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Revolutionizing inventory management: A comprehensive automated data-driven model using power BI incorporating industry 4.0

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Abstract

This is a study on advanced inventory management approaches in the mechanical industry using data-driven models, accompanied by Power BI analytics. Drawing insights from broad collaboration with relevant industrial expertise at different organizational scales, our research work addresses the intricacies and challenges in maintaining optimal inventory levels concerning growing industries and operational risks.

In this global mechanical firm, we analyzed historical data using descriptive and predictive analytics to understand the trends of the past and to forecast future inventory needs. Descriptive analytics provided base insights about the present status of inventory, while predictive analytics helped proactive management of stock levels classified into on-hand and critical level categories for greater efficiency in strategies related to planning at the coordination end with its suppliers and mitigating risks.

Core to our methodology will be the implementation of an automated data-driven machine-learning approach that brings minimal intervention from humans to solve some of the most critical problems in inventory management. One major contribution this study adds is a major product: a Power BI dashboard that visualizes critical part numbers falling below threshold values and recognizes suppliers with historical shipment shortages. Armed with this intuitive dashboard, supplier-coordinating engineers are better placed to take proactive action on inventory shortages, greatly improving operational efficiency in supply chain resilience.

Keywords: Inventory management; Power BI; Industry 4.0; Big data; Supply chain management

1. Introduction

Companies must consider inventory management as a vital component of their business as this is directly related to profitability and revenue. However, the difficulties inherent in this procedure have endured, as numerous firms continue to depend on obsolete or ineffective techniques. The emergence of sophisticated data-driven tools, like Power BI, presents a hopeful resolution to these enduring problems, allowing organizations to transform their inventory management procedures. This research study introduces a thorough and automated data-driven methodology for managing inventory, utilizing the functionalities of Power BI. This paper explores the significant value of data governance, the fusion of AI and BI, and the fundamental principles of efficient inventory management, based on insights from reputable industry sources.

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1.1. Background and Significance

In the digital age, data has emerged as a strategic asset with the power to propel organizations toward unparalleled levels of economic prosperity [1]**.** The rapid shift from traditional industry to an economy based on information technology has underscored the critical role of data governance in ensuring the trustworthiness and reliability of data [2]. The growing volume of data generated by customers, tools, and business processes has overwhelmed traditional business intelligence tools, leading to the recognition that "spreadsheets and dashboards will be replaced by AI-powered tools that explore data, find insights, and make recommendations automatically" [3]. The integration of AI and business intelligence, as demonstrated in the case study "Bringing AI to BI" [4], has the potential to revolutionize inventory management by automating the process of inferring navigable data structures from unstructured data sources.

1.2. The Importance of effective inventory management in supply chain and manufacturing

Effective inventory management plays a crucial role in supply chain and manufacturing operations, with significant implications for profitability, customer satisfaction, and overall efficiency [5]. Organizations can improve the effectiveness of their supply chains by improving inventory operations, leading to lower holding costs, fewer stockouts, and improved supply chain reliability. Furthermore, by giving priority to inventory items that require less attention, organizations can achieve significant time and resource savings, allowing them to focus on more essential obligations. Nevertheless, BI solutions implementation is associated with several challenges such that a lot of companies find it difficult to integrate and utilize business intelligence (BI) tools and technology, hence it hinders the ability to fully capitalize on the advantages offered by these tools. The problems can be attributed to multiple factors, including the absence of training and a technology driven approach that prioritizes data-driven decision-making, inadequate data governance, and the complexity of integrating BI tools with existing systems.

1.3. Challenges faced in traditional manufacturing system

Traditional manufacturing systems often rely on outdated or inefficient inventory management methods, leading to a range of challenges. These challenges include:

- Inaccurate forecasting: Sole Reliability on historical data and mundane manual processes can lead to inappropriate demand predictions, which can result in either excessive or insufficient inventory levels.

- Insufficient visibility: Visibility of current inventory levels and the dynamics of the supply chain echelon might hinder timely decision-making and result in sub-optimal allocation of inventory.

- Inefficient processes: The manual recording and reporting of inventory can consume a significant amount of time and is prone to mistakes, which can hinder the overall effectiveness of the business. Traditional inventory management systems may have challenges in effectively handling the increasing complexity and volume of data, which can affect the organization's capacity to expand and adjust to evolving business needs.

- Reactive approach: Adopting a reactive mindset, as opposed to a proactive one, can cause delays in responding to fluctuations in demand or supply, which can result in stockouts or excessive inventory.

