would be expected for almost all the investigated business processes. However, this study did not include virtual resources or explore the impact of BPM activities on work design. Simulations proved to be a valuable way to validate the initial measurements. However, it cannot consider technological advances over time or their impact on staff roles and work design. The key components of virtualization are discussed in the following section.

#### *a: HYPERVISOR*

A hypervisor, which is a virtual machine monitor, is a software layer that enables multiple virtual instances of operating systems [81]. It enhances applications and other computing resources for running on a single physical machine. The hypervisor allocates and utilizes resources, such as CPU, memory, and storage. This ensured that each virtual machine was isolated from the others. The hypervisor is a critical component of virtualization technology that enables the efficient

and secure utilization of physical resources and provides a virtualized environment for multiple virtual machines. There are two types of hypervisors: types 1 and 2. Type 1 hypervisors run directly on the hardware of the host machine and are known as bare-metal hypervisors [81]. They provide high performance and efficiency and are tightly integrated with the underlying hardware. Type 1 hypervisors are often used in enterprise datacenters and cloud computing environments. Type 2 hypervisors run on top of a host operating system and are known as hosted hypervisors [81]. They are less efficient than type 1 hypervisors because they rely on the host operating system for hardware access. Type 2 hypervisors are often used in desktop virtualization and testing environments.

#### *b: VIRTUAL MACHINES*

A virtual machine (VM) is a software emulation of a physical device that runs an operating system and applications [89]. Virtual machines are created and managed by a hypervisor, which is a key component of virtualization technology. Hence, the hypervisor allocates physical resources such as the CPU, memory, and storage from the underlying hardware and creates a virtual environment for the virtual machine [81]. The virtual machine is installed with an operating system and applications similar to a physical machine. They are widely used in enterprise data centers, cloud computing, and other environments. Virtual machines provide several benefits, including

1. Isolation: Each virtual machine is isolated from other devices and underlying hardware, providing a secure environment for running applications.
2. Resource utilization: Multiple virtual machines can run on a single physical machine, allowing for the efficient utilization of resources such as CPU, memory, and storage.
3. Flexibility: Virtual machines can be created, deleted, and moved between physical devices quickly, providing flexibility in managing computing resources.
4. Testing and development: Virtual machines can be used for this purpose by allowing developers to test applications in different operating system environments without requiring physical hardware.

#### *c: VIRTUAL DISKS*

Virtual disks are a vital component of virtualization technology that allow virtual machines to access storage resources in a virtualized environment [89]. A virtual disk is a file stored on a physical disk that acts as a virtual hard drive for a virtual machine. It can be created by a hypervisor or operating system running on a virtual machine [83]. The hypervisor manages virtual disks and can be configured to have different sizes and storage types. They can be stored in different types of storage media, including local disks, network-attached storage, and storage area networks. Virtual disks are a crucial component of virtualization technology that provide a flexible and efficient way to manage storage

resources in a virtualized environment [90]. The study noted that they are widely used in enterprise datacenters, cloud computing, and other settings. Virtual disks provide several benefits, including:

1. Flexibility: Virtual disks can be easily created, revised, and moved between physical storage devices, thus providing flexibility in managing storage resources.
2. Isolation: Each virtual machine has a virtual disk that provides isolation from other virtual machines and the underlying hardware.
3. Performance: Virtual disks can be optimized by configuring parameters such as block size, caching, and access patterns.
4. Snapshots: Virtual disks can be used to create images that are point-in-time copies of the disk. This allows administrators to easily roll back to the previous state of the virtual machine.

#### d: VIRTUAL NETWORK

A virtual network is a crucial component of virtualization technology that enables virtual machines to communicate with one another [91]. In addition, these resources can communicate with different physical and virtual machines in a virtualized environment. In a virtual network, virtual machines are connected to virtual switches managed by a hypervisor. The virtual switches are then connected to physical switches and routers, allowing the virtual machines to communicate with other devices on the network [80]. Virtual networks are a vital component of virtualization technology that provide a flexible and efficient way to manage network resources in a virtualized environment. Consequently, they are widely used in enterprise data centers, cloud computing, and other computing environments [92]. Virtual networks provide several benefits, including:

1. Isolation: Each virtual network is isolated from other virtual and physical networks, thereby providing a secure environment for virtual machines to communicate.
2. Flexibility: Virtual networks can be easily created, resized, and configured, providing flexibility in managing network resources.
3. Scalability: Virtual networks can be scaled up or down to meet the changing needs of a virtual environment.
4. Performance: Virtual networks can be optimized by configuring parameters such as bandwidth, latency, and quality of service.

#### e: MANAGEMENT TOOLS

Management tools are essential virtualization technologies [93]. This enables administrators to manage and monitor virtual machines, networks, and other features. Management tools are critical for virtualization. Administrators can efficiently monitor virtualized environments [22]. As a result, they are widely used in enterprise data centers, cloud computing,

and other computing environments. Management tools provide a wide range of features and capabilities, including:

1. Virtual machine management: Management tools enable administrators to create, configure, and manage virtual machines, including provisioning virtual disks, configuring virtual networks, and managing virtual machine templates.
2. Performance monitoring: Management tools enable administrators to monitor the performance of virtual machines, virtual networks, and other virtualization components, including metrics such as CPU and memory usage, disk I/O, and network bandwidth.
3. Resource allocation: Management tools enable administrators to allocate resources to virtual machines and other virtualization components, including setting CPU and memory reservations and limits.
4. Automation: Management tools enable administrators to automate daily tasks such as deploying virtual machines, configuring virtual networks, and managing virtual machine backups.
5. Reporting and analysis: Management tools enable administrators to generate reports and analyze virtualization performance, usage, and trends.

#### 2) MODERN VIRTUAL RESOURCES

Modern corporate environments are more data-driven than ever. The availability of digital resources has resulted in a nearly limitless supply of processing power that can be made available within short timeframes. Studies have investigated the impact of virtual resources on workflow scheduling applications [94]. This study examines the commercial application of running business-IT functions in virtual environments compared to traditional ones. Organizations' return on investment is considered when investing in BPM [74]. These commercial considerations have a direct effect on adoption. Aspects such as following proper guidelines and optimizing workflow design in business operations impact the efficiency of systems. When followed, these aspects result in an efficient, meaningful, and logical workflow [35]. After investigating the opportunities for automation in real-world scenarios, it was established that data processing is a common element that affects the reliability of a workflow system [53]. Owing to computer processing power for business operations, automation for a modern organization is more data-oriented than when it is more physical.

Virtual resources provide a unique opportunity for trigger-based automation. The same triggers commonly used in BPM workflows can trigger changes in a virtual environment [11]. A helpful link between workflow triggers, a key component of BPM systems, and virtual resources exists, but does not form part of this research. The virtual resources are not limited to computer processing [11]. This study established that offsite and offshore labor forces are becoming increasingly available to businesses to perform specific tasks. Another study investigated the commercial impact of BPM,



focusing on the automation of business processes and relocation of business processes to low-wage countries [95]. This study examined cost reduction and productivity differences between locations. They found that automation and sourcing opportunities are usually evaluated independently, which can result in suboptimal commercial returns. These findings show that the interdependencies between automation and sourcing need to be adequately considered and present a decision model to support these considerations. Thus, the availability of virtual resources is changing how people and organizations think about BPM and automation.

Researchers conducted a longitudinal study that moved beyond the simulations by assessing work processes over time [22]. The results showed that only 50% of the organizations successfully implemented a workflow management system for at least one of the business processes they had targeted. In addition, the successfully implemented processes indicated significant productivity improvement, showing the assurance of benefits from workflow automation through BPM. The impact of work design should have been considered, but the critical success factors of implementing support management and cultural changes are discussed. However, this study lacks quantitative evaluations based on empirical and experimental research. The initial process executions result in a higher effort than the subsequent process changes. In addition, the impact of domain knowledge on implementation efforts was significant, supporting the notion that work design is substantial [96]. This study asserted that more experimental research is needed to investigate the impact of virtualization.

### 3) KEY STEPS IN ADOPTING VIRTUALIZATION

Virtualization adoption involves several key steps that must be followed to ensure successful implementation. The first step in virtualization adoption is to assess the organization's needs. This includes evaluating the current IT infrastructure, identifying improvement areas, and determining the benefits of virtualization [97]. Organizations must also consider the cost of virtualization adoption and whether they align with their overall goals and objectives [10]. The second step in virtualization adoption is to determine a virtualization strategy. It entails deciding which type of virtualization is most suitable for the organization, whether server virtualization, desktop virtualization, or application virtualization [91]. Organizations must consider the infrastructure required to support the virtualization solution and the technical expertise required. The third step in virtualization adoption is implementation planning. This involves creating a detailed project plan outlining the steps to implement the virtualization solution [40]. The project plan should also include a timeline, budget, and list of resources required. Involving all stakeholders in the planning process is essential to ensure buy-in and support [98].

