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BUSINESS PROCESS RE-ENGINEERING IN THE ERA OF AUTOMATION: CHALLENGES AND OPPORTUNITIES FOR ENTERPRISES

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Abstract

Business Process Re-engineering (BPR) has been a strategic technique that organizations used at the core level to compete for efficiency. As automation technologies advance, it will be important for enterprise to address new business processes management risks and possibilities. This paper aims at investigating the expertise of BPR in the automation age to understand how automation tools such as RPA, AI, and ML are redesigning conventional business processes. It speaks to issues, which revolve around the application of automation into BPR to achieve goals like increased productivity, reduced cost, and better decision-making systems. But it also concentrates on the large risks involved in the integration such as the displacement of workers, technology issues and adopting a new culture of operation within organizations. The paper continues to discuss multiple approaches that companies can implement when attempting to effectively manage the integration of BPR and automation, specifically discussing how advancements in technology should support the objectives of a business. The final section of the research discusses the prospects of BPR in connection to automation and its effects on enterprise competitiveness in an increasingly dynamic business environment.

I. INTRODUCTION

An emerging pattern in today's factories is the automation of more and more processes. Planning a new assembly line or redesigning an old one both reveals a tendency towards assembly automation. Machines, rather than human operators, carry out a process known as automation [1]. Workload, mistakes, and labour expenses are all reduced as a consequence of automation. The automation of industrial systems greatly improves manufacturing performance in low uncertainty environments [2].

To achieve major gains in important, current metrics of performance, such as cost, quality, service, and speed, BPR entails "the fundamental rethinking and radical redesign of business processes."[3]. To remain competitive in the global market, several organisations have been rethinking their business procedures in recent years. Most BPR initiatives are finding that the Internet is an essential enabling technology [4][5]. The use of workflow management software is just one more way that technology is paving the way for better process performance in collaborative networking settings. Integrating, coordinating, and communicating between the automated and human-operated steps of a business process is what makes process automation possible using a workflow management system [6][7].

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A company can't begin re-engineering unless its top brass sees the need to shake things up and rethink its long-term goals, as shown in Figure 1. Business processes that should be re-engineered are often chosen by the enterprise's strategic management. The second step of the Business Process Model is re-engineering. BPR Framework for Re-engineering, which takes into account all the tasks as well as those that have been carried out in the course of dealing with business procedures[8][9].

- The re-engineering objectives are established in the goal-definition phase.
- Information Acquisition, which involves gathering data required for both business process modelling and the Re-engineering Process.
- Modelling, this is concerned with representing the (new) company process using models.
- Evaluation, which focuses on comparing the re-engineering objectives with the business process model

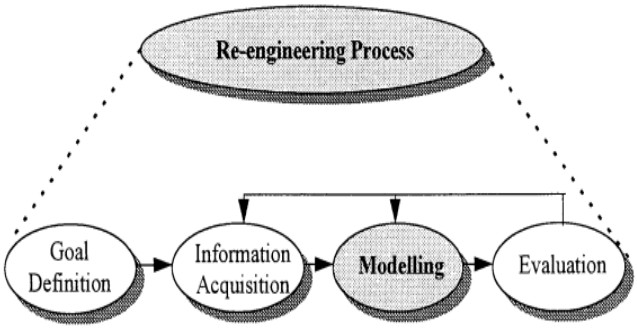

Figure 1: The Re-engineering Process and its sub processes

Additionally, the benefit of using existing data is being increasingly shown by AI and ML [10][11][12][13]. Its value makes it possible to learn from data in order to find hidden patterns and develop fresh approaches to challenging real-world issues [14][10].

Organization of the paper

The structure of the following papers is as follows: Section II offers the Business process re-engineering: An Overview, Section III gives the Artificial intelligence in BPR, Section IV discusses the Automation technologies in BPR then, and Section V discusses some Literature Review, Section VI summarized the paper with Conclusion And Future Work.

II. BUSINESS PROCESS RE- RE-ENGINEERING

Overview

We must first grasp what process, business process, and re-engineering imply in order to comprehend business process re-engineering. In the introductory section, we defined the process and business process [15][16]. The process should, however, have a beginning and an endpoint that involves people from different organisations [17]. The terms clinical process definition and clinical workflow are also technically synonymous [15]. It was said that the BPR

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idea first surfaced in the 1990s. A management strategy that reconsiders current business procedures and their interconnections is known as business process re-engineering[18][19]. The process, structure, and culture are redeveloped in an effort to increase basic process efficiency by the use of radical and fundamental techniques, such as the modification or elimination of non-value-adding operations [20][21]. Through the use of an integrated and methodical approach, business process re-engineering improves analysis and redesign of the organization's structure, processes, and activities in order to reduce costs and improve service quality. Significant changes in the corporate landscape necessitated a re-engineering of process workflows, which is primarily what gave rise to BPR[22][23]. Figure 2 shows the overview of BPR.