- Siloed data: Fragmented data across different systems and departments can impede the organization's ability to gain a holistic understanding of its inventory and supply chain [6].

- Efficient processes: Manual and fragmented inventory management processes can be time-consuming, error-prone, and inconsistent, hindering the overall efficiency of the organization.

- These challenges underscore the need for a more comprehensive, automated, and data-driven approach to inventory management, which can be addressed through the integration of AI-powered BI tools like Power

1.4. Objective

Through this research study, we explain a Novel and automated data-driven model for managing inventories, utilizing the functionalities of Power BI. This model seeks to transform enterprises' approach to inventory optimization by tackling the main difficulties of traditional inventory management systems. With this proposal, the ultimate goal is to achieve higher margins of profitability, higher customer happiness, and increased operational efficiency using cutting-edge tools and technologies.

1.5. The purpose of creating an automated data-driven model

The purpose of creating an automated data-driven model for inventory management is to mainly enhance the accuracy of demand forecasting. Moreover, BI implementation can significantly increase the accuracy of demand forecasting. Through the integration of real-time data from many sources, the model can utilize advanced analytics and ML and AI algorithms to produce more accurate predictions of demand. This helps to minimize the likelihood of having excessive or insufficient inventory. Furthermore, the model seeks to offer improved clarity regarding inventory levels and the dynamics of the supply chain. Through the consolidation of data from several systems and processes, the model provides a comprehensive and up-to-date perspective on inventory levels, allowing for prompt and well-informed decision-making. Furthermore, the approach aims to optimize inventory management procedures: Through the automation of processes such as placing orders, restocking inventory, and generating reports, the model can greatly enhance the effectiveness of inventory management, allowing for the allocation of resources towards more strategic endeavors.

1.6. Why Power Bl is chosen for this task

Power BI is the chosen platform for this automated data-driven inventory management model due to its robust capabilities in data integration, visualization, and advanced analytics. Power BI's ability to connect to a wide range of data sources, including enterprise resource planning systems, supply chain management software, and external data providers, allows for the consolidation of disparate data into a unified, centralized platform [7]. Furthermore, Power BI's intuitive and highly customizable dashboards and reporting capabilities enable organizations to gain immediate insights into their inventory levels, consumption patterns, and supply chain performance [8].

Moreover, Power BI's intuitive user interface and drag-and-drop functionality enable the creation of interactive dashboards and reports, providing decision-makers with a comprehensive and easily accessible view of inventory data. Additionally, Power BI's integration with AI and machine learning algorithms, such as those used in demand forecasting and inventory optimization, allows for the development of a truly data-driven and automated inventory management solution. [9]. By leveraging the capabilities of Power BI, organizations can overcome the limitations of traditional inventory management systems and unlock the full potential of their data, leading to improved decision-making, enhanced operational efficiency, and increased profitability. [9]

1.7. Scope and Limitations

The scope of this research paper is to present a comprehensive, automated data-driven model for inventory management using Power BI. The model will focus on the following key components:

1.7.1. Scope

- Comprehensive Data Integration
- Advanced Analytics and Machine Learning
- Real-Time Monitoring and Reporting
- Automation of Routine Tasks
- Scalability and Adaptability

1.7.2. Limitations

- Initial Implementation Cost and Complexity
- Data Quality and Accuracy
- Dependency on Technology
- Resistance to Change
- Privacy and Security Concerns

2. Literature Review

Inventory management has been a critical aspect of supply chain operations for decades, with organizations employing various strategies and techniques to optimize their inventory levels. The lack of integration between different business systems, such as purchasing, sales, and accounting, made it difficult to obtain a holistic view of inventory and supply chain operations. [10]. However, these traditional approaches have been increasingly challenged by the growing complexity of modern supply chains, the rise of e-commerce, and the need for near real-time responsiveness to customer demands.

2.1. Overview of traditional methods and their limitations

Traditional inventory management methods, such as Economic Order Quantity, ABC analysis, and Min-Max inventory levels, have been widely used in the past [11]. However, these methods often rely on static, historical data and may struggle to adapt to the dynamic nature of modern supply chains. The centralized production-inventory models discussed in the literature [11] have been useful in decentralized decision-making settings, but they may not adequately capture the strategic role of inventories in capturing revenue and market share, particularly in customer-scarce markets. Moreover, traditional approaches often suffer from siloed data, inefficient processes, and a lack of visibility into the overall supply chain, leading to suboptimal inventory decisions and increased operational costs [12].