The fourth step in virtualization adoption is to deploy a virtualization solution. Installing the necessary software

and hardware and configuring the virtualization environment entail the installation of essential software and hardware [92]. Organizations must also consider security and backup solutions to protect their virtual environments [99]. The fifth step in virtualization adoption is to train staff. This includes training IT staff on the virtualization solution and its operation [11]. The study established that ensuring that staff members have the necessary skills to operate and maintain a virtualization environment is essential. The final step in virtualization adoption is to monitor and manage the performance. It involves tracking KPIs, such as system availability, user experience, and resource utilization [38]. Organizations can use monitoring tools and dashboards to track KPIs and identify areas for improvement. Virtualization is a complex process involving several key steps [100]. These steps include assessing organizational needs, determining a virtualization strategy, planning implementation, deploying the virtualization solution, training staff, and monitoring and managing performance. Consequently, organizations that adopt virtualization can achieve improved efficiency, increased agility, cost savings, enhanced security, and many other benefits [97]. Hence, organizations can successfully implement virtualization and transform their IT infrastructure.

### 4) ADOPTION OF VIRTUALIZATION ACROSS INDUSTRIES

The adoption of virtualization across industries has been widespread and varied in recent years. The pioneering industries using this technology are IT companies. Virtualization has been widely adopted by the IT industry to improve efficiency, reduce costs, and increase agility. This has enabled companies to run multiple virtual machines on a single physical server, thereby reducing the need for physical hardware and increasing the utilization of existing resources. In the data management age and the need to scale storage systems and security, other industries such as medicine, finance, retail, education, and the government are adopting it [24].

#### *a: ADOPTION OF VIRTUALIZATION IN THE IT INDUSTRY*

Virtualization in the information technology (IT) industry has a rich history. It has significantly impacted how organizations operate and manage their IT resources. The concept of virtualization can be traced back to the 1960s when the idea of time sharing was introduced [59]. However, until the late 1990s and the early 2000s, virtualization began to gain widespread traction as a technology for managing IT resources. The adoption of virtualization was driven by the need to use hardware resources better, reduce costs, and increase the agility of IT systems. Virtualization has evolved and improved in recent years. Today, it is widely recognized as a critical technology in modern data centers. Most companies have adopted virtualization technology, with virtual machines (VMs) being the most commonly used [81]. Virtualization has enabled organizations to run multiple virtual machines on a single physical server, reducing the need for physical hardware and increasing the utilization of existing resources. It has also

facilitated the creation of new and innovative IT solutions such as cloud computing, transforming how organizations manage and deliver IT services [101]. In terms of impact, virtualization has enabled organizations to increase efficiency, reduce costs, improve security, and increase the availability of IT services. It has also allowed organizations to respond more quickly to changing business requirements, reduce downtime, and improve business continuity.

#### *b: ADOPTION OF VIRTUALIZATION IN THE MEDICAL INDUSTRY*

Research on the adoption of virtualization in the medical industry has shown that virtual consultation and telemedicine are becoming more common. Progress is enabling patients to receive medical advice and treatment from the comfort of their homes. It has improved access to care and reduced travel, thus saving time and money for patients and healthcare providers [56]. Patients can receive medical advice from their own homes, reducing the need for travel and making healthcare more accessible. As convenience from this trend increases, it is gradually becoming easier for physicians and patients to make workable schedules with the lowest cost of travel and related expenses.

In Nigeria, patients can efficiently and safely access healthcare needs by digitizing medical services. In addition, technology has improved healthcare delivery efficiency with less need for administrative tasks and walk-in [102]. Additionally, better health outcomes have significantly increased, as patients can receive medical advice and treatment more quickly and efficiently. Further research is needed to ensure that virtualization is safe and responsible for the continuous use and protection of private data. Nevertheless, the benefits of virtualization in the medical industry have been widely recognized, and its use is expected to continue to grow in the coming years. Its adoption in the industry has positively impacted patient care and medical education while reducing costs and improving efficiency.

#### *c: ADOPTION OF VIRTUALIZATION IN THE FINANCE INDUSTRY*

Virtualization has played a significant role in revolutionizing the finance industry in recent years. Its adoption in finance began in the early 2000s and quickly became an essential tool for many financial organizations [103]. Some early pioneers of virtualization in the finance industry were Citigroup, JPMorgan Chase, and the Bank of America. These financial companies saw the potential for virtualization to improve service delivery [37]. Thus, by developing reliable IT infrastructure that creates value for customers, companies could serve customers while reducing the costs associated with credit or account statement preparation paperwork. The research noted that service innovations were significantly impacted by virtualization capabilities. With virtualization, financial organizations have reduced IT infrastructure costs and improved their applications' efficiency and performance.

Virtualization has also allowed organizations to respond quickly and efficiently to changes in their business environment. As a result, businesses can rapidly deploy new applications and services or scale back their IT infrastructure, as needed. Therefore, the virtual desktop infrastructure (VDI) is a critical example of virtualization technology in the finance industry [89]. The study noted that VDI allows financial organizations to provide their employees access to their desktop environment from any device, anywhere, at any time. Consequently, it has made it possible for employees to be more productive and efficient, as they no longer need to be tied to a physical desktop or location.

Server virtualization is another example of virtualization in the finance industry. Server virtualization allows financial organizations to run multiple virtual servers on a single physical server, thereby reducing the hardware needed and costs [97]. This has been imperative in the finance industry, where many organizations have increased their data center efficiency by up to 15% [104]. In addition, the study noted that the technology infrastructure could be optimized to consume less energy through better optimization of algorithms targeted to function with less power demand. Over the years, several visionaries have played a vital role in adopting and impacting virtualization in the finance industry. One such visionary is Simon Crosby, a co-founder and the former CTO of XenSource [105]. Crosby was one of the early pioneers of virtualization and was instrumental in helping financial organizations understand the potential benefits of virtualization. Another visionary in the finance industry is the VMware CEO Pat Gelsinger. Another study noted that Gelsinger was instrumental in bringing virtualization to the mainstream [106]. Moreover, he helped establish VMware as one of the leading virtualization companies in the world. He has continued to drive the company forward, and his vision has helped shape the future of virtualization in the finance industry.

#### *d: ADOPTION OF VIRTUALIZATION IN THE RETAIL INDUSTRY*

Virtualization has significantly impacted the retail industry, transforming how retailers operate and interact with customers. Adopting virtualization technology in the industry has made retailers seek new ways to improve their operations and enhance their customer experience. Cloud computing is a critical example of the virtualization technology used in the retail sector [107]. The study noted that cloud computing allows retailers to move their IT infrastructure and applications to virtual environments. Thus, they can be accessed and managed anywhere in the environment. Consequently, it has allowed retailers to reduce their IT costs and improve the scalability and reliability of their applications. Another example of virtualization technology in retail is virtual reality (VR) and augmented reality (AR). VR and AR have revolutionized how retailers interact with customers, allowing them to provide immersive experiences and enhance their shopping experiences [108]. Retailers can use VR and AR to showcase products, demonstrate product features and benefits, and create interactive experiences to engage and excite customers.

Over the years, several visionaries have played a vital role in the adoption and impact of virtualization in the retail industry. One such visionary was Jeff Bezos, the founder and CEO of Amazon. Bezos was an early pioneer of e-commerce after leading the bookselling sector into the digital marketplace [109]. The study noted that Bezos was instrumental in transforming the retail industry through his vision and leadership. Satya Nadella, Microsoft's CEO, is another visionary in the retail sector. Nadella is a critical driver of Microsoft's cloud-computing strategy [90]. His vision has helped bring technology to the forefront of the retail industry. He also strongly advocated using VR and AR in retail. In addition, Nadella has worked to make these technologies accessible and affordable to retailers of all sizes. Virtualization has profoundly impacted the retail industry and continues to play a critical role in shaping its future. This technology has allowed retailers to improve their operations and enhance their customer experiences. Moreover, it has paved the way for innovations and advancements in the future.

#### *e: ADOPTION OF VIRTUALIZATION IN THE EDUCATION INDUSTRY*

Virtualization in the education industry can provide numerous benefits for scaling and improving the quality of language education. Access to technology has improved as virtualization has enabled students to access technology and resources that may not be available in traditional classroom settings [110]. It can help improve the quality of language education and support students in achieving their language-learning goals. Flexibility has become an integral benefit of virtualizing education. It allows students to access language courses anywhere and anytime, thus providing greater flexibility and convenience [40]. This can help to increase student engagement and improve learning outcomes. Flexibility is another benefit of cost effectiveness. Eliminating the need for physical classrooms and other infrastructure has reduced the costs of language education. This can help make language education more accessible and affordable for a broader range of students. In addition, the scalability level in this transformation of traditional education has enabled educators to reach a much larger audience regardless of geographic location.

