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BUSINESS PROCESS OPTIMIZATION THROUGH SIMULATION USING IBM WEBSHERE MODELER SOFTWARE

Abstract: Simulations are essential tools in the analysis and optimization of business processes. They enable the modeling of complex systems and processes to predict outcomes under various conditions, without the need to implement these changes in a real-world setting. This paper explores how simulation tools can enhance business processes. Simulations are used to replicate real operations in a virtual environment, allowing for performance analysis and the identification of potential improvements. In the context of business process optimization, simulation helps in understanding the impact of resource changes, such as adjustments in employee numbers, on overall efficiency and productivity. Simulation plays a significant role in the modern logistics sector, enabling organizations to improve operational efficiency across various aspects. Additionally, simulation tools help identify and resolve bottlenecks within the supply chain, thereby enhancing process speed and efficiency. By optimizing the flow of materials and information, simulation contributes to reducing delays and increasing accuracy in logistical operations. These aspects collectively allow organizations to enhance logistics performance, reduce costs, improve customer service, and ultimately strengthen their competitiveness in the market.

Keywords: simulation; optimization; logistics; business processes

1. Introduction

The research focuses on the optimization of the commissioning process using IBM WebSphere Modeler software. Commissioning, a key phase in logistics and supply chain management, involves the collection and preparation of products for delivery based on detailed customer specifications. The efficiency of this process directly affects overall operational performance, costs, customer satisfaction, and the organization's competitiveness in the market. By thoroughly defining business processes and examining process orientations, optimization methods, and IBM WebSphere Modeler software, it becomes possible to enhance commissioning efficiency, minimize losses, and improve operational effectiveness. Detailed modeling and simulation of business processes help identify and eliminate bottlenecks and inefficiencies. The study explores the definition, modeling, and simulation of the commissioning process, with practical application revealing challenges and offering recommendations for improvement. It also highlights the importance of clearly defining and managing business processes, along with exploring analytical and software methods for process optimization.

2. Defining Business Process and Process Orientation

ISO 9001:2015 defines a process as a set of interconnected activities that transform inputs into outputs. Business processes must be clearly defined to ensure their efficiency, with each activity having well-defined inputs and outputs. Properly defined processes reduce the risk of errors and inefficiencies, and also facilitate compliance with industry regulations. Additionally, clear processes enable the implementation of technological solutions, such as business process management software, to automate tasks and track performance. However, challenges in defining business activities within processes include resistance to change, dynamic business environments, and the need for flexibility in unpredictable situations. Resource management, including human, material, and financial resources, is crucial for optimizing costs and time. The efficient allocation of resources ensures operational continuity and prevents disruptions in production or service delivery.

Business processes are categorized into operational, support, and management processes.



Operational processes are essential for producing goods or services, support processes ensure the smooth functioning of operational activities, and management processes involve planning, control, and coordination of activities within the organization. Process development can be viewed through several stages, including phases such as Ad hoc, Defined, Linked, and Integrated, which illustrate the transition from unstructured to fully integrated processes, with a gradual increase in efficiency and adaptability. These stages demonstrate the evolution from unstructured to fully integrated processes, with increased efficiency and adaptability at each level. While challenges in adopting process orientation include organizational culture, resource limitations, and technological hurdles, the benefits are clear: improved efficiency, quality, flexibility, and continuous improvement. In summary, organizations face unique challenges when implementing business process orientation but can achieve success through a flexible, continuously improving approach that aligns with strategic goals and fosters collaboration.

2.1. Process Documentation and Mapping

Documenting and mapping business processes is crucial for improving organizational efficiency and control. It helps create clarity by outlining each step, responsibility, and relationship within a process, ensuring transparency for all stakeholders. Weske (2023.) describes how business process modeling not only serves to document the current state, but also provides a foundation for deeper analysis and further process improvement. This process also identifies inefficiencies, bottlenecks, and areas for improvement, leading to better productivity.

Documentation involves detailing each step, including inputs, outputs, resources, and responsible individuals, while mapping provides a visual representation, often through flowcharts. These tools simplify understanding and help identify improvements. More advanced techniques like BPMN offer greater precision, but require more expertise.