2.2. Historical evolution of inventory management practices

Over the years, inventory management practices have evolved from basic reorder-point systems to more sophisticated techniques. The introduction of enterprise resource planning systems and other business information systems has enabled greater integration and automation of inventory management processes. However, these systems often rely on MRP-based models that may not fully address the complexity of modern supply chains, particularly in periods of disruption, such as the COVID-19 pandemic [12].

2.3. Data-Driven Approaches in Inventory Management

The limitations of traditional inventory management methods have led to the increasing adoption of data-driven approaches, which leverage advanced analytics, machine learning, and optimization techniques to improve inventory planning and decision-making. Robust data governance is a fundamental prerequisite for the successful implementation of any data-driven initiative, including the proposed inventory management model. Data must be viewed as a strategic asset, and organizations must adopt a systematic approach to ensure its trustworthiness, reliability, and accessibility. As the sources highlight, the lack of reliable and quality data is a significant obstacle to the effective implementation of business intelligence systems. To address this challenge, organizations should follow a comprehensive data governance framework that provides a clear recipe for harnessing data as a strategic asset.

Treating data as a strategic asset is a fundamental principle in achieving success in the digital age [13]. The integration of data into everyday operations and strategic business decisions has provided organizations with new resources and competitive advantages [13]. Business intelligence systems have emerged as a powerful tool for harnessing the value of data, allowing for the collection, storage, and analysis of both internal and external information [5].

However, the implementation of such systems is not without its challenges. The readiness of the organization, in terms of resources and managerial culture, is critical to the successful adoption of BI solutions [10]. Developing a comprehensive strategy to ensure the highest possible utilization of BI tools and processes is essential for maximizing the benefits these systems can provide, such as increased profits, improved efficiency, process optimization, and time/cost savings [8].

In this research paper, we propose a novel, data-driven model for revolutionizing inventory management using the power of Power BI. This model addresses the key barriers to BI adoption, including the lack of reliable and quality data, and provides a systematic framework for harnessing the transformative potential of data-driven decision-making [5]

2.4. Introduction to data analytics and its impact on inventory management

Data analytics and advanced modeling techniques, such as reinforcement learning, have shown great potential in addressing the challenges of inventory management. [13]. By leveraging these tools, organizations can gain deeper insights into demand patterns, supply chain dynamics, and the impact of various factors on inventory levels. Data-driven

approaches can help organizations optimize their inventory levels, improve demand forecasting, and enhance supply chain visibility, leading to increased efficiency, reduced costs, and better customer service. [12,13]. Based on these forecasts, the model can then optimize inventory levels, ensuring that the right products are available in the right quantities at the right time. This not only reduces the risk of stockouts or excess inventory but also minimizes the associated carrying costs and improves overall inventory turnover [14].

2.5. Case studies or examples of data-driven inventory management

One example of a data-driven approach to inventory management is the use of distributional constrained reinforcement learning, as discussed in the literature. [13] This technique allows for the optimization of inventory levels while accounting for the uncertainty and complexity of supply chain environments. Another example is the integration of finished goods inventory management with key inventory drivers, as described in a study on the pharmaceutical supply chain [12]. This multidisciplinary approach provides a more comprehensive understanding of the factors influencing inventory levels and enables practitioners to make more informed decisions, particularly during periods of supply chain disruption.

2.6. Tools and Technologies

The advancements in data analytics and business intelligence tools have significantly enhanced the capabilities of organizations in managing their inventory effectively. One such tool that has gained widespread adoption is Power BI, a powerful data visualization and analytics platform developed by Microsoft. Power BI's ability to integrate data from multiple sources, perform advanced analytics, and create interactive dashboards makes it an ideal tool for inventory management. [15,16]. The Power BI can automate key inventory management processes, including demand forecasting, stock level optimization, and replenishment planning. Using advanced predictive analytics and machine learning algorithms, the system can analyze historical sales data, market trends, and other relevant information to generate accurate forecasts of future demand. The automated nature of this process allows organizations to respond quickly to changes in demand, reducing the time and effort required for manual inventory management tasks.