The language bias problem is solved by innovating language-translating AI and having translators that safeguard the quality standard of the deployed education content. This process has enabled educational needs to be met from a growing demand [111]. This study shows that using AI improves interactive systems, indicating reliable access to language education for students worldwide. Furthermore, this capability has enabled language educators to customize language courses to meet students' specific needs and learning styles. This improves the effectiveness of digital education by ensuring that students receive the support they need to succeed. Collaboration is another benefit of virtualization in the industry [11]. This has enabled students to collaborate and interact with each other and language educators in real

time, regardless of geographic location. It can help build communities and foster a sense of belonging among students, thereby improving their motivation and engagement. Virtualization can potentially transform the educational industry and enhance the quality of language education. Such progress can be achieved by providing greater flexibility, affordability, scalability, customization, and collaboration.

#### *f: ADOPTION OF VIRTUALIZATION BY THE GOVERNMENT*

Virtualization has had a significant impact on the way governments operate, transforming the way they provide services to citizens and managing their operations. The adoption of virtualization technology by the government began in the early 2000s [74]. Governments have sought new ways to improve their operations and enhance the delivery of public services. Cloud computing is a critical example of virtualization technology in use by the government. This study established that cloud computing capacity could allow governments to move their IT infrastructure and applications to a cloud-based environment. They can be accessed and managed anywhere and at any time. This has allowed governments to reduce their IT costs, improve the scalability and reliability of their applications, and better serve the needs of citizens. Another example of virtualization technology from this study is the government's use of virtual resources for online meetings and teleconferencing. Virtual conferences and teleconferencing have allowed governments to collaborate and communicate more effectively without the need for travel.

Virtual meetings and teleconferencing have made these technologies accessible and affordable for governments of all sizes. Virtual meetings and teleconferencing are critical to global cooperation [112]. The infrastructure has led continental intergovernmental bodies, such as the African Union (AU), to reform their diplomacy. The study noted that while virtual conferencing has brought challenges to cooperation among countries, it is an opportunity to reassess the founding of the AU to reimagine its continental diplomacy. These virtual technologies have allowed intergovernmental organizations to connect worldwide without travelling. Thus, it reduced travel costs and made it easier for officials to work together to achieve their goals. For example, the United Nations (UN) and its umbrella agencies, bodies, and related committees have had to adapt to the realities of the COVID-19 pandemic through videoconferencing [113]. The study noted that the advancement of diplomatic relations among nations during intergovernmental meetings was achieved using virtual conferences and teleconferencing. Thus, it has ensured improved communication and collaboration between member countries. In addition, it has allowed for more effective addresses of regional issues to promote cooperation. Similarly, the European Union (EU) has been using virtual meetings and teleconferencing to improve communication and collaboration among its member countries and promote regional integration [114]. Hence, this method has improved communication and collaboration between various

departments and field offices. Moreover, its organs and governmental and nongovernmental partners have increasingly become capable of leading and cooperating more effectively when responding to humanitarian crises.

##### 5) GLOBAL ATTITUDES TOWARD VIRTUALIZATION

Global attitudes toward virtual resources vary depending on country, cultural background, and individual experiences. In general, there is growing recognition of the importance and convenience of virtual resources. Increasing awareness of virtualization resources and their potential downsides and risks. In developed countries, access to technology and the Internet has led to widespread use of virtual resources for education, work, communication, and entertainment [91]. This study established that virtual resources are essential tools for modern life in these countries. In less developed countries, access to technology may be limited. However, there is still growing recognition of the potential of virtual resources to improve access to information, education, and economic opportunities. The growth of decentralized finance (Defi) as a disruptive financial technology has recently soared owing to the widespread use of cryptocurrencies in the global digital economy. Defi technology has led to the rise of virtualization in developing and less-developed nations [115]. It is easier and quicker to conduct transactions using these technologies. Consequently, attitudes toward virtual resources have become a topic of interest for many researchers [116].

Studies have found that virtual resources, such as social media, significantly influence people's attitudes. A survey by the Pew Research Centre found that most adults in the United States primarily use technology as a news source for major health issues. Many people have used the Internet to assess how leaders have reacted to the COVID-19 pandemic [117]. A vital point of interest during the pandemic was the use of internet access by nurses for entertainment, news, and personal and professional development [118]. The use of virtual resources shows similar trends in favorability across Europe. A European Commission (EU) study found that most Europeans rely on the internet for valuable scientific information [119]. This study found that digital resources can be used to inform people regarding scientific data and related insights. Such utility of virtual resources is realizable by proper and comprehensive adaptation of virtualization. As people find the Internet to be filled with various resources, according to the study, the ability to compete and trustworthy resources can foster reliable research [50].

Another study found that people were more likely to trust virtual resources from established sources [120]. These include well-known websites and significant technological companies. An online study of 357 social media users, especially Facebook, showed positive attitudes toward virtual news resources. People recognize the benefits of trusted sources in their development. However, misinformation is prevalent because of concerns regarding the adverse effects of exploiting virtual news resources to spread misinformation

[121]. In addition, these attitudes are likely to continue to evolve as technology and the use of virtual resources continue to change. In addition, regardless of location, concerns about privacy, security, and the potential for addiction and negative impacts on mental health are increasingly being raised regarding virtual resources. Thus, global attitudes toward virtual resources are complex and nuanced, reflecting the benefits and challenges of this rapidly evolving technological area.

##### C. CONCEPT OF WORK DESIGN

The theory of work design is evolving and could be a good fit for some gaps in the BPM literature. Another study investigated the evolution of work design, contesting the belief that work design applications are limited to the manufacturing industry. Instead, they note that a global shift from manufacturing economies to service and knowledge economies has dramatically altered the nature of work in organizations [122]. This study proposes that work design theory and research are changing and shows two emerging viewpoints on work design: relational and proactive perspectives. Relational perspectives assert that increased interactions between co-workers and service recipients impact how jobs, roles, and tasks become more socially embedded. Comparatively, theoretical perspectives identify the importance of employees taking the initiative to predict and change how work is performed based on increasing market volatility and dynamism. These two concepts complement the BPM concepts, such as rule-based workflow automation.

Work design is a consequence of process-improvement practices related to manufacturing [123]. Work design is critical for process improvement in the manufacturing industry. It involves designing and implementing workflows and processes that align with the business goals and strategies. In manufacturing, work design results from process improvement practices that streamline operations, reduce waste, and improve the efficiency and quality. The focus on process improvement in manufacturing is driven by the need to remain competitive in ever-evolving markets. Manufacturers constantly seek ways to reduce costs, improve product quality, and increase productivity. Work design plays a crucial role in achieving these goals, as it helps ensure that processes are optimized to meet the specific needs and requirements of the manufacturing environment. To achieve effective work design in manufacturing, it is essential to consider various factors, such as equipment and technology availability, human resources, and environmental impact. Process improvement practices in manufacturing often involve the adoption of new technologies, such as automation and robotics, which can significantly affect work design. These technologies can improve the speed and efficiency of the processes. However, they require careful consideration and integration into the existing workflows and processes.

Another study discussed BPM theory and attempted to identify critical success factors in BPM projects [124]. This study proposes a framework for identifying these factors

and measuring their impact, as this determines BPM failure. They also provide a method for identifying and measuring an organization's BPM maturity, positing that this directly impacts the identified success factors. As they apply to BPM, the common theme among these three theories is the need for continual change. Organizations must change and adapt to new business practices, market conditions, technological advances, and the results of BPM program implementation. Critical success factors include transitioning from generalist workers to high specialization, appointment of process owners, and training and empowerment of employees. These factors represent work design elements that must be redesigned for the successful implementation of business process automation. The study does not investigate the use of virtual resources but cites leveraging innovation and best practices as a critical success factor. This strongly indicates that further research on work design and virtual resources would be beneficial.

The work design theory can be expanded to include knowledge management [125]. Hence, they are more relevant to modern business environments. Their study challenges the traditional view that employees passively perform their assigned tasks. Instead, they investigate the types of proactive behaviors of individual employees at work and explore the impact of greater participation of employees in BPM and knowledge management processes. It builds on the finding of [122] a proactive perspective. While further research and expansion of work design theory are needed, this study clearly shows the link between work design and efficiency.

