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DATA-DRIVEN DECISION MAKING IN MANUFACTURING: LEVERAGING POWER BI AND SQL TO ENHANCE MANUFACTURING OPERATIONS IN ERP SYSTEM

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Abstract

The contemporary manufacturing system is described by increasing complexity within the company as it is based on the business model, intense global competition and the critical need for operational agility and resilience which can take the different production schedules and can still maintain the productivity percentage to the full capacity which eventually reduces the overhead rate. Traditional decision-making processes, often relying on intuition and delayed report which makes it difficult to capture the opportunity to recover from the lost revenue opportunity. The adoption of the data driven decision making has become essential, transforming data from a passive record into strategic asset. This paper explores how Microsoft PowerBI and SQL, integrated within and alongside Enterprise Resource Planning (ERP) systems and internal adaptive manufacturing system which eventually helps every employee along with the management to watch what exactly is going on in the manufacturing plant. ERP systems and adaptive manufacturing system serve as the central repositories for the vast amounts of operational and transactional data, while SQL provides robust capabilities for managing, querying, and transforming this data. PowerBI can be leveraged to develop real time reports and monitoring reports which can be very much helpful in building visualizations and dashboards, in depth-analysis and informed decision making across manufacturing operations. The usage of the different tools can increasingly help in revenue optimization by enhanced visibility, optimized production processes, improved quality control, and more strategic inventory and supply chain management. While challenges related to data quality, integration, technical complexity, scalability, talent gaps, and change management exist, the quantifiable benefits in terms of efficiency gains, cost reduction, and risk mitigation underscore the transformative potential of leveraging Power BI and SQL for data-driven decision making in manufacturing within the ERP context.

Keywords: Data-Driven Decision Making, Power BI Dashboards, SQL for Manufacturing Analytics, ERP System Optimization, Predictive Analytics in Manufacturing, Real-Time Data Visualization, Smart Manufacturing Systems, Supply Chain Intelligence, Operational Efficiency in ERP, Business Intelligence in Industry 4.0

1. Introduction:

The manufacturing sector across the world is going through very challenging and transforming phases driven by complex reciprocal traffics in the supply chain across the world, volatile

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markets, and global competitiveness by developed and developing nations. Currently, the manufacturing companies demand operational agility and resilience. Data Driven decision making involves systematic collecting, analyzing and applying data, which eventually makes the system process driven and resilient. In today's generation, organizations which has the most reliable, all-round data available are more likely to achieve business objectives and also have competitive advantage.

Business intelligence is fundamental to enabling data driven decision making by transforming raw data into actionable insights. These tools basically collect, integrate, analyze and present business information to support decision making for the management which provides visibility for everyone into performance, trends, and revenue optimization. Microsoft PowerBI is a widely adopted BI platform, while SQL is the standard for interacting with relational databases commonly used in manufacturing for storing operational data. The combination of Power BI and SQL provides manufacturers with the means to access, analyze, and visualize data for data driven decision making. Getting all the information from the company's internal adaptive manufacturing and ERP system, where both the system acts as an integrated platforms for managing core business processes and housing critical data related to procurement, production, inventory and finance. However, these tools has very much high impact in decision making when the data quality, internal processes within the company reach the matured stage which eventually highlights the importance of robust data management nd integration processes.

2. The Role of Power BI in Manufacturing Operations

PowerBI is the business intelligence software that allows to connect diverse data sources, transform data and create interactive reports and dashboards. It makes data analysis and visualization monitor real time basis and helps top management decision making a lot easier. For manufacturing, PowerBI offers features relevant to managing complex processes and large datasets. PowerBI plays a crucial role in current manufacturing operations by enabling real time analytics. It also helps in scheduling and monitoring production processes, track machine performance, manage inventory, and optimize supply chain, leading to increased operational efficiency and improved quality. Role played by PowerBI:

1. Data Integration and Visualization: PowerBI seamlessly integrates with various data sources, including ERP system, Internal Adaptive Manufacturing system, production databases, IoT sensors and supply chain and inventory management tools. This software helps in collaborating with multiple departments and gives an innovative and creative way of looking at the business which top management, providing decision makers with comprehensive understanding of their operations.