2.7. Specific focus on Power Bl and its features relevant to inventory management

Power BI's features, such as real-time data integration, advanced forecasting, and optimization algorithms, can be leveraged to develop a comprehensive, automated inventory management solution. For example, Power BI's integration with ERP systems can provide a centralized view of inventory data, allowing organizations to monitor stock levels, identify trends, and optimize replenishment strategies. Additionally, Power BI's integration with machine learning models can enable more accurate demand forecasting, leading to improved inventory planning and reduced stock-outs. [16,17]. A critical component of the proposed model is the integration of Power BI's robust reporting and data visualization capabilities. By aggregating and presenting key inventory metrics and performance indicators in a user-friendly, interactive dashboard, the model empowers decision-makers with real-time, data-driven insights.

This streamlined reporting system enables managers to quickly identify trends, anomalies, and opportunities for improvement, facilitating more informed and agile decision-making [18]. Furthermore, the model's ability to generate custom reports and analyses based on user-defined criteria allows for a high degree of flexibility and personalization, ensuring that the information provided is tailored to the specific needs of each organization. By combining the principles of data governance, quality management, automated inventory optimization, and advanced reporting, the proposed model offers a comprehensive, data-driven approach to revolutionizing inventory management.

This approach has the potential to deliver significant benefits, including increased operational efficiency, reduced costs, improved customer satisfaction, and a more responsive and agile supply chain [8,19,20]. As organizations continue to navigate the challenges of the digital age, the adoption of such innovative, data-centric models will undoubtedly play a crucial role in shaping the future of inventory management.

2.8. Case studies or examples of Power BI implementation in inventory management

A global company, as discussed in the literature, successfully improved its inventory management metrics by incorporating ABC analysis and Power BI into its operations. By integrating data from multiple sources, the company was able to gain a holistic view of its inventory, identify slow-moving items, and optimize stock levels accordingly. This implementation resulted in a significant reduction in inventory holding costs, improved customer service levels, and enhanced decision-making capabilities for the organization. [2]. Interactive charts and graphs can be used to track inventory turnover, identify slow-moving or overstocked items, and forecast future demand [21]. In a study of small and medium-sized enterprises, researchers found that Power BI-based dashboards were an effective way to manage

the cash conversion cycle of the supply chain [3]. The dashboards provided a clear, visual representation of inventory levels, order fulfillment, and other key performance indicators, enabling managers to make more informed decisions and improve overall supply chain efficiency.

Another case study, focusing on a digital services company in Peru, highlights how Power BI can be used to generate comprehensive reports and visualize sales data by commercial advisors [22]. The dashboard allowed managers to assess whether sales targets were being met and identify top-performing sales representatives, enabling them to make more informed decisions about resource allocation and sales strategies. As the importance of business intelligence in inventory management continues to grow, Power BI's versatility and user-friendly interface make it an increasingly attractive option for organizations looking to optimize their supply chain operations.

3. Methodology

To ensure the comprehensiveness and relevance of our research on inventory management in the context of data-driven models using Power BI, we liaised extensively with experts from various sectors within the mechanical industry. This interaction was pivotal in gathering detailed insights, validating our research questions, and shaping the direction of our study. Experts were chosen from the industry with employees 1-50, 51-100, 101-500, 500, and more. As the industry grows, increased interaction of humans is observed to manage the inventory level and the high risk of getting inventory out of control. We propose an automated data-driven machine-learning approach that can resolve inventory management business issues with minimal human interaction.

3.1. Data Collection

The data used for this study was received in the form of Excel sheets from a multinational mechanical firm. Dummy data was created based on actual data for publication purposes. The sample data set of N=50 was selected for the study. Two years of data were considered for the study. A descriptive analytical approach was used to analyze past trends and performance. The following data type was considered for the study,

- Part Number- It's a unique identification assigned to a particular component or assembly to distinguish itself from other components.
- Daily Demand (D)- The daily demand of a part number was calculated based on yearly usage (YU) of that part and working days (WD) in a year.

$$D = YU / WD \ldots\ldots\ldots\ldots\ldots (1)$$

- Available qty- It's a quantity on hand, available to satisfy daily demand.
- Inventory Control Engineer- An engineer was assigned to particular amounts of part numbers to carry out supply chain duties related to those part numbers. Email addresses were used in the study to send out notifications to engineers with corresponding part numbers.
- Critical level of inventory- Predictive analytics was used to decide the critical level of inventory. It uses historical data to predict future inventory needs, helping organizations manage their stock levels proactively.