## 1) FOUNDATIONS OF WORK DESIGN

Work design has been widely discussed and researched in the business and management fields. It refers to the planning, creation, and execution of tasks and activities essential for organizational operations and maintenance. It is a systematic approach for designing and optimizing work systems that includes the design of work tasks, processes, and systems integrated with organizational goals and objectives (see Figure 5). Traditional work design has evolved from Taylorist work design principles, which focus on efficiently using resources to maximize output and minimize costs [126]. In conventional work design, work is viewed as a series of tasks that can be broken down into smaller components and analyzed to determine the most efficient way to perform them. This approach led to the creation of standardized work procedures, defined roles and responsibilities, and machine-like operations to increase efficiency and productivity. However, the focus was on efficiency and productivity rather than on the satisfaction and well-being of workers.

The foundation of work design is to understand the coordination, performance, and relationships between tasks and activities in order to achieve goals. Work design aims to create an effective and efficient process that meets the needs of an organization and its stakeholders [8]. Workplace design has a long history in industrial and organizational psychol-

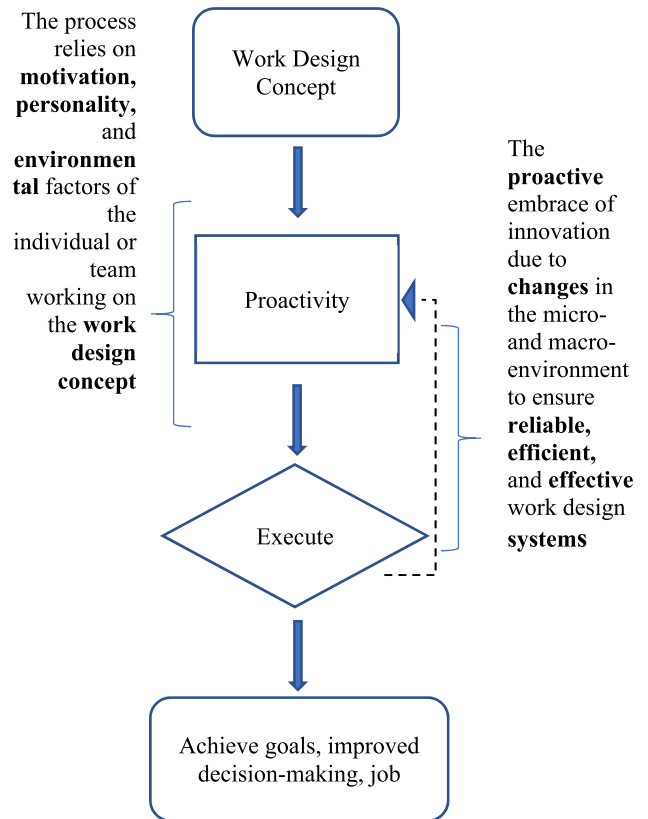


FIGURE 5. Illustration of proactive perceptiveness in work design.

ogy. In the early 20th century, researchers and practitioners focused on standardizing and optimizing work processes using mathematical models and time and motion studies to improve efficiency [127]. This work has led to the development of scientific management, a method of work design that focuses on the best ways to perform specific tasks. Over time, the focus of work design has shifted toward understanding the social and psychological aspects of work. Researchers have studied the impact of work design on employee satisfaction, motivation, and well-being and how these factors can affect the performance and success of an organization. This shift in focus led to the development of a human-centered approach to work design, which emphasized the importance of involving employees in the work design process and considering their needs and preferences.

Traditionally, work design has focused on creating jobs and systems to improve work efficiency and effectiveness. However, in the age of technology, work design has expanded to encompass the use of technology to optimize work processes and systems. This was achieved by developing modern BPM systems that integrate virtualization, automation, and work design [21]. Thus, the traditional approach is continuously challenged by the advancement of technology and changing nature of work. The shift toward knowledge-based work, the increasing use of automation and digitalization, and the changing demographics of the workforce have led to the need

for a more flexible and adaptive approach to work design [125]. In the context of BPM, modern workplace design must consider the use of virtualization, the integration of technology, and the need for collaboration and teamwork.

## 2) WORK DESIGN IN THE AGE OF TECHNOLOGY

In the age of technology, work design refers to the creation, development, and maintenance of work systems, processes, and practices to improve productivity and efficiency. According to Parker and Grote, with the advent of technology, work design has taken on a new meaning, characterized by integrating technology into the working environment. Technology integration into work design has revolutionized work performance and increased efficiency and productivity. For example, automating processes through software, robotic systems, and machine learning has allowed businesses to streamline and standardize work processes. This reduces the time and effort required to complete tasks. Technology has also allowed it to gather, analyze, and act on data in real time. Hence, it provides a more comprehensive view of operations and enables businesses to make informed decisions. Workers should be placed at the center of investigating tools and methods that assist human labor in mitigating associated risks [128]. This study established that workflow systems often ignore workers, which hinders effective work performance. They examined previously documented case studies and analyses of more recent workflow implementations. While there were cases that showed an initial disruption of work, changes to the design of the work and the configuration of the BPM toolset were able to remedy an issue. They also noted that these impacts can be minimized by effective knowledge management and staff empowerment. Interestingly, while this analysis does not explicitly include an investigation into work design, it does refer to changes that need to be made in the flow of work and system design.

Another study conducted a statistical analysis of 324 companies by applying the critical success factors to BPM identified in a previous case study [129]. This step followed the operationalization of these factors by combining them into logical practices. They show that following these vital practices can improve the operationalization and adoption of BPM, which they describe as the business process orientation of the organization. They found that one of these critical practices was directly related to employee training and work practices. They noted that business processes traditionally expend time and resources dedicated to having management make decisions for workers. Organizations learn to automate these decision steps and alter employee practices to follow process decisions, rather than constantly referring to a supervisor. It follows the critical methods of employee training and empowerment. This study established the need for a work design to be considered. However, it falls short of investigating work design theory itself. The use of case studies to identify critical success factors and statistical analyses to identify essential practices were effective. This

allowed them to combine both qualitative and quantitative research practices. These findings are now challenging to see process improvement practices from a broader range of business activities and BPM tools [130]. In the last five years, researchers have challenged the traditional work design theory. It is not necessarily a top-down process conducted by management because of the impact of external influences outside the control [131]. Thus, the work design can be completed systematically and modified as part of a dynamic business process.

## 3) WORK DESIGN IN THE FUTURE OF ARTIFICIAL INTELLIGENCE (AI)

Technological advancements have recently influenced work design, particularly the development of computers and information systems. Work design systems have become increasingly sophisticated owing to the emergence of artificial intelligence (AI). AI would be preferable in production as companies work toward achieving higher optimization of processes with an error-free rate [132]. This is because AI produces more during a significantly shorter period. AI will have lower fixed costs than human labor, requiring employment benefits and having time downs. AI's fixed price is lower than that of human labor [133]. Hence, this makes this futuristic technology preferable for productivity input, given significant advancements in robotics and ML technology for the future of work. Thus, AI can potentially transform the design and performance of a work. Virtualization, in particular, has the potential to revolutionize work design by allowing organizations to create virtual environments for modelling and testing work processes before execution. Work design foundations are rooted in understanding how work is performed and the relationships between tasks [122]. However, over time, the focus of work design has shifted toward a worker-centered approach, considering employee satisfaction and well-being. Recently, it has been influenced by technological advancements such as virtualization in BPM systems.

Human labor is becoming more expensive, with a limited capacity to deliver productivity at levels that do not reduce the cost of business. Thus, organizations are researching other ways to meet these expectations. AI research and development are becoming a promising future for organizations, especially with regard to work design [134]. AI in the future of workplace design has been a topic of considerable interest and debate in recent years. Integrating AI technology into business processes and work design can significantly change how work is performed and organized. The impact of AI on work design is expected to be both positive and negative. It depends on various factors, such as the nature of the task, level of AI integration, and skills and expertise of the workforce.

One of the key benefits of AI in work design is its increased efficiency and productivity. AI technologies such as machine learning and natural language processing can automate routine tasks, freeing workers to focus on more complex

and value-adding activities [111]. This can lead to reduced operational costs, improved output quality, increased worker satisfaction, and reduced turnover. In addition, it solves the problem of human labor, where efficiency and productivity increase until they become limited. Thus, it would require more people who must be highly skilled to solve this challenge at an increased production cost. However, the integration of AI into the work design raises several concerns. Some workers may feel threatened by potential job loss [135]. In addition, other workers may feel resentful about being replaced by machines. There are also ethical concerns regarding the use of AI in decision-making, particularly in areas where human judgment is critical.

In addition to the benefits of increased efficiency and productivity, technology has enabled work design to be more adaptive and flexible. Work processes can evolve quickly as new technologies become available or business needs change [30]. This has resulted in greater agility and resilience under changing market conditions, allowing companies to respond quickly to new opportunities and challenges. Despite these benefits, integrating technology into work design has raised new challenges. One of the biggest challenges is ensuring that work systems remain user-friendly and accessible to employees regardless of their technical ability. In addition, the rapid pace of technological change can make work systems obsolete quickly, requiring businesses to continually invest in new technologies to stay competitive.