2.Real Time Analytics and Proactive Decision Making: Manufacturing is a fast-paced industry where timely decision-making is crucial. PowerBI provides real time analytics which is very useful for stakeholders for real time decision making and allows for better understanding of trends and patterns.

3.Enhancing Supply Chain Management: PowerBI provides insights into inventory levels, supplier performance, and demand forecasts, helping to optimize supply chain operations. It

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allows transportation expenses, shipment costs, optimal route planning, cost effective supply chains. Real time downtime through various data points which can increase the total cost of the products.

3. Optimizing Equipment Effectiveness: Analyzing the machine and equipment available in house of the manufacturing plants, where PowerBI helps in predicting maintenance needs, reduce downtime, and improve overall equipment effectiveness (OEE) . This approach helps in minimizing disruptions and maximizes production output.

4. 3. The Role of SQL in Manufacturing Operations

- SQL is fundamental and plays a crucial role in manufacturing enabling collaboration of the multiple departments which makes it efficient in data management and analysis. It helps efficiently track production data, managing inventory and optimizing the supply chain, ultimately improving efficiency and informed decision making. The SQL database also helps in monitoring stock out levels, tracking work orders and analyzing quality data. SQL provides precision and flexibility to access specific data for analysis. Developing complex queries, filtering data, performing calculations and format data for BI tools like PowerBI. Efficient SQL queries ensure fast data extraction without impacting source systems. Stored procedures automate repetitive tasks. Various scenarios where SQL makes it much more impactful.

1. Data Storage and Management:

SQL database about various manufacturing data, including inventory, materials, production data, and vendor sourcing information. Relational databases like Microsoft SQL Server and Oracle MySQL are commonly used to manage this data, ensuring its integrity and organization.

2. Inventory management

SQL allows manufacturing to track inventory counts, stockouts at the end of the month for inventory and Work in Progress valuation, ensuring sufficient raw materials requirements and finished products. It enables easy retrieval of inventory data, monitoring and making sure that inventory levels are present so that there are no changes on the lead times.

3. Production Planning

SQL helps in Work in Progress, inventory valuation reports, generating various other reports, tracking throughput for each and every department in production. It also facilitates the identification and adjustment of production processes to optimize efficiency and reduce waste.

4. Quality Control

SQL also helps in generating overall reports of Service Order %, scrap rates and rework rates. It also helps in identifying what are the potential issues within the product which makes the customer less satisfied, so there are process and ideas of improvements with the overall company

5. Reporting and Analysis

SQL provides a powerful way to generate reports and analyze manufacturing data. This data can be used to identify trends, measure performance, and make informed decisions about the production processes.

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Benefits of using SQL include efficiency, accuracy, and scalability in handling large, structured data volumes. Direct querying allows granular analysis. SQL's widespread adoption makes it accessible for data access and manipulation. SQL is the workhorse that prepares data for Power BI's visualization. Furthermore, SQL's widespread adoption and relatively straightforward syntax make it accessible to a broad range of IT personnel and data analysts, facilitating data access and manipulation within the organization. While Power BI provides the user-friendly interface for visualization, SQL is the workhorse that prepares and delivers the underlying data, making it an indispensable tool in the manufacturing data analytics stack.

4. Integration of PowerBI and SQL with ERP system with Manufacturing Company - The true power of PowerBI and SQL while integrating with ERP system in the manufacturing companies with complex business structure and internal processes is when for example when the executive of the company needs to understand the high level KPIs for the informed decision-making process. This landscape typically includes various operational and business systems that serve as the primary source of data. At the enterprise level, ERP systems manage the core business processes, including finance, human resources, sales, supply chain and procurement and inventory management. Within the production floor, there is an internal adaptive manufacturing system which tracks and manages production activities, while the SCADA system monitors and control industrial processes. Increasingly, IoT devices and sensors are deployed across the plant to collect real – time data on machine performance, environmental conditions, productivity and the quality of the products while coming out of the machines.