Benefits of process documentation and mapping include improved communication, efficiency, regulatory compliance, and easier employee training. However, challenges include the complexity of processes, the need for expert knowledge, time investment, and maintaining up-to-date documentation. To add, Rosemann and vom Brocke (2020.) explain how one of the persistent challenges in business process management is bridg-

ing the gap between technical models created by IT professionals and the real business realities experienced by practitioners. They emphasize that despite improvements in modeling notations and tools, maintaining model relevance and alignment with business goals requires ongoing stakeholder engagement and iterative validation.

Despite these challenges, well-documented and mapped processes enhance decision-making, reduce costs and improve collaboration.

2.2. Business Process Management

Management is the process of planning, organizing, directing, and controlling resources to achieve specific goals. It involves coordinating activities, decision-making, resource allocation, and monitoring performance to ensure desired outcomes. The foundation of business process management lies in explicitly defining business processes, which can then be analyzed, improved, and executed effectively (Weske, 2012).

Key goals of business process management include:

- Increasing efficiency
- Reducing costs
- Improving quality
- Enhancing customer satisfaction
- Improving flexibility and agility

Business process management systems (BPMS) are software tools designed to coordinate and execute business processes. These systems reduce costs, improve efficiency, and enhance organizational flexibility, ultimately strengthening market competitiveness. Implementing a BPMS requires a comprehensive approach, involving goal definition, stakeholder engagement, and continuous performance monitoring.

Performance measurement and monitoring are crucial for identifying bottlenecks and driving continuous improvement. Key performance indicators (KPIs) such as cycle time, error rates, process costs, and customer satisfaction provide concrete metrics to assess process success. Methodologies like PDCA (Plan-Do-Check-Act) and Kaizen help implement changes, track outcomes, and refine strategies.

Technology plays a significant role in optimizing business processes, automating routine tasks, integrating systems, and ensuring regulatory compliance. It also facilitates collaboration and enhances employee mobility through tools for



remote access and real-time performance analysis.

Customer experience is also critical in business process management. Optimizing processes to provide value and positive experiences leads to higher customer satisfaction, loyalty, and ultimately, increased revenue. Satisfied customers contribute to organizational growth by attracting new clients and enhancing reputation.

Effective business process management leads to improved performance, cost reduction, and efficiency. With the integration of technology and a focus on continuous improvement, organizations can achieve sustainable growth and competitive advantage.

2.3. DMAIC Method and its Role in Continuous Process Improvement

The DMAIC approach, a core principle of Six Sigma, has its roots in early 20th-century quality management practices, starting with Frederick Taylor's scientific management and Walter A. Shewhart's development of control charts and the PDCA cycle. Bill Smith at Motorola refined Six Sigma in the 1980s to reduce process variation and improve quality. DMAIC, which stands for Define, Measure, Analyze, Improve, and Control, is a structured methodology widely used to enhance business processes across various industries.

DMAIC's flexibility allows it to be applied in fields such as manufacturing, finance, healthcare, and IT. In manufacturing, it increases efficiency and reduces waste, as seen in Toyota's operations. In finance, it improves transaction accuracy and customer satisfaction, while in healthcare, it enhances patient safety and operational efficiency. IT uses DMAIC to streamline software development and reduce errors. This adaptability makes DMAIC a valuable tool for continuous improvement. Key benefits of DMAIC include improved operational efficiency, enhanced product quality, and a culture of continuous improvement. By identifying bottlenecks and inefficiencies, DMAIC helps organizations optimize resources, improve processes, and increase productivity. The methodology's iterative process ensures long-term success by enabling organizations to adapt quickly to changes.

However, DMAIC does have limitations. It can be time-consuming due to its reliance on data collection and analysis, and its focus on historical data may hinder its ability to predict future issues.

Additionally, DMAIC's emphasis on incremental improvement may limit radical innovation. Organizations can overcome these limitations by combining DMAIC with other methodologies, such as Lean or Agile, to drive both process optimization and innovation.

In conclusion, DMAIC is a powerful tool for improving business processes. When adapted to the specific needs of an organization and combined with modern technologies, it can enhance efficiency, quality, and customer satisfaction, ensuring long-term competitiveness in a dynamic market.

3. Business Process Optimization Methods

In today's business environment, there is a constant need to improve efficiency, quality, and competitiveness, which requires the application of various business process optimization methods. Davenport and Short (1990) define business process optimization as business reengineering and radical redesign aimed at achieving dramatic improvements in key performance metrics such as cost, quality, service, and speed. This definition emphasizes the importance of transforming business processes to enhance operational performance, involving complete reconstruction, such as changing organizational structures or introducing new technologies.