In conclusion, work design in the age of technology has brought about significant changes in the business environment. This has increased efficiency, productivity, and adaptability. However, it has also created new challenges that businesses must address to stay competitive. Hence, ensuring the successful integration of AI into work design is essential by carefully considering the implications and risks associated with this technology. Developing broad and clear strategies for implementing AI technologies responsibly and ethically is vital [136]. It may involve collaboration with workers and other stakeholders and developing training programs and other support mechanisms to help workers adapt to new technologies. The impact of AI on work design is likely to be significant and wide ranging. It depends on various factors, including the nature of the task, level of AI integration, and skills and expertise of the workforce [137]. Therefore, organizations must strategically and responsibly integrate AI into work design to ensure that the benefits of AI are realized, and the potential risks are mitigated.

#### 4) KEY STEPS IN ADOPTION OF WORK DESIGN

Adopting work design principles can lead to numerous benefits for organizations. These benefits include increased productivity, employee satisfaction, and overall organizational performance [8]. The first step in adopting work design is to understand the current work environment. It includes identifying the tasks that employees perform, the resources available, and the challenges they face. In addition, organiza-

tions must identify the pain points and areas where employees struggle to effectively perform their tasks. Once the current work environment is understood, the next step is to define work objectives and goals. The action includes identifying the KPIs the organization wants to achieve through the work design adoption process [127]. These KPIs may include productivity, employee satisfaction, or customer satisfaction. The third step is to analyze the work processes. Organizations must identify the steps involved in performing each task and determine how to streamline these steps to make the process more efficient. Achieving this will entail eliminating unnecessary steps and automating the steps involved. Another step is to create job roles and responsibilities that align with work objectives and goals. Additionally, the step involves organizations defining the skills, knowledge, and experience required for each job role and each employee's responsibilities. The stage consists of creating job descriptions and defining performance expectations for each job role.

The fifth step is to design the work environment. This action involves creating a physical and virtual environment that enables employees to perform their tasks effectively [22]. This may include providing employees with the necessary tools and resources, such as computers, software, and equipment, and designing a workspace that supports collaboration and productivity. The final step is to implement and monitor the adoption of work design. Organizations need to implement new work designs and monitor the results to ensure that the work objectives and goals are achieved [88]. Hence, this may involve collecting data on KPIs, monitoring employee feedback, and adjusting work design as needed. Generally, work design adoption can benefit organizations, including increased productivity, employee satisfaction, and overall organizational performance. Thus, understanding the current work environment, defining work objectives and goals, analyzing work processes, creating job roles and responsibilities, designing the work environment, and implementing and monitoring work design adoption is vital [22]. These steps enable organizations to optimize their work environments and achieve their goals. Hence, these steps are critical to making work design adoption effective in allowing organizations to succeed in an increasingly competitive business environment.

#### 5) WORK DESIGN ACROSS INDUSTRIES

Work design optimizes processes, reduces waste, and improves efficiency and quality across various industries. Thus, the importance of work design is not limited to a single sector but is applicable across a wide range of industries [8]. These sectors include manufacturing, medicine, retail, finance, and government.

##### *a: APPLICATION OF WORK DESIGN IN THE MANUFACTURING INDUSTRY*

Work design is a critical component of process improvement practices aimed at streamlining operations and reducing manufacturing costs. Effective work design in this sector

often involves the integration of new technologies, such as automation and robotics, to improve the speed and efficiency of processes [57]. Thus, it is crucial to optimize operations, reduce waste, and improve efficiency and quality. Effective work design in the manufacturing industry requires careful consideration of various factors, including equipment and technology availability, human resources, and environmental impacts [138]. In recent years, the integration of new technologies, such as automation and robotics, has significantly impacted work design in manufacturing. These technologies can substantially improve the speed and efficiency of processes. However, they require careful consideration and integration into the existing workflows and processes. An essential application of work design in the manufacturing industry is the adoption of lean methodologies [139]. This study established that lean methodologies are process improvement practices that reduce waste, improve quality, and increase efficiency.

Work design is a critical component of lean methodologies, as it helps ensure that processes are optimized to meet the specific needs and requirements of the manufacturing environment. For example, lean methodologies could involve the elimination of non-value-adding activities [139]. Other benefits include standardizing processes and integrating new technologies such as automation and robotics. Another critical application of work design in the manufacturing industry is the integration of Industry 4.0 technologies [82]. Industry 4.0, such as the Internet of Things (IoT), AI, and ML, are revolutionizing the manufacturing industry. These technologies can improve efficiency, reduce costs, and significantly enhance quality. However, they require careful consideration and integration into the existing workflows and processes. Therefore, work design is a critical component of integrating Industry 4.0, technologies in manufacturing, as it helps to ensure that these technologies are aligned with business goals and strategies.

Work design is a critical component of process improvement in the manufacturing industry. Effective work design in manufacturing requires careful consideration of various factors, including integrating new technologies such as automation and robotics, to achieve optimal results. In addition, adopting lean methodologies and integrating Industry 4.0 technologies are critical applications of work design in the manufacturing industry to reduce waste, improve quality, and increase efficiency.

## *b: APPLICATION OF WORK DESIGN IN THE MEDICAL INDUSTRY*

### *Healthcare Sector*

Work design plays a crucial role in improving patient outcomes and reducing costs in the health care sector. For example, effective work design in healthcare can involve streamlining patient flow and implementing process improvement practices, such as lean methodologies to reduce waste and improve quality [98]. Effective work design in the

healthcare industry requires careful consideration of various factors, including patient needs, regulatory requirements, and their impact on healthcare professionals. In recent years, the integration of new technologies such as electronic health records (EHRs) has significantly impacted work design in healthcare [140]. These tools can significantly improve the speed and efficiency of these processes. However, they require careful consideration and integration into the existing workflows and processes. An essential application of work design in the healthcare industry is the adoption of lean methodologies. For example, lean methods can eliminate non-value-adding activities, standardize processes, and integrate new technologies, such as EHRs and telemedicine [25].

Another critical application of work design in the healthcare industry is the integration of patient-centered care practices. Patient-centered care practices focus on patients' needs and preferences, and aim to improve patient outcomes and satisfaction [60]. Work design is critical to patient-centered care practices, as it helps optimize processes to meet patients' needs and requirements. For example, patient-centered care practices can involve the integration of patient feedback into process design, standardizing patient flow, and implementing process improvement practices. Hence, work design is critical for process improvement in the healthcare industry. Effective work design in healthcare requires careful consideration of various factors, including integrating new technologies such as EHRs, to achieve optimal results. Adopting lean methodologies and integrating patient-centered care practices are vital applications of work design in the healthcare industry. Its value is realized by improving patient outcomes, reducing costs, and increasing efficiency.

### *Pharmaceutical Sector*

Work design plays a crucial role in the pharmaceutical industry, impacting the quality of products and overall efficiency of pharmaceutical organizations. Effective work design in the pharmaceutical industry requires careful consideration of various factors, including product safety, compliance with regulations, and impact on pharmaceutical professionals. In recent years, the integration of new technologies such as AI and IoT has significantly impacted work design in the pharmaceutical industry [82]. These technologies can considerably improve the speed and efficiency of these processes. However, they require careful consideration and integration into the existing workflows and processes. One essential application of work design in the pharmaceutical industry is the adoption of six-sigma methodologies. Six Sigma is a data-driven process improvement methodology that reduces defects and improves quality [123]. The study noted that work design is a critical component of Six Sigma. It is also established that work design ensures that processes are optimized to meet the specific needs and requirements of the pharmaceutical industry. Another crucial application of work design in the pharmaceutical industry is the improvement of the product development processes. Effective work



design in the pharmaceutical industry can involve optimizing product development processes to reduce cycle times, improve product quality, and increase overall efficiency.

#### *c: APPLICATION OF WORK DESIGN IN THE RETAIL INDUSTRY*

Proper work design frameworks are critical for the success of the retail industry. They enable organizations to optimize processes, improve efficiency, and enhance customer experience. The impact of proper work design frameworks in the retail sector can be significant and wide ranging [70]. Its effects are felt across all business areas, from the customer experience to the bottom line. First, this study noted that proper work design frameworks in the retail industry could improve customer experience. Organizations can streamline the customer journey by evaluating and optimizing processes, reducing wait times, and improving the overall experience. Thus, this can increase customer satisfaction and loyalty, positively impacting the bottom line through repeated business and positive word-of-mouth recommendations. Another impact of proper work design frameworks in the retail industry is the increased efficiency. Retailers can eliminate waste and reduce the time and resources required to complete tasks by evaluating and optimizing processes in their work design [141]. Hence, they can increase productivity, lower operating costs, and improve profitability. Additionally, proper work design frameworks can help organizations identify and prioritize opportunities for automation, which can further improve efficiency and reduce costs.