Figure 2: Business Process Re-engineering

Information and communication technologies may be used to accomplish business process re-engineering in automation, often known as BPR [3]. The effective execution of repetitive corporate procedures is being made possible by these technologies, which allow for the replacement of physical labour [24]. It is one of BPR's main operations since it brings about an efficient shift in the way work is done via, among other things, simplified procedures, faster information flow, paperless transactions, and so on[25]. Costs are reduced and productivity is increased as a result for organisations.

Benefits of Business Process Re-engineering

The re-engineering of business processes does have its advantages [26]:

1. Competitive advantage: BPR may provide businesses a long-term competitive edge in their sector by promoting notable gains in productivity, quality control, and customer satisfaction. BPR gives businesses a long-term competitive edge in their sector by generating notable gains in productivity, quality, and customer satisfaction[27].
2. Enhanced quality: The goal of BPR is to increase product and service quality by decreasing the occurrence of mistakes and defects via process redesign. Organisations may boost customer satisfaction and loyalty by providing higher-quality results via process standardization, best practice enforcement, and quality check integration[28].
3. Faster time-to-market: BPR streamlines product development, production, and delivery processes, helping organisations expedite time-to-market for new goods and services.

Faster responses to customer demand are possible when organisations improve their agility and decrease cycle durations [29].

4. Improved customer satisfaction: By rethinking processes from the customer's perspective, BPR aims to provide value to consumers. Organisations may boost customer loyalty and retention by enhancing service delivery, responding faster, and providing higher-quality services.
5. Increased efficiency: Streamlined workflows, shorter cycle times, and improved utilisation of resources are the results of BPR's intensive process reform. Organisations may do more with fewer resources via the elimination of non-value-adding and redundant jobs, leading to greater efficiency [30].
6. Reduced costs: Lowering operational expenses and leading to substantial savings for organisations is possible via the reduction of redundant procedures, automation of manual operations, and improvement of resource allocation [31].
7. Strategic alignment: With the help of BPR, companies may adjust their procedures to meet their long-term goals. Organisations may guarantee efficient resource allocation to meet their strategic aims by redesigning work processes and concentrating on value-adding activities [32].

Challenges in Implementing Business Process Re-engineering with Automation

The re-engineering of business processes is not without its difficulties [33]:

1. Resistance to Technological Change: Fear of job loss or problems adjusting to new technology are two reasons why employees could fight automation [34].
2. High Implementation Costs of Automation: The use of automation technology like AI and RPA involves making a huge capital investment [35].
3. Integration with Legacy Systems: Challenge of integrating new automated systems with old and inflexible legacy systems.
4. Complexity of Process Redesign: Documenting processes is important in automation since business processes are most often not a straightforward linear process.
5. Skill Gaps in Automation Expertise: Lack of internal technical personnel and the development of specialised competence in employing automation technology [36].
6. Data Privacy and Security Risks: Automating also exposes more data in processes to security threats and compliance risks to the process.
7. Difficulty in Ensuring Process Flexibility: Automated processes are less dynamic to accommodate the dynamic and complex changes in business requirements or even exceptions [37].
8. Dependency on Vendors and Third-Party Software: Dependency on external suppliers for technologies that may represent restricted power and less malleability.
9. Challenges in Measuring ROI: The tendency to measure BPR as a result of automation initiative hard and where possible in the short run.
10. Monitoring and Maintenance of Automated Processes: It needs to be done continuously to prevent some of the automated processes from becoming inaccurate, inefficient or irrelevant [38]v.

11. Managing Short-Term Disruptions: Automating tasks and processes in the organization may lead to a change in productivity at the early stages of the implementation [39].
12. Alignment with Strategic Goals: Maintaining the control requirements' relevance within the parameters of changing organisational goals and strategies [40].