Table 1 Section of data used for the study

Part number	Daily demand	Available qty	Engineer	Email	Daily demand	Critical qty
154-732	1	20	Akash	aakadam93@gmail.com	1	15
154-733	5	150	Akash	aakadam93@gmail.com	5	75
154-734	4	50	Akash	aakadam93@gmail.com	4	60
154-735	7	70	Akash	aakadam93@gmail.com	7	105
154-736	2	50	Akash	aakadam93@gmail.com	2	30
154-737	3	30	Josh	Josh@gmail.com	3	45

154-738	7	90	Josh	Josh@gmail.com	7	105
154-739	10	200	Josh	Josh@gmail.com	10	150
154-740	50	600	Josh	Josh@gmail.com	50	750
154-741	70	900	Josh	Josh@gmail.com	70	1050
154-742	4	150	Josh	Josh@gmail.com	4	60
154-743	2	60	Josh	Josh@gmail.com	2	30
154-744	5	60	josh	Josh@gmail.com	5	75

3.2. Dashboard creation steps

The Power BI tool is utilized to craft a dashboard showcasing specific part numbers falling below the critical level. This dashboard's intuitive and automated interface aids inventory control engineers in proactively preventing inventory shortages.

- Import Dummy data to Power BI in the form of Excel sheets.
- Clean up the dataset in the Power Query editor section. The cleaning is going to comprise size formatting and clearing bad data. Every dimension of the dataset should be set up with the appropriate formatting option. An example of a power query tool is shown below in an image.

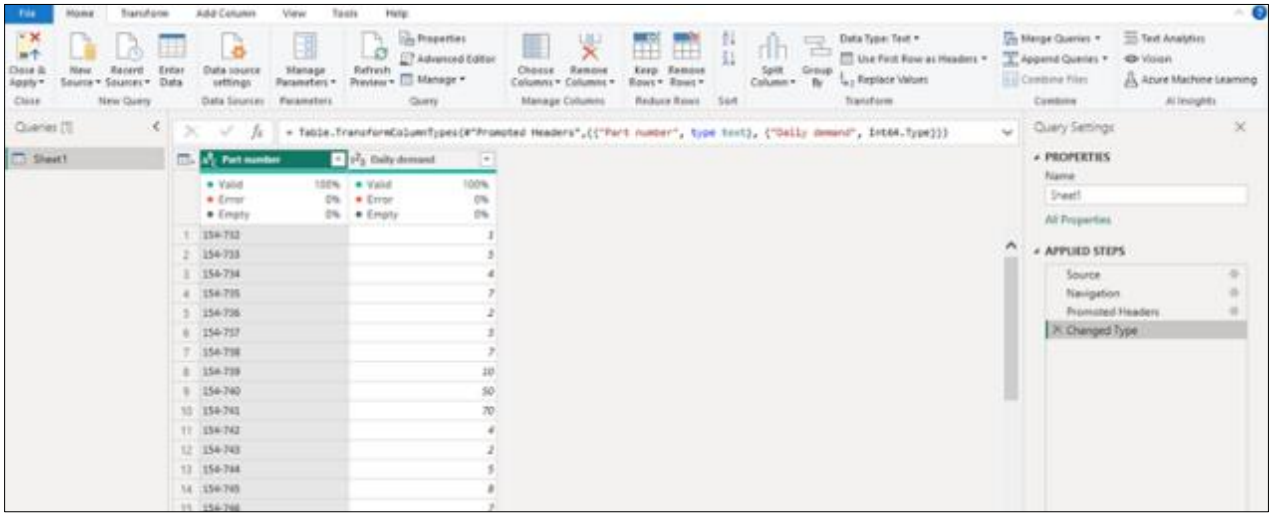

Figure 1 Power Query editor section

- Import all required Excel worksheets. For this dashboard. Five different Excel sheets were used to import data. Once the import is complete, Power BI will create relations with all the worksheets. Edit the relations at the model view tab as needed. The below image shows an example of relation management between imported files.