In addition, implementing suitable work design frameworks can help organizations stay competitive in the ever-changing retail industry [70]. Retailers can quickly adapt to market and customer demand changes by continually evaluating and optimizing processes. It allows organizations to stay ahead of the curve and remain competitive in the face of growing competition. Hence, executing proper work design frameworks is critical for the success of the retail industry. By improving customer experiences, increasing efficiency, and helping organizations stay competitive, appropriate work design frameworks can significantly impact the bottom line and overall success of retail organizations.

#### *d: APPLICATION OF WORK DESIGN IN THE FINANCE INDUSTRY*

Work design has profoundly impacted the finance industry, affecting various aspects from banking to insurance and everything in between, such as credit scoring. Thus, enhancing the industry's talent management model is a reliable way to enhance competitiveness. This approach is reliable for ensuring an effective work design. It provides a structured approach for organizations to achieve this, especially in the banking sector. This has impacted the banking industry by improving the efficiency and effectiveness of customer-facing processes. By optimizing the processes, banks can reduce wait times, improve customer experiences,

and increase overall customer satisfaction [78]. Work design has also helped banks streamline internal processes, thereby reducing the time and resources required to complete tasks. Thus, the ease of executing tasks such as assessing and approving loans has improved their bottom line, leading to increased productivity and profitability.

Firms can efficiently conduct accurate and effective credit-scoring processes. Optimizing processes by adopting technology in their work design reduces the time and resources required to assess creditworthiness and customer experience [78]. Financial risks and reports have become easier to implement through proper auditing and assurance mechanisms. Other economic players, such as insurance firms, can rely on these reports to evaluate claims and policies to prepare comprehensive and accurate settlements. More reforms in the industry have become worker-centric, motivating and encouraging employees to perform better.

#### *e: APPLICATION OF WORK DESIGN BY THE GOVERNMENT*

Government work design refers to defining, structuring, and executing work within government organizations. Over the years, work design in the government sector has undergone significant changes primarily driven by technological advancements, political landscape changes, and public service delivery expectations [76]. In the early days of government work design, tasks were performed manually, and employees were mainly responsible for clerical and administrative tasks. However, with the advent of new technologies, work design in government has become more sophisticated, and the focus has shifted from manual to automated processes. For instance, computerization and the Internet have enabled government organizations to streamline processes, increase efficiency, and improve the quality of service delivery. One example of the impact of work design on government is the adoption of e-governance. It refers to the use of information and communication technologies to provide public services electronically. E-governance has revolutionized how government agencies interact with citizens, significantly reducing the time and costs associated with manual processes [76]. In addition, the study showed that e-governance enables citizens to access public services online. These services include applying for passports, registering businesses, and paying taxes. Hence, it improves service delivery quality and increases citizen satisfaction.

Another example of work design by the government is the adoption of agile methodologies. Agile methodologies are a set of practices and principles aimed at increasing the efficiency and flexibility of software development projects [26]. In the government sector, this study established that agile methodologies were applied to improve the design and delivery of public services. For instance, government organizations can use agile methodologies to prioritize and manage projects, allocate resources, and respond to changing requirements. Government work design has undergone significant changes over the years driven by advancements in technology, changes in the political landscape, and shifts

in public service delivery expectations. Thus, the impact of proper work design frameworks in the government sector is significant, with improvements in efficiency, quality of service delivery, and citizen satisfaction [76]. However, there is still much work to be done to ensure that work design in the government continues to evolve and respond to the needs of citizens.

#### 6) GLOBAL ATTITUDES TOWARD WORK DESIGN

Work design is a crucial aspect of any workplace as it impacts employee satisfaction, productivity, and, ultimately, the success of a business. Thus, it is essential to assess how entities view work designs globally [21]. The study examines global attitudes toward work design for potential improvement of practices by one organization through comparison. Global attitudes toward work design consider factors such as importance, standard procedures, and their impact on employee satisfaction and productivity. The importance of work design varies globally depending on cultural and economic factors. For example, in developed countries, work design is often viewed as a critical component of job satisfaction and career growth [74]. Comparatively, in developing countries where employment opportunities may be limited, work design is seen as a means of securing employment and generating income. Work design is important and depends on the industry and job type. For example, work design is essential for fostering creativity, collaboration, and innovation in creative fields such as advertising and design. Standard work design practices vary globally; however, there are several universal principles. First, work design should involve job analysis, which includes the identification of job tasks, responsibilities, and requirements. Second, work design should aim to reduce physical strain, monotony, and workload imbalances. This can be achieved through job rotation, enlargement, or enrichment. Finally, work design should be flexible, allowing employees to adjust their work schedules to accommodate their personal and family responsibilities.

Work design has a significant effect on employee satisfaction and productivity. A well-designed work environment leads to higher job satisfaction and engagement, reduced absenteeism, and increased productivity [8]. The effect of work design on productivity is particularly crucial in the current economic climate, where companies are looking for ways to improve efficiency and reduce costs. Work design can also impact employee retention rates, as employees who are satisfied with their jobs and work environments are likely to stay with the company. In conclusion, work design is a critical aspect of any workplace that impacts employee satisfaction, productivity, and ultimately, the success of a business. While attitudes toward work design vary globally, several universal principles are crucial for creating a well-designed work environment [21]. Companies that prioritize work design and create a flexible and engaging work environment are more likely to retain employees, boost productivity, and succeed in the long run.

#### D. RESEARCH ON THE RELATIONSHIP BETWEEN BPM, VIRTUALIZATION, AND WORK DESIGN

The relationship among BPM, virtualization, and work design is complex and multifaceted [48]. BPM is a systematic approach to optimize and automate business processes. Simultaneously, virtualization involves creating virtual environments to run business processes. Work design refers to creating work systems to ensure that they effectively and efficiently meet organizational goals. Virtualization and BPM are closely related, focusing on optimizing and automating business processes [92]. Thus, virtualization creates environments that allow organizations to run business processes more efficiently and cost-effectively. BPM provides a framework for optimizing and automating these processes, enabling organizations to improve the speed and accuracy of transactions. Combining virtualization and BPM enables organizations to create a seamless and integrated environment for running business processes, reducing costs, and improving efficiency. Work design is also closely related to BPM and virtualization, as it is critical for ensuring that work systems are practical and efficient [97].

Technology is reshaping work and pushing it into the digital universe [21]. Hence, it is increasingly vital to reassess the work design with technological advancement. Work design is continually analyzing and optimizing work systems in virtualization and aligning this technology with organizational goals and meeting the needs of employees and customers. Hence, incorporating proper BPM system design and virtualization into work design will ensure that organizations improve their work environment design [142]. Moreover, this enhances their ability to meet the needs of employees and customers. Thus, the relationship among BPM, virtualization, and work design is complex and multifaceted. BPM and virtualization are closely related and focus on optimizing and automating business processes. At the same time, work design is critical in ensuring that work systems are practical and efficient. By combining BPM, virtualization, and work design, organizations can create an integrated and seamless environment for running business processes, improving efficiency, and reducing costs.

#### 1) INFLUENCE OF VIRTUALIZATION ON WORK DESIGN FOR EFFICIENT BPM SYSTEM DESIGNS

Virtualization concepts play a significant role in shaping work design in organizations [97]. Virtualization technology has revolutionized how organizations manage their IT systems, allowing greater efficiency, flexibility, and security. Virtualization has also impacted work design, creating new opportunities for organizations to optimize their work processes and systems [100]. Cloud computing is a vital virtualization concept that influences the work design. Cloud computing has enabled organizations to use virtualization technology to create virtualized computing resources that can be delivered over the Internet. Cloud computing has enhanced access to computing resources on demand without requiring

physical infrastructure [81]. It has transformed work design by enabling organizations to access computing resources from anywhere, at any time, allowing for greater flexibility and efficiency in work processes. Another virtualization concept that influences work design is containerization. Containerization refers to the use of virtualization technology to create isolated environments for applications and services. Another study found that this technology allows organizations to run multiple applications and services on a single physical server, improving efficiency and reducing costs [143]. Furthermore, containerization has enabled firms to deploy and manage applications and services more flexibly and scalably, allowing for more significant innovation in work design.