The goal of optimization is to eliminate inefficiencies, reduce variability, and improve customer satisfaction. Eliminating inefficiencies focuses on removing non-value-adding activities, while reducing variability ensures consistency in product and service delivery. Continuous improvement and customer focus are vital to achieving high quality and remaining competitive in a dynamic market. However, challenges in setting and achieving optimization goals include overambitious targets, lack of resources, and insufficient technical support, which can limit success and lead to resistance to change.

Business process optimization methods can be categorized into analytical methods and software solutions. Analytical methods involve techniques to analyze and improve processes, identifying bottlenecks and inefficiencies. These methods form the basis for informed decisions on where and how to implement changes with minimal risk. Software solutions leverage advanced technology to automate processes, manage workflows, and visualize performance in real-time. They enable organizations to quickly implement changes, track



performance, and predict problems before they arise. Mendling, reijers and van der Aalst (2021.) state how successful business process optimization depends on combining thorough analytical approaches to identify inefficiencies and bottlenecks with adaptable software solutions that support automation, continuous monitoring, and quick adjustments to evolving business needs.

Often, organizations combine both approaches for a holistic optimization strategy. Analytical methods provide deep insights into processes, while software solutions enable rapid implementation, monitoring, and adjustments. This combination supports continuous improvement, enhances operational efficiency, and helps organizations maintain a competitive edge.

3.1. Analytical Methods for Process Optimization

Analytical methods for business process optimization include a suite of techniques aimed at analyzing, modeling, and improving processes to boost efficiency, reduce costs, and enhance quality. These methods utilize data analysis and quantitative approaches to guide informed decisions on process improvements. For any organization focused on operational efficiency and high-quality outcomes, implementing these methods is crucial. By analyzing data within processes, organizations can identify and address issues, leading to significant improvements.

Davenport (1993) emphasizes that analytical methods offer in-depth data insights that support fact-based decision-making. Techniques for data processing and analysis allow organizations to gain a deeper understanding of operations, markets, and other relevant areas. Systematic data analysis reveals patterns and trends, providing a solid foundation for decisions based on facts rather than intuition. In contrast to reactive management approaches, analytical methods enable organizations to anticipate issues and manage processes proactively. By using advanced techniques such as statistical models and deep analytics, organizations can identify potential weak points and implement risk-reduction strategies before problems arise, enhancing flexibility, efficiency, and responsiveness to change.

However, analytical methods are not without challenges. They rely heavily on data quality; missing or inconsistent data can compromise the accuracy of analytical results. Interpreting com-

plex results can be difficult, requiring specialized knowledge to apply insights correctly. Additionally, there are limitations in predicting rare or unexpected events, such as natural disasters or geopolitical changes, which may disrupt operations unexpectedly.

Prominent analytical methods include linear programming, nonlinear programming, dynamic programming, stochastic programming, and integer programming. Each offers unique strengths in addressing various optimization challenges across diverse business processes.

4. Description of IBM WebSphere Modeler Software and its Application

IBM (International Business Machines Corporation) is a global technology and consulting organization responsible for developing IBM WebSphere Modeler and other groundbreaking technologies. IBM WebSphere Modeler is a business process modeling tool that allows organizations to visualize, analyze, and improve their processes effectively. As part of IBM's business process management portfolio, this tool supports operational efficiency and optimization efforts.

The development of IBM WebSphere Modeler began in the late 1990s and early 2000s as IBM recognized the growing need for advanced tools that enable detailed modeling and analysis. Its integration with IBM's WebSphere suite allowed users to connect process modeling with broader IBM solutions, enhancing alignment and process efficiency. Over time, IBM continued refining WebSphere Modeler, incorporating features such as improved simulation and integration with IBM Business Process Manager, ultimately making it part of IBM's broader automation portfolio, including platforms like IBM Business Automation Workflow and IBM Robotic Process Automation.

IBM WebSphere Modeler features an intuitive interface that facilitates business process modeling and analysis through a main workspace, drag-and-drop diagramming, analysis, and simulation tools for testing processes across various scenarios. Managers and engineers utilize this tool to optimize workflows, resolve bottlenecks, document processes, and support change management. In industries like manufacturing, it aids in improving production line efficiency and reducing costs by modeling and simulating equipment layouts and testing adjustments to maximize production speed and minimize labor costs.