A common architecture pattern for leveraging data from these multiple systems like ERP, Internal adaptive manufacturing system, IoT sensors and devices involves extracting different sources of data into one database, which are often transactional systems optimized for processing daily operations rather than complex queries in SQL. Extracting data from the different sources from ERP system and internal adaptive system allows for historical analysis and reporting without impacting the performance of the every system present within the system. At the same time, when we want to logging the data from MES, SCADA, IoT devices, which is often high volume and real time, can be collected and processed, sometimes through middleware or by building data pipelines, before being stored in a database or data lake (in PowerBI). SQL is the primary programming language used to manage and query these centralized data stores, preparing the data for consumption by BI tools. PowerBI, then connects to these SQL database or data warehouses to access the prepared data, Power BI’s various data connection modes, including import, Direct Query and Composite models, allow flexibility in how the data has been extracted, processed , make different types of joins within the data models in PowerBI, refreshing and balancing the need for real-time insights with performance considerations for large datasets. Data Pipelines and ETL (Extract, Transform, Load) processes often built using cloud based tools like Amazon Web Services, Azure Data Factory or SQL Server Integration Services (SSIS), are crucial for moving data from source systems (ERP, MES, SCADA, IoT) to the analytical database, ensuring the data is clean, transformed and ready for analysis.

With One source of information and building integrated architecture provides a single source

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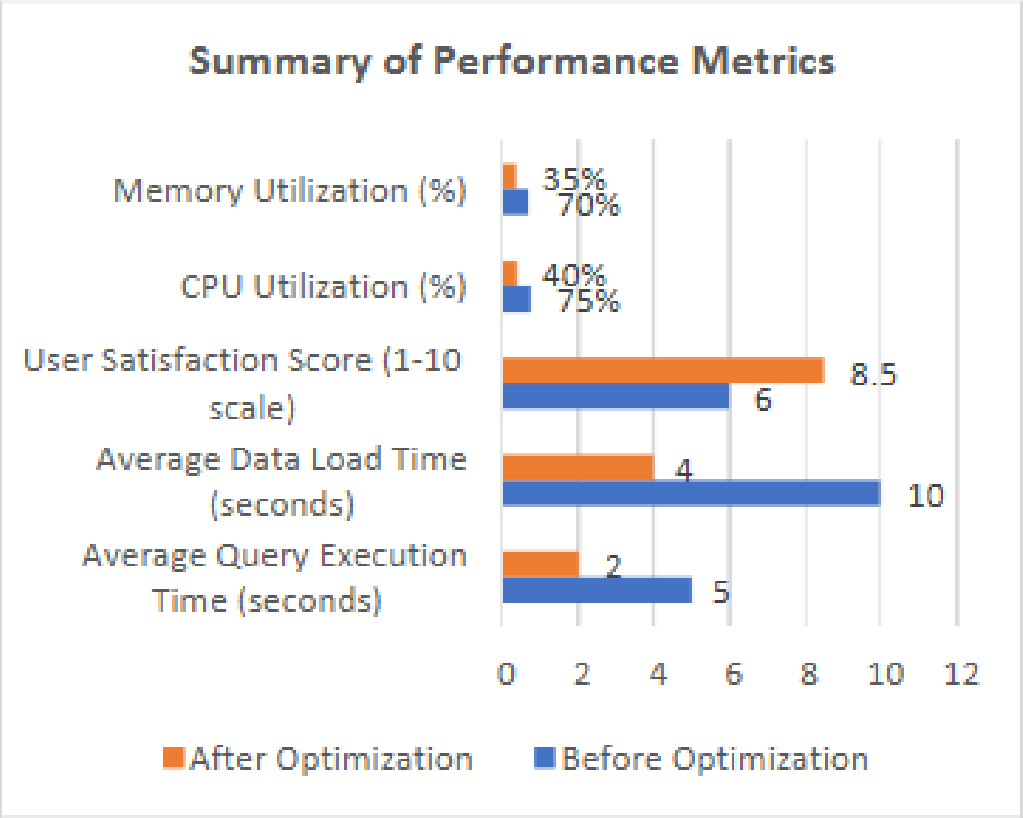
of truth for manufacturing data, breaking down data silos that often exist between different operational systems. By consolidating data from ERP, MES, SCADA, and IoT into a SQL database, structure the database in such a way by creating different use case data tables and views with the system which can be easily be integrated into PowerBI for Visualization purposes, developing manufacturers gain end-to-end visibility across their operations, from raw material procurement and production scheduling to quality control and finish goods inventory, building product margins which gives comprehensive view on how the company is performing. This comprehensive view is essential for identifying the company's issues with respective to multiple department collaboration, understanding the impact of issues in one area on another and making holistic decisions that optimize the entire value chain. The ability to integrate real time data from the different departments like production floor (via MES, SCADA, IoT, etc.) , sales, finance, supply chain and inventory with business data from ERP systems in PowerBI allows for dynamic monitoring and rapid response to changing conditions. This integrated approach, which includes PowerBI for visualization and SQL for data management, enables not only production teams but also different departments within the company to leverage the diverse data assets to drive operational excellence.