Virtualization continually impacts the adoption of improved infrastructure in work design to respond better to utilizing virtual machines' capacities [144]. The process allows organizations to run multiple virtual machines on a single physical server, reducing the costs of relying on multiple physical servers. This will enable organizations to optimize their work processes while saving time and space and reducing the vast management responsibilities required before integrating and adopting virtual resources. Virtual machines have enabled organizations to create virtual versions of physical devices and resources, allowing greater flexibility and innovation in work design [100]. Virtualization has played a crucial role in workplace design by creating environments that support business processes. The advancement of this technology and related concepts will likely continue to shape the future of organizational work design. This allows firms to use technology to develop new work designs and improve efficiency and effectiveness.

Generally, modern BPM systems integrate virtualization and work design to enable organizations to streamline their work processes and improve productivity. This is achieved by automating work processes, reducing manual intervention, and allowing workers to focus on higher-level tasks [145]. The virtualization process in work design enables organizations to create flexible and scalable systems that respond to changing business needs and demands. The process improves value after integration into the work design because of its unlimited benefits, allowing firms to develop efficient and effective work processes [100]. These steps enable the agility of business responses to changing market demand. As technology evolves, work design is expected to become crucial in optimizing work processes and systems.

## 2) EXPERIENCE WORKING WITH BPM SYSTEM DESIGNS

The design of BPM systems has become a critical issue for organizations as it influences the overall effectiveness and success of BPM initiatives. One key aspect of the experience of working with the BPM system design is user satisfaction. Several studies have shown that user interface quality and ease of use are essential factors in determining user satisfaction with BPM systems. For example, a survey [38] found that

most BPM users were satisfied with their systems, the most important being the ease of use and level of control over the process. This finding is supported by that of another study [146]. User satisfaction was positively correlated with the level of control over the process and ease of use of the BPM system. Another critical aspect of the experience of working with the BPM system design is the level of user engagement. One study [147] found that user engagement was a critical factor in the success of BPM initiatives. Engaged users are more likely to adopt and use the system effectively. This finding is supported by a study by [146], which found that user engagement is positively correlated with satisfaction.

In addition to user satisfaction and engagement, the level of automation and integration with other systems are essential factors in the experience of working with BPM system designs. For example, one study [148] found that the level of automation was positively correlated with the level of user satisfaction and the success of the BPM initiative. Likewise, the study [55] found that integrating with other systems was positively correlated with the level of user engagement and the success of the BPM initiative. Another study surveyed 219 individuals working with the BPM system on a daily basis [149]. The research sought to investigate several areas of BPM, including applications used, level of maturity, realized benefits, and possible outsourcing opportunities. Outsourcing opportunities were included, representing one of the few studies that provides virtual resources as a primary consideration. As with previous research in this review, BPM is an ongoing consideration for organizations and must constantly change and evolve to provide strategic and operational benefits. Business process automation alone can provide a short-term competitive advantage. Still, it must be accompanied by more extensive organizational changes to deliver long-term benefits. A key finding was that most organizations did not achieve BPM maturity. Hence, while BPM practices are becoming more common, they are still in their infancy and very much considered in the formative stages of development.

However, this insight into virtual resources is limited by outsourcing [149]. It does not include any other type of virtual resources. Over 25% of respondents attempted outsourcing. Its value varies according to the area in which the business is located. Respondents cited concerns about losing core competencies and corporate culture, and a lack of understanding of which business processes could benefit from outsourcing. This indicates that systems and work design changes would need to be in place to ensure that these concerns are addressed to take advantage of outsourcing. This research falls short of linking work design and virtual resources with BPM as a solution to some of the concerns raised by their study. Despite these concerns, BPM is evolving as more organizations reach increasing growth and understanding of its adoption, execution, and maintenance.

Generally, the experience of working with BPM system designs is influenced by various factors, including user satisfaction, engagement, automation, and integration with other systems [8]. These findings suggest that organizations should

focus on designing easy-to-use BPM systems. In addition, these techniques should provide a high level of control to users and be well integrated with other systems to ensure their success. In conclusion, the experience of working with BPM system designs is an important issue for organizations. Some studies have shown that the levels of user satisfaction, user engagement, automation, and integration with other systems are critical factors in determining the success of BPM initiatives. The results of these studies provide valuable insights for organizations seeking to improve their BPM systems and enhance their overall experience of working with these systems.

### 3) EVOLVING INTERSECTION OF ORGANISATIONAL CULTURE AND BPM SYSTEM DESIGN

A study was conducted to explore the notion that organizational culture directly impacts BPM projects and their effectiveness [65]. This study found that factors external to processing operations can have a fundamental impact and should be considered when designing a BPM system. Further research is needed to explore the effects of external factors, such as work design, on BPM systems. Another study investigated the impact of changes in the business environment during the implementation of BPM and knowledge management projects. Human resources are critical success factors [79]. Specifically, these implementations were more successful when the process supported the workers' ideas and actions, enabling them to participate [128]. This indicates that the work design is a critical element in the practical application of the BPM and warrants further theoretical investigation.

The relationship between organizational culture and BPM system design has been changing rapidly with the evolution of technology. Therefore, the intersection of these two aspects has become increasingly complex and intertwined. Thus, the impact of BPM system design on organizational culture and vice versa is becoming more pronounced. One of the critical studies in this area is the research paper by [65], which explores the impact of BPM system design on organizational culture. This study found that BPM system design can significantly impact corporate culture, particularly its impact on work processes, work design, and work behavior. For instance, the study found that BPM system design can influence the structure and norms of work processes, work design, and work behavior, shaping the organizational culture. Another study highlighting the impact of BPM system design on corporate culture [36] found that BPM system design can positively impact corporate culture by promoting teamwork, communication, and employee collaboration. Moreover, this study found that a well-designed BPM system can help improve organizational efficiency, transparency, and accountability, positively impacting corporate culture.

The BPM evolved since its conception in the 1990s [129]. Early adopters have seen their responses in various industries and economic conditions, including bull and bear markets, and a global recession. Throughout the reviewed literature,

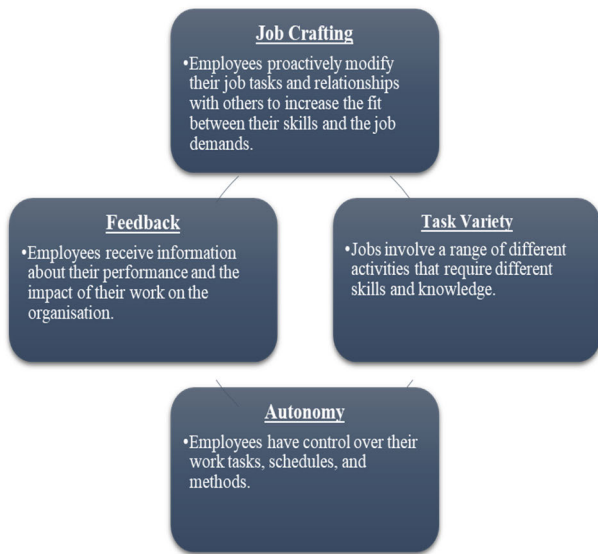
an adaptable answer is vital for organizations to benefit from BPM system designs. Such agility is essential, as organizations are continuously impacted by legislative, competitive, economic, and social forces. Thus, their BPM practices must be flexible in order to provide them with competitive and strategic advantages. The rise and increasing level of adoption of virtual resources by organizations is undeniable and must be included in BPM considerations. Likewise, work design must be considered as BPM changes how organizations utilize employees. The consequences of work design theory are tangible, and the literature supports further investigation of the modernization of traditional concepts [150].

Technology and modern business practices seem to innovate and change faster than research can conduct [55]. As such, there are significant gaps in the literature, and often, one component may be covered in the literature, but not in combinations. For example, the limited literature covers work design, virtual resources, and BPM. However, they were covered separately to varying degrees. As organizations achieve greater maturity in their BPM practices, greater insight has been available to researchers. The research suggested in this proposal follows from the reviewed literature. The reviewed studies have shown that BPM and work design theory must be updated to remain relevant to modern business. They also show that virtual resources are increasingly being utilized in ways that directly impact business processes, employees, and culture. However, there is a lack of research combining all these elements. Thus, further investigation is needed into the need for work design and virtual resources to be an architectural consideration of business process automation [150].

Today, the BPM system design can also impact the development of an organization's strategy and decision-making processes. Research has shown that the integration of BPM system design and organizational culture can result in the creation of a culture of continuous improvement. For instance, integrating BPM system design and organizational culture can help organizations identify and address problems and opportunities for improvement [65]. This led to a continuous improvement cycle. The intersection between corporate culture and BPM system design is becoming increasingly complex and vital. The BPM system design can significantly impact organizational culture, including its impact on work processes, work design, work behavior, administrative efficiency, transparency, and accountability. Additionally, integrating BPM system design and corporate culture can create a culture of continuous improvement, leading to improved decision-making processes and better organizational outcomes.