Opportunities for Business Process Re-engineering in Era of Automation

The key opportunities of BPR in the era of automation are[41]:

1. Enhanced Operational Efficiency: Automating minimises human intervention, resulting in improvement in the speed and efficiency of a process [42].
2. Cost Reduction: Computerization reduces these costs since manual work is eliminated reducing the labor Bills complexities [43].
3. Improved Accuracy and Consistency: Reducing the presence of human personnel means that many issues of inefficiency, inaccuracy and inconsistency are eliminated [44].
4. Data-Driven Decision-Making: Automated systems enable data and analytics to be given in real-time – thereby enabling decisions to be made based on actual data [45].
5. Scalability: Scalability is a key feature of automated processes, allowing them to manage rising workloads with little or no resource increases [46].
6. Improved Customer Experience: Such improvements will produce quicker and more precise procedures with greater customer satisfaction [47].
7. Enhanced Agility and Flexibility: Automations help businesses to respond quickly to fluctuations in the market and customer preferences [48]v.
8. Streamlined Compliance and Reporting: Robotic process automation can assist in compliance with regulations by reducing variability of processes and by generating consistent records of activity.
9. Increased Employee Focus on High-Value Tasks: People are in a position to pay personal time and attention to important business initiatives when robotic software is performing routine and tedious tasks.
10. Innovation and Process Optimization: Automation helps to make the necessary adjustments and avoid stagnation in the processes taking place at a company.
11. Reduced Time-to-Market: Accelerated process enables organisations to bring products and services to the market within shortest time possible.
12. Better Resource Allocation: Automation allows for smarter resource use by aligning workforce and assets with strategic priorities.
13. Enhanced Collaboration and Communication: Digital workflows and automated processes improve coordination and streamline communication across departments.
14. Predictive and Preventive Capabilities: AI-powered automation enables predictive maintenance and demand forecasting, reducing downtime and optimising supply chain efficiency.
15. Sustainability and Reduced Waste: Automated processes can help reduce waste and improve resource efficiency, supporting sustainability goals [49].

III. ARTIFICIAL INTELLIGENCE (AI) IN BUSINESS PROCESS RE-ENGINEERING

Among the many subfields that make up computer science is AI. When it comes to the transformation of key business programs, AI techniques are more suited, operational, and cost-efficient [50][51]. However, there are a number of hazards associated with employing AI, including the lack of data for analysis, the inability to get the necessary amount of data, the inadequate quality of the data that is accessible, and a lack of knowledge about the inherent risks of AI[52][53]. AI is a hypothesis that aims to explain how computers learn and do tasks that normally require human intellect. A few examples of such activities include visual perception, result-oriented decision-making, voice recognition, and learning under ambiguity[54][55]. AI programs may sift through data in search of patterns and then make decisions based on those patterns [56]. They are structured and coded to learn from the data at their disposal using programming techniques, which can happen organically during their style or indefinitely to improve computer systems' performance through data exposure without the need to follow explicitly programmed instructions of artificial intelligence, software development projects, and organisational management[57].

1. ML
2. DL
3. SR
4. NLP

1. Machine Learning (ML)

ML is a technique that may improve computer systems' operations and performance by exposing them to new data, all without relying on explicitly coded methods [58]. ML is an area of AI that focuses on improving the efficiency and accuracy of software systems via the application of statistical models and algorithms. ML is essentially the process of automatically finding patterns in data and using them to generate predictions.

2. Deep Learning (DL)

The area of AI and computer science known as DL incorporates ML methods inspired by the way the brain functions, namely ANN. One key difference between deep learning and task-specific algorithms is the former's emphasis on learning data representations. One subset of ML algorithms, DL methods, has exploded in popularity due to their cracking performance in computer vision and voice recognition tasks [59][60].

3. Speech Recognition (SR)

The ability for computers or software systems to recognize individual words or phrases spoken aloud and transform them into a format that computers can understand is known as speech recognition. Speech recognition (SR) is primarily concerned with a small set of statement phrases and words, and it will only recognize them when uttered clearly. In the branch of computational linguistics known as "speech recognition," researchers work across disciplines to create methods and tools that computers can use to understand and mimic human speech.

4. Natural Language Processing (NLP)

The field of NLP describes how to train computers to analyse and process massive volumes of data in natural language and permits interactions between comprehensible languages and information systems. It is a subfield of computer science and AI. Engineers in the software industry face a formidable obstacle in the form of human speech when developing NLP systems; this is particularly true in cases when the human voice is clear, unambiguous, and accurate, or when the set of vocal instructions is limited. However, natural human speech isn't always appropriate and accurate. Natural human vocabulary has an indeterminate language structure that may depend on a number of sophisticated crucial factors, in addition to slang, regional dialects, and social context[61].

IV. AUTOMATION TECHNOLOGIES IN BUSINESS PROCESS RE-ENGINEERING

BPR has evolved beyond traditional redesign techniques, now incorporating a range of automation technologies that fundamentally transform workflows, making them faster, more accurate, and highly scalable. Automation technologies like RPA and IPA have become essential tools in BPR, offering enterprises advanced solutions for efficiency and effectiveness.