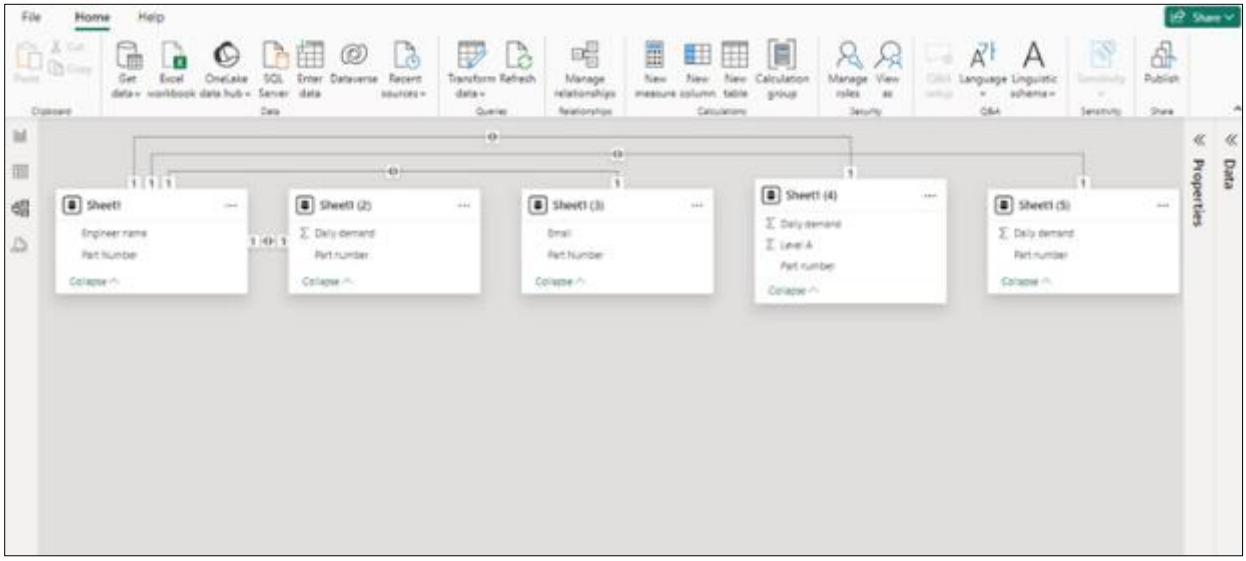

Figure 2 Relation management within Power-BI

- Once all the relations are set up between available data, start building the dashboard at report view. A report view is a blank white screen with multiple visualization options. The below image shows a report view.

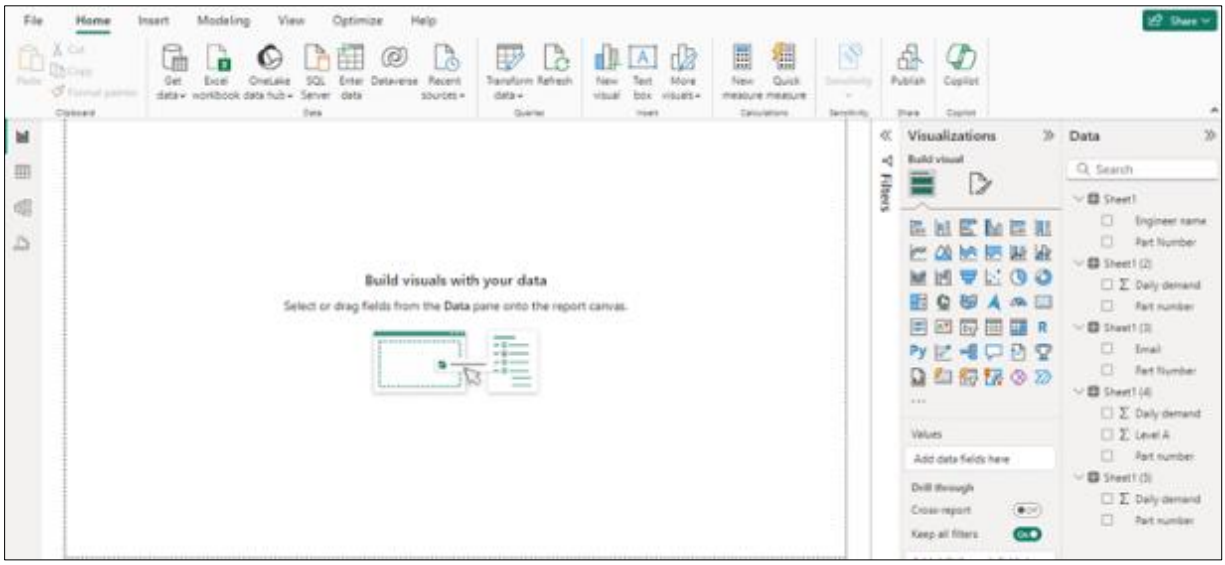

Figure 3 Power-BI report view

- The dashboard is created as shown below. An automated flow was designed to run a command every at morning 7 am to send an email to a corresponding engineer, whose part number quantity is below the critical level.