5. Optimization of the Order-Picking Process Using IBM WebSphere Modeler

This chapter will provide a description of the order-picking process, followed by the mapping and documentation of the process. Building on the documentation and mapping, a DMAIC analysis will be conducted, along with the application of IBM WebSphere Modeler software to identify and implement the optimal solution for bottlenecks identified within the order-picking process.

5.1. Order-Picking Process Description

The order-picking process begins when a customer places an order for the required products. The sales department receives and confirms the order (verifying customer details, product quantities, and accuracy). Once confirmed, the order is entered into the system and forwarded to the warehouse department. In the warehouse, the order is reviewed and prioritized. Products are checked for availability, and employees are assigned to pick full pallets or individual items. Once all products and quantities are confirmed available, the picking activity begins. Employees use devices to pick the required products and quantities. If any items or quantities are unavailable, the warehouse updates the order, adjusting quantities to match available stock. The sales department contacts the customer for approval to proceed with the updated order. If the customer does not approve, the order is canceled, and the picking process stops.

Once the order is updated, the picking process continues with the adjusted quantities. After the picking is complete, the products are prepared for delivery, typically by wrapping pallets with plastic and placing them in the designated zone. When this is done, the order-picking process ends, and the next process begins. While not part of the order-picking process, customers may place a follow-up order for unavailable items.

5.2. DMAIC analysis

The organization faces issues with errors in order picking and extended processing times for certain orders. These problems lead to reduced operational efficiency and customer dissatisfaction due to discrepancies in product quantities. With a high volume of orders and varying product sizes, fewer employees are under greater pressure, increasing

the risk of picking incorrect product quantities. Additionally, due to this pressure, there is often a lack of oversight on prepared orders awaiting dispatch, leading to incorrect quantities being picked and impacting customer satisfaction. The project scope encompasses all activities, tasks, and deliverables required to achieve the project's objectives. Proper scope definition ensures alignment of stakeholder expectations, efficient resource allocation, and clear planning. It identifies the activities that are included in the project and excludes those that are not to avoid scope creep. A stakeholder register is a key project management tool for identifying and analyzing the needs and interests of relevant stakeholders. This tool helps the project team plan and manage the project by providing an overview of stakeholder requirements and priorities, ensuring that project resources and efforts are aligned with critical goals. Through collaboration with the warehouse and logistics managers, I gathered data on average order picking time, order receipt time, order review and prioritization, order updates, cancellations, dispatch preparation, and customer contact. These data points enable the creation of an accurate simulation reflecting real-time activities, aiding in process optimization.

The Pareto chart is used to identify and analyze the most significant factors in the process, based on the 80/20 rule. It highlights that a large portion of issues stem from a small number of causes. The Pareto chart helps prioritize actions to focus on addressing the most critical problems. For this case, the most frequent issue identified is incorrect order picking.

The Ishikawa diagram (Fishbone diagram) is used to uncover the root causes of problems. This tool categorizes potential causes and helps focus on the key factors behind an issue. For the problem of incorrect order picking, the primary cause identified is employee-related factors, such as inadequate staffing, low motivation, negligence, fatigue, and failure to follow procedures. The most significant of these causes is the lack of adequate staffing.

To further explore this, the Five Whys technique is applied. By asking "why" repeatedly, the technique helps identify the root cause of a problem and enables the implementation of effective, long-term solutions. Addressing workforce-related issues through this method will help reduce errors in the order-picking process, improve operational efficiency, and enhance customer satisfaction.



5.3. Application of IBM WebSphere Modeler in Optimizing the Order Picking Process

The first step toward confirming or rejecting the conclusion regarding the employment of additional warehouse order pickers is to create and simulate the current state of the process, particularly the segment surrounding this activity. The data available is entered into the software, and the current state of the simulation is developed.

Since the conclusion from the DMAIC analysis is not related to a change in the entire process but rather to the addition of extra personnel, specifically the hiring of more workers, the overall process design will remain unchanged, with the focus shifting to statistical analysis. In the first scenario, we simulate the current state.