Figure 1: Summary of Performance Metrics [4]



The bar chart provides a comparative overview of system performance metrics before and after optimization, highlighting improvements in efficiency, speed, and user experience.

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After optimization, memory utilization dropped significantly from 70% to 35%, and CPU utilization decreased from 75% to 40%, indicating more efficient resource usage. These reductions suggest that the system became lighter and less taxing on hardware.

The user satisfaction score, measured on a scale from 1 to 10, rose from 6 to 8.5, reflecting a substantial improvement in user experience and system responsiveness.

In terms of performance speed, average data load time improved from 10 seconds to 4 seconds, and average query execution time reduced from 5 seconds to just 2 seconds. These enhancements indicate faster data retrieval and smoother user interactions with the system.

Overall, the figure clearly shows that the optimization efforts led to significant gains in performance, usability, and system efficiency, resulting in a more responsive and resource-efficient environment.

Performance Tuning Technique	Initial Performance	Optimized Performance	Performance Gain
Query Rewriting	100	60	40
Indexing (Non-Clustered)	100	40	60
Caching (Enabled)	100	50	50
Data Model Optimization	100	60	40
Partitioning	100	30	70

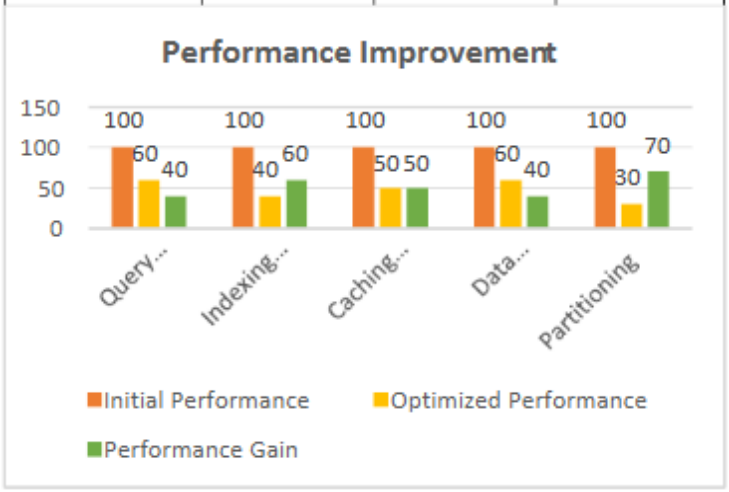

Figure 2: Report on Performance Tuning in PowerBI and SQL [4]

The figure presents a detailed comparison of performance tuning techniques in Power BI and SQL, showcasing how different optimization strategies contribute to improved system efficiency. Each technique begins with a baseline or initial performance score of 100, representing the unoptimized state. After applying the respective tuning methods, the

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optimized performance scores reflect substantial reductions in processing load and execution time, leading to notable performance gains.