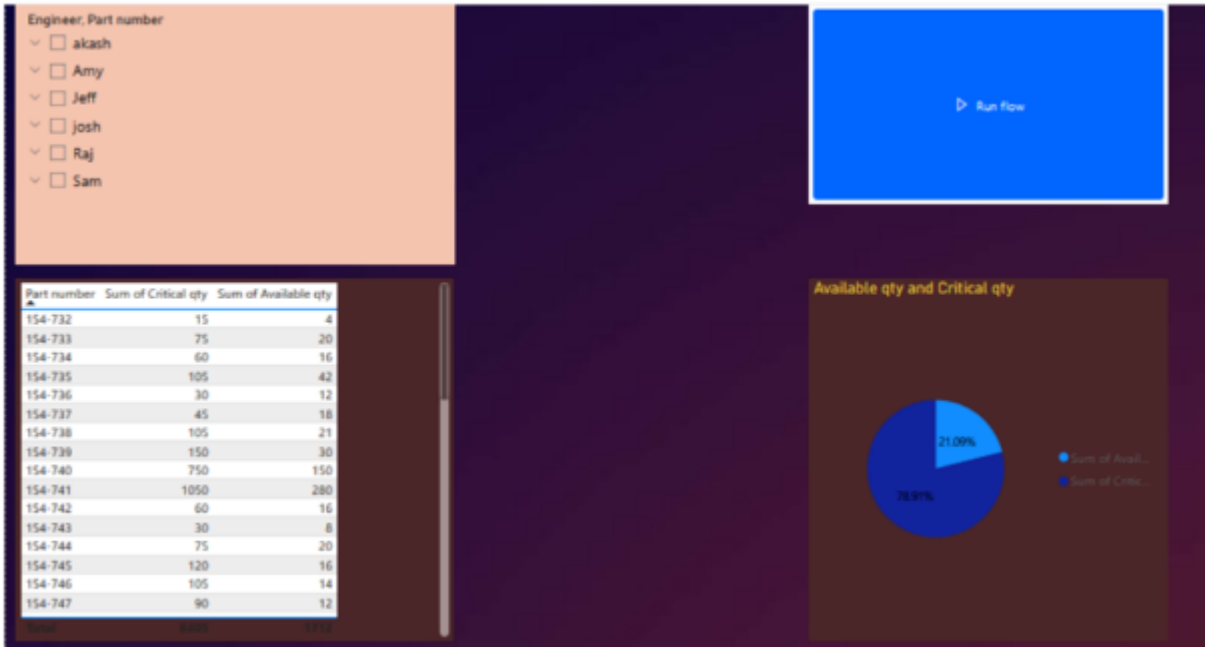

Figure 4 Final Dashboard

- Connect to the SQL Server database and schedule an automatic daily refresh of the dataset in Power BI, ensuring the most recent data is available before executing any automated workflows.

3.3. Case study

This case study has chosen a multinational manufacturing company, Reliable Manufacturing Services (RMS), specializing in producing parts for the automotive industry, to clarify the practical application and its benefits of a comprehensive, automated data-driven inventory management system using Power BI. RMS has operations in North America, Europe, and Asia. Because of its current manual processes, it faced significant challenges in inventory management, related to overstocking and stock-outs, as well as high operational costs.

The implementation of the Power BI model yielded significant improvements for RMS:

3.3.1. Inventory Optimization

- Achieved a 20% reduction in excess inventory, freeing up warehouse space and reducing carrying costs.
- Reduced stockouts by 25%, ensuring consistent product availability and improving customer satisfaction.

3.3.2. Operational Efficiency

- Streamlined procurement processes led to a 15% reduction in procurement cycle times.
- Automated tasks reduce manual workload, allowing staff to focus on higher-value activities.

3.3.3. Cost Savings

- Overall operational costs decreased by 12%, contributing to increased profitability.
- Optimized inventory turnover rates, enhancing cash flow management.

3.3.4. Informed Decision-Making

- Real-time data insights facilitated quick, informed decision-making.
- Enhanced visibility into global inventory performance helped identify and address issues proactively.