Robotic process automation (RPA)

RPA therefore refers to the application of robotics to complete those tasks that are repetitive in nature and are governed by set of rules. These bots work with applications and systems in the same way a human would do things as data entry, form processing and data transfers with ease and efficiency [62]. RPA is used with great effectiveness when applied to high repetition, low complexity activities like purchase invoices or customer service.

Intelligent process automation (IPA)

RPA is advanced with the introduction of AI and ML to produce the IPA system. IPA can fully automate the process chain by including tasks that require decision making and data learning in them [63]. This way, IPA allows BPR to web-enable entire workflows, for example, a full cycle order management process that happens across the company departments and various decision points. With IPA, enterprises get better and more effective automation that learns from its performance and feedback.

1. **Role of Automation in enhancing Business Process Re-engineering (BPR):** Here are key areas where automation plays a transformative role in BPR:
    - Accuracy and Consistency: It reduces the risk of human intervention and eliminates unreliable and unpredictable human factors in business processes. RPA for example can carry out repetitive activities or processes and deliver consistent results than if it was done manually [64].
    - Speed and Efficiency: These automated systems work way faster than people and help to reduce time being wasted across the different departments. For example, AI-driven data processing reduces the time required for data analysis, helping businesses make faster decisions.

- Scalability: Automation enables processes to be scaled up without a proportional increase in resources. Once an automated system is in place, it can handle high volumes of transactions without additional personnel, making it ideal for scaling operations.
- Enhanced Decision-Making: AI and ML can analyse large datasets, identifying trends and insights that aid decision-making. This data-driven approach helps businesses adapt processes based on predictive insights, optimising outcomes [65].
- Improved Customer Experience: Streamlined customer service operations and quicker response times are made possible by automation. For example, AI chatbots can handle customer queries 24/7, enhancing service delivery without adding manual workload.

2. **Integration of Automation and Business Process Re-engineering:** The integration of automation technologies in BPR fundamentally changes the way processes are redesigned and optimised. Here's how these technologies are applied[66]:

- End-to-end Process Transformation: Automation technologies allow BPR to move beyond isolated task improvement and instead focus on end-to-end process optimisation. IPA, for instance, integrates multiple automation technologies to streamline entire workflows that involve decision-making and cross-functional tasks. For example, automating the entire procurement-to-pay cycle can reduce manual intervention and improve process efficiency.
- Real-Time Process Monitoring and Optimization: Automation enables continuous process monitoring, making it possible to identify inefficiencies in real-time. ML models can detect anomalies or bottlenecks as they occur, triggering automated responses to adjust workflows. This real-time optimisation helps maintain peak efficiency and respond to changes without delay.
- Data-Driven Process Redesign: With AI and ML, organisations can harness large datasets to uncover patterns and inform process redesign. Data analytics can reveal areas of improvement, guide workflow adjustments, and even predict outcomes. This approach ensures that BPR efforts are not only based on theoretical redesign but are also grounded in actionable insights from existing process data.
- Hybrid Workforce Management: Automation allows BPR to integrate human and digital workforces effectively, assigning routine tasks to bots while leaving more strategic tasks to human employees.
- Cross-functional collaboration: Automation streamlines information sharing and collaboration across departments. Automated workflows reduce silos, allowing for seamless data transfer and process handoffs between functions.

V. LITERATURE OF REVIEW

This section provides related work on BPR in the era of automation. Table I also summarises the reviews of literature that are mentioned below:

This paper, **Xin (2009)** gathered the approach and development of BPR, as well as the evaluation of EC and BPR tools in the business process. With the growth of EC, IT advancements have drastically altered how companies run, and in order to stay competitive, firms are interested in re-engineering and tackling business process management[67].

This paper, **Rahayu, Setvowati and Novianti (2023)** intends to use the E-Form Information System to find holes in current processes and suggest a re-engineered model of those processes. Based on its analysis and design of workflows using BPR, this study provides five components for the firm model. The article continues by talking about how rental businesses must enhance their basic business processes to stop the leaking of client data. In order to determine what variables contribute to this risk, it provides a fishbone analysis. Observation, interviews, and literature reviews are some of the data-gathering tools used in this descriptive-qualitative analysis[68].

This paper, **Al-Anqoudi and Al-Hamdani (2022)** suggests using a ML model to re-engineer company processes by identifying and classifying different forms of waste based on Lean Six Sigma principles. ML model development for waste elimination was motivated by Lean Six Sigma ideas. The article suggests machine learning model input features derived from interviews with Lean Six Sigma Black Belts and specialists in BPR project implementation[69].