### 4) IMPACT ON BPM SYSTEM DESIGN FROM DIMENSIONS OF WORK DESIGN

Work design has four main dimensions: organizations rely on to ensure cohesive, effective, and efficient cooperation among employees and stakeholders. These dimensions



**FIGURE 6.** Dimensions of work design.

include job crafting, skill variety, autonomy, and feedback [151] (Figure 6). In today's dynamic business environment, organizations must ensure that their employees' work optimizes their performance, job satisfaction, and organizational outcomes. Achieving these goals requires organizations to consider different dimensions of work design, including job crafting, task variety, autonomy, and feedback [8]. Job crafting refers to the process by which employees proactively modify their job tasks and relationships with others to improve the fit between their skills and the demands of their roles. Job crafting was positively related to job satisfaction, engagement, and performance. Job crafting promotes the development of expertise, which can positively impact organizational outcomes [127]. In the context of the BPM system design, job crafting can help employees identify tasks that are more aligned with their skills and interests. This leads to increased engagement and job satisfaction. Furthermore, job crafting can enable employees to identify areas of the BPM system that can be improved, thereby leading to increased efficiency and effectiveness.

Task variety, as a dimension of work design, refers to the degree to which a job involves various activities that require different skills and knowledge. Task variety was positively related to job satisfaction, engagement, and performance [8]. In addition, task variety has been shown to promote learning and development, which can positively impact organizational outcomes. In the BPM system design, task variety can enable employees to develop various skills and knowledge, thereby increasing job satisfaction and performance [125]. Additionally, task variety can ensure that employees are exposed to different aspects of the BPM system, leading to increased knowledge and understanding. Autonomy, another dimension of work design, refers to how employees control their work tasks, schedules, and methods. Independence was positively

related to job satisfaction, engagement, and performance. Autonomy has also been shown to promote creativity and innovation, which can positively impact organizational outcomes [135]. In the context of the BPM system design, independence can enable employees to work on tasks aligned with their skills and interests, leading to increased job satisfaction and performance. In addition, freedom can promote creativity and innovation, enabling employees to identify and implement improvements in the BPM system.

Finally, feedback refers to the degree to which employees receive information about their work performance and their impact on the organization. Feedback was positively related to job satisfaction, engagement, and performance [135]. Furthermore, feedback has been shown to promote learning and development, which can positively impact organizational outcomes. In the context of the BPM system design, feedback can enable employees to identify areas of the BPM system that require improvement, leading to increased efficiency and effectiveness [137]. Hence, feedback would allow employees to understand the impact of their work on the organization, leading to increased job satisfaction and engagement. Taken together, the work design dimensions can have a significant effect on BPM system design. By incorporating job crafting, task variety, autonomy, and feedback into the design of the BPM system, organizations can promote employee engagement, job satisfaction, and performance. In addition, by facilitating learning and development, creativity, and innovation, and identifying areas for improvement, organizations can ensure that the BPM system is continuously optimized to meet the organization's needs [141]. Thus, the dimensions of work design, including job crafting, task variety, autonomy, and feedback, can significantly impact BPM system design. Organizations can promote employee engagement, job satisfaction, and performance by incorporating these dimensions into the design of a BPM system. Meanwhile, they can ensure that the system is continuously optimized to meet the organization's needs. As such, organizations should consider the dimensions of work design when designing.

## IV. DISCUSSION AND FUTURE RESEARCH

### A. DISCUSSION OF THE FINDINGS

This review explores virtualization and work design integration in BPM system design by analyzing the results of existing relevant studies in this field. This supports the essential role of BPM systems in supporting organizational processes and achieving business goals [21]. The findings of this study show that integrating virtualization and work design into BPM system design can enhance the flexibility, scalability, and agility of BPM systems. This will enable organizations to respond more effectively to changing business needs and market conditions.

#### 1) SCALABILITY

One of the key benefits of integrating virtualization and work design in BPM system design is the ability to provide greater

flexibility and scalability [41]. Virtualization technology allows resources to be allocated dynamically, enabling organizations to respond quickly to changing business demands. Work design principles can also be integrated into the BPM system design to ensure that tasks are assigned to maximize efficiency and reduce the risk of bottlenecks. One benefit derived from this principle is integrating virtualization, and work design in BPM system design is the ability to enhance agility [26]. Virtualization technology can enable organizations to rapidly deploy new systems and applications. Simultaneously, work design principles can be used to ensure that the processes are designed to be as flexible as possible. It can enable organizations to respond more effectively to market changes, customer demands, and new business opportunities.

## 2) ALIGNMENT TO STRATEGY

Studies have established that businesses need to develop a robust governance framework to effectively manage their BPM systems [125]. This study noted that a well-designed governance framework can ensure that the BPM system is aligned with the business's strategic objectives and operates efficiently and effectively. Companies can achieve their goals by establishing clear roles and responsibilities. In addition, businesses can create policies and procedures and develop performance metrics to measure the efficacy of a BPM system [41]. Integrating virtualization and work design in BPM system design could produce an effective tool to drive business strategies to action. As such, businesses that invest in integrating virtualization and work design into their BPM system design will be prepared to compete in the modern business landscape [27].

## 3) RESOURCE ALLOCATION

One of the key findings of this research is that virtualization can greatly enhance BPM system design by enabling more flexible and efficient resource allocation. Thus, virtual machines would allow organizations to allocate resources on demand and reduce the costs of maintaining physical servers [5]. Moreover, virtualization allows for effortless scalability and disaster recovery, which are critical for ensuring business continuity in the face of unexpected disruptions. Work design integration can improve employee productivity and job satisfaction by enabling flexible work arrangements and task allocations [8].

## 4) CULTURE & ENGAGEMENT

The study identified key factors contributing to successful virtualization and work design integration through a literature review and case study analysis. These include technical capabilities, organizational culture, and employee engagement [27]. Organizations can create a more engaged and motivated workforce by designing work processes around the capabilities and preferences of individual employees. In addition, work design integration can enable more efficient

collaboration and knowledge sharing, which are essential for achieving BPM system goals [27].

Generally, the potential benefits of integrating virtualization and work design in BPM system design are significant [152]. Organizations that embrace these approaches will likely improve productivity, scalability, and employee engagement outcomes.

## B. RECOMMENDATIONS AND FUTURE RESEARCH

Virtualization and work design integration in BPM system design enables organizations to achieve greater agility, flexibility, and efficiency while improving employee engagement and satisfaction. However, its successful implementation requires careful attention. The identified focus domains entail technical, organizational, and cultural factors, and ongoing monitoring and evaluation to achieve the desired outcomes [135]. Thus, future research should explore the long-term impact of virtualization and work design integration on BPM system performance, and the factors that influence the adoption and sustainability of these approaches.

### 1) EMERGING TECHNOLOGIES

Further studies could also investigate the use of emerging technologies, such as AI and blockchain, to enhance BPM system design and implementation [153]. This could include an empirical study incorporating diverse sample sizes to increase the study's external validity compared to the currently available literature. This would allow for a more accurate representation of various firms' BPM practices and experiences in different regions.

### 2) CASE STUDIES OF ACTIVE BUSINESSES

Another opportunity is that future research could be conducted in a real-world setting to complement the simulated environment used in most current literature. It would provide a more accurate assessment of the impact of virtualization and work design on BPM in an actual work environment.

### 3) LEADERSHIP, CULTURE & ENGAGEMENT

Finally, future research could explore the effects of other factors on BPM, such as the role of leadership, organizational culture, and employee engagement. These factors can be incorporated into the design of the BPM systems to improve their effectiveness and efficiency.

Although this review offers valuable insights into the influence of virtualization and work design on BPM, there is ample room for further exploration. Future research can build on the findings of this study and expand the scope of knowledge on BPM.

## V. CONCLUSION

The literature review highlighted the vital role of virtualization and work design in BPM system design. Virtualization and work design are essential components of BPM system design that can enhance the performance and effectiveness of these systems. Virtualization technology can improve the

flexibility and scalability of BPM systems. By contrast, work design can improve employee satisfaction, productivity, and performance. The literature review shows that the BPM system design should be approached as a comprehensive process. This approach includes process modelling, automation, workflow management, integration, analytics and reporting, governance and compliance, and continuous process improvement. These components are critical for the successful development of BPM systems. This review also highlights the challenges in designing and implementing effective BPM systems. These challenges include managing complexity, ensuring system security, overcoming resistance to change, and balancing the technological and human factors. The literature review provides insights and best practices for addressing these challenges and designing BPM systems that meet the needs of modern organizations. Overall, this literature review emphasizes the importance of a holistic approach to BPM system design. Organizations that invest in designing effective BPM systems can improve their business processes, reduce costs, and increase customer satisfaction. Virtualization and work design are critical components of BPM system design that can help organizations achieve this goal.

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