The simulation reveals that 150 orders are generated, and the processing time for these orders takes approximately three days. One order picker is involved in the process, along with a warehouse manager who is responsible for overseeing it. Additionally, there is one sales representative. The average cost per individual process is EUR 2.241.

The next step involves a more detailed analysis, extracting further insights that will provide the organization with a better understanding of the current situation. The analysis highlights that the processing time, assuming no delays or bottlenecks, would typically take 18 minutes. However, upon examining the first order arrival, it becomes evident that the process is delayed and takes 48 minutes instead. This is because the orders arrive faster than the order picker can process them. As a result, the picker cannot complete the first order before the next one arrives, which means they start preparing for the next order before finishing the previous one. The final step—preparing the order for shipment—is done during any available free time between activities.

This pattern repeats itself, causing the total time to complete one order to exceed six hours due to a backlog of orders. The workforce, in terms of the number of order pickers, is insufficient to keep the process on track as initially projected. Consequently, some customers will have to wait for their orders, or, in practice, workers will need to work overtime to compensate for the backlog, ensuring customers do not face delays.

It should also be noted that, based on the simulation results, an optimal average of 150 orders is completed per day. However, the number of completed orders per day is only 10 due to the constraints mentioned. Given the issue with the

number of order pickers, the next step involves simulating the same process but with the addition of another picker. The simulation results of this adjusted scenario are then analyzed.

In conclusion, based on the simulations and analyses conducted, the optimal number of employees that the organization should hire is two, meaning the organization should have a total of three employees dedicated solely to order picking in order to ensure the process and its duration are optimal and efficient. It is important to emphasize that the structure of the process itself is optimal, and there is no need to alter the sequence of activities or add new ones to the existing workflow. Additionally, it should be noted that the simulation results indicate the optimal number of employees required for the process to function efficiently. Employees are entitled to annual leave and sick leave, and the dynamic system is not unfamiliar with handling exceptional situations.

6. Conclusion

In conclusion, based on the simulations and analyses conducted, the optimal number of employees that the organization should hire is two, meaning the organization should have a total of three employees dedicated solely to order picking in order to ensure the process and its duration are optimal and efficient. It is important to emphasize that the structure of the process itself is optimal, and there is no need to alter the sequence of activities or add new ones to the existing workflow. Additionally, it should be noted that the simulation results indicate the optimal number of employees required for the process to function efficiently. Employees are entitled to annual leave and sick leave, and the dynamic system is not unfamiliar with handling exceptional situations. Therefore, the organization would not be making a mistake by hiring one more employee (for a total of four pickers) in anticipation of exceptional situations or periods of annual leave, during which it could operate with one fewer employee for a certain period. However, the conclusion of this study, as already stated, is that the organization should operate with three order pickers. The results of the current state simulation revealed a bottleneck in the order picking and preparation for delivery stages, which aligns with the findings from the previous DMAIC analysis. The bottleneck occurred due to a shortage of employees, meaning that when the picking activity starts, the employee does not have enough time to complete the process (prepare the picked products



for delivery) before the next order comes in. In practice, the employee completes the picking, but the preparation of the picked goods is delayed. This causes the process to take much longer than expected, as the bottleneck prevents timely completion. Adding one more employee leads to significant improvements, as employees handle more orders, increasing throughput and reducing bottleneck pressure, resulting in a more stable process. However, the bottleneck still exists, though it becomes more apparent and quicker to identify in the simulation with just one employee. Simulating with three employees (the optimal number) produces the best results, reducing delays and ensuring process efficiency. The simulation with four employees does not lead to significant changes in processing time, but it introduces unnecessary costs. Although the time and outcomes remain the same, the cost increases due to the additional employee. However, as

mentioned earlier, if the organization hires four employees, it accounts for situations like annual leave or sickness. In practice, having four order pickers ensures that even if one employee temporarily leaves, the process remains efficient with three employees, the optimal number, maintaining workflow stability. In the future, business process simulation software is expected to evolve in multiple directions. The integration of artificial intelligence (AI) and machine learning will greatly enhance the capability of simulation tools to predict and analyze complex scenarios. AI will enable these tools to identify patterns and generate more accurate forecasts based on large datasets, thereby improving the precision and efficiency of simulations. Furthermore, software solutions will become more flexible and adaptable, offering the ability to dynamically adjust simulations in real time in response to changes in business conditions and environments.



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