4. Results

4.1 Optimize Inventory Outcomes:

The automated data-driven inventory management model proposed on Power BI indicated much efficiency in the inventory control of the case manufacturing company Reliable Manufacturing Services. These results were collated after the integration of real-time data, predictive analytics, and automation had been made. These are some key results:

- Less excess inventory: A 20% reduction in excess inventory was realized, partly because of improved demand forecasting resulting from the integration of Power BI. This gave a fair forecast of what the inventory would be in the future, thus reducing the chances of overstocking.
- Minimization of Stockout: Stockout occurrence reduced by 25%. The model's ability to auto-notify engineers when part numbers approached critical inventory levels allowed the company to be responsive and ensure at all times that essential components were available to hand.
- Improved inventory turnover: It allowed for better rotation of inventories, with the automation of procurement and its real-time monitoring. Hence, the company felt the movement of goods down the grip of the supply chain, reducing storage costs while making sure that, in due time, the stock levels get replenished.
- Reduction in Operational Cost: For example, all operational expenses decreased by 12% in total. The key drivers for this were the minimization of manual processes, better planning of inventories, and optimization of procurement cycles.
- Enhanced Efficiency in Procurement: The automated inventory system shaved 15% off the procurement cycle times, thus enabling the firm to key in smooth operations in the supply chain and give swift responses in case demand fluctuates.

5. Discussion

Indeed, this is a perfect example of how some data-driven inventory management systems powered via Power BI have worked preferably in the most complex manufacturing environment. Lower excess inventory and improved stockouts are indicators that predictive analytics and automated alerts will quintessentially drive insight and greater speed into decision-making processes. The system singled out key inventory management tasks to be automated by integrating real-time data with automated workflows, which helped improve performance.

This is underscored by an observed 12% reduction in operational costs, representing very real opportunities for high-value cost savings when traditional manual inventory processes give way to automated, data-driven approaches. The savings come from the elimination of inefficiencies, reduced labor costs, and better resource allocation across the supply chain.

This was even more effective in the predictive capability of the Power BI system to reduce stockouts. Because the forecast was closer to real demand, this system aligned the inventory level with the needs of production, hence enabling continuous operation without disruption due to a shortage of components. This reduction in stockouts by as much as 25% ensured customer satisfaction as well.

Moreover, with Power BI allowing the organization to integrate different data sources onto one platform, inventory visibility was improved. The real-time data would further enable engineers and decision-makers to identify the trends and anomalies, thus enabling quicker response times when fluctuations in the supply chain did occur. The automated system also contributed to a reduction in the risk of human error, which incidentally is one of the issues commonly recorded with traditional inventory management processes.

Although the results look quite promising, certain challenges have to be given their due share for further improvement. The initial implementation costs of such a system might already be too high for some organizations, not to mention the learning curve for personnel. Another challenge could be that this model may strongly depend on the kind of data fed into it. Poor quality data input might impair the accuracy of forecasts and predictions.

6. Conclusion

The paper has elucidated how to effect change through a holistic, automated data-driven inventory management system with Power BI in a multinational manufacturing environment. We used the Reliable Manufacturing Services case study to drive home the point of the practical application and substantial benefits reaped from this approach.

This ensured that RMS had the right inventory information, always current and in real-time from disparate sources, in a single central system. Interactive, role-based dashboards developed value insight specific to various departments,

enabling better decision-making throughout the organization. Using Power BI's machine learning capabilities vastly increased the accuracy of demand forecast predictions, therefore aligning inventory levels closer to actual demand, greatly reducing the occurrence of stockouts or overstock situations.

It automated routine tasks associated with inventory management and streamlined procurement processes, bringing important efficiency gains with associated cost savings. Beyond and above this, continuous monitoring of performance by the Power BI dashboards enabled early identification of any issues and their resolution to ensure optimum operational efficiency.

The results RMS has achieved a 20% reduction in excess inventory, a 25% reduction in stockouts, a 15% reduction in procurement cycle times, and a 12% decrease in total operational costs, are greatly attesting to the fact that this model works. Not only did these improvements enhance customer satisfaction and profitability, but they also provided RMS with a real and sustainable competitive advantage within this complex and dynamic market.

The adoption of Power BI in inventory management at a multicultural manufacturing company like RMS epitomizes an important step toward making a discipline. In summary, the offer concentrates on the fact that for changing practices of inventory management in light of the greater goals of Industry 4.0, it is necessary to fully take advantage of state-of-the-art data-driven solutions. The roof of this kind of innovative model would therefore be very critical to constitute operational excellence and long-term sustainability for organizations moving through the shifting global supply chains.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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