This research study **Ramdass and Sukdeo (2022)** examines the present difficulties by use of a manufacturing facility's implementation of BPR. The study's overarching goal is to help businesses better serve their customers by identifying and addressing the root causes of production and delivery issues that arise throughout pre- and online production. In order to understand the root reasons for inefficiency in this industry, data was collected utilising a qualitative approach using a case study technique[70].

In this paper, **Mora and Sanchez (2020)** Higher education institutions are used to digital transformation and the pressures of modern digitalisation; the challenge is in implementing them effectively. Because of this, this paper suggests a theoretical framework for implementing digital transformation in higher education institutions using RPA and BPM[71].

The study, **Bevilacqua et al. (2016)** has shown the substantial benefits of line automation, including a notable rise in workstation saturation, improved alignment with Just in Time principles, a decrease in the number of employees, and an increase in the rigour of the quality control process. The investigation was only conducted on one of the company's production lines. The results of this study demonstrate the substantial advantages of assembly process automation as it pertains to organised implementation. Managers of processes and logistics who

are engaged in the design or planning of a new assembly line may find the results particularly useful [2].

TABLE 1: Summary of the literature review of Business Process Re-engineering in the Era of Automation

Reference	Objective	Application Area	Contributions	Challenges	Future Work
[67]	Review BPR and EC tools for business process re-engineering (BPR) and methodology evolution.	General Business Process	Discusses how EC and IT advancements impact BPR; highlights firms' approaches to improving business process management for competitive advantage.	Difficulty in standardising EC tools across diverse business processes.	Further exploration into EC tools' adaptation in various industries and updated BPR methodologies.
[68]]	Identify process gaps and propose re-engineered process model with E-Form Information System.	Rental Services	Proposes five components for BPR in rental companies, focusing on preventing customer data leakage through improved core business processes.	Security challenges related to data privacy and implementation of effective preventive measures.	Explore more secure data management techniques and expand re-engineering model to other service industries.
[69]	Develop a machine learning model to classify waste in business processes using Lean Six Sigma.	Waste Identification in Processes	Proposes a machine learning model based on Lean Six Sigma concepts to identify and eliminate waste in business processes. Input attributes are defined with input from Lean Six Sigma experts.	Complexity in training ML models with limited, domain-specific datasets and real-world waste classification issues.	Testing and validation of the model in real-world applications, refining waste categorisation and expanding to other waste types.
[70]	Analyse BPR at a manufacturing facility to address production defects and delays.	Manufacturing	Identifies causes of production inefficiencies in manufacturing, providing insights and recommendations to enhance customer delivery by reducing pre-production and online production issues.	Resistance to change from stakeholders and challenges in real-time data collection during production processes.	Implement BPR across other production lines and expand to automated tracking systems for real-time analysis.

[71]	Propose a digital transformation model for Higher Education Institutions (HEIs) with BPM and RPA.	Higher Education Institutions	Presents a model to guide HEIs through digital transformation by integrating BPM with RPA to address digitalisation pressures.	Complex integration of BPM and RPA in legacy systems of HEIs, requiring significant adaptation.	Further research on RPA integration with other digital transformation tools across various academic and administrative functions.
[2]	Assess impact of line automation on assembly processes	Assembly Line in Manufacturing	Reports significant improvements in workstation utilisation, adherence to Just-in-Time principles, reduced labour, and enhanced quality control, underscoring the benefits of structured automation implementation for process and logistics managers in assembly line planning.	Initial investment costs and training requirements for automation technologies.	Expansion of automation strategies to other assembly lines and evaluation of long-term operational impacts.

VI. CONCLUSION AND FUTURE WORK

The integration of automation technologies into Business Process Re-engineering (BPR) presents both significant opportunities and challenges for enterprises. As a result, automation simplifies organisational processes, lower business expenses, enhances reliability, and facilitates quick decision-making, making it a crucial factor for any organisation which wants to be relevant in the market system. However, the combination of automation with BPR also poses challenges to the technological, skill development and organisational culture. This means that enterprises should adopt a broader approach and ensure that the automation solution is integrated into the enterprise's goals and objectives, apart from having an appreciation of issues such as displacement of the workforce and resistance to change. Consequently, trusting the related risks and successes of BPR and automation, organisations can lead the way and define the ultimate shifts in their strategy and approach in the future. The future of BPR is future development of automation technology, will remain the key issue of BPR to change the business environment of industries in terms of efficiency and flexibility, or even lasting enhancement.

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