- Query Rewriting reduced the performance load from 100 to 60, resulting in a 40% performance gain, by simplifying or restructuring complex queries for faster execution.
- Non-clustered Indexing delivered a more impressive 60% gain, lowering the performance load to 40, by enabling faster data retrieval through better indexing strategies.
- Caching (when enabled) cut the load to 50, achieving a 50% gain by reducing repeated data fetch operations and improving access speed.
- Data Model Optimization also yielded a 40% improvement, bringing performance to 60, by restructuring data models for greater efficiency and responsiveness.
- Partitioning provided the highest improvement among all techniques, with a 70% performance gain. This was achieved by dividing large datasets into manageable segments, reducing query complexity and accelerating execution, resulting in an optimized performance of 30.

The bar chart reinforces these findings visually, showing significant reductions in performance load across all methods. Partitioning and indexing stand out as the most effective techniques, while others still contribute meaningfully to overall system improvement.
In summary, the analysis demonstrates that strategic performance tuning across query design, data architecture, and caching can dramatically enhance processing efficiency in Power BI and SQL environments, supporting faster analytics and improved user experiences**.**

5. Enhancing Manufacturing Operations with PowerBI and SQL
PowerBI, a business intelligence tools and SQL – a language for managing structured data, can be powerful tools for enhancing manufacturing operations by providing real time insights, optimizing processes, and improving decision making. Leveraging PowerBI and SQL provides manufacturers with powerful capabilities to enhance operations across several key areas:
1. Production Process Optimization: Real time monitoring of production lines is enabled by connecting PowerBI and SQL to data sources like an internal adaptive manufacturing system for production and inventory tracking, MES, SCADA and IoT sensors from the different parts of the production floor and machined parts as well which can also be served as intermediaries. Developing Dashboards can display critical KPIs such as Overall Equipment Effectiveness (OEE), cycle time, and throughput from various departments to understand and track the efficiency and inefficiency. By building these different dashboards, production management can quickly identify production bottlenecks, understand root causes of in-efficiencies and optimize the workflows. Forecasting and Predictive analytics within PowerBI, often using data prepared by SQL data tables and views, potentially leveraging AWS and Azure Machine Learning, which can help in forecasting machine failures, enabling proactive maintenance and reducing unplanned downtime. This shift from reactive to being proactive in predictive strategies significantly improves operational efficiency and stability. Quantifiable results include a 25% reduction in unplanned downtime and a 15% increase in production efficiency.
2. Inventory Management:

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- PowerBI Dashboards, fed by supply chain, inventory and stock out data stored with the SQL database which is the one source of information coming from ERP system, internal adaptive manufacturing system and various other devices provide real time visibility into stock levels across different locations. This helps manufacturers to optimize inventory levels, balancing the need to meet the demand with the costs of holding the excess stock or little less stock. Predictive analytics using Azure Machine Learning within PowerBI can be applied to historical and as well current incoming sales by getting to know the close probability of those sales with production data, which can be queries with SQL, will significantly help in improving demand forecasting accuracy. More accurate forecasts help in reducing stockouts during peak demand and minimizing overstock situations, leading to cost savings. Different collaboration with the different set of departments will help in building tools with the help of SQL and PowerBI which is integrated with the ERP system and various other Internal system will helps aid in inventory forecasting and tracking components needed for production. Quantifiable benefits include 30% reduction in defects rates and a significant reduction in the total cost to build the particular products.

3.Quality Control:

6. - Product Quality is crucial in manufacturing space because it will help gauge customer satisfaction. And one of the ways is to gauge customer satisfaction is to make everything data driven which is connected to data quality in SQL database which is integrated with PowerBI (from MES or quality management system), provides dashboards for tracking various KPIs like defect rate, service order, First Pass Yield (FPY), and scrap rate. Visualizing these KPIs helps identify quality issues in real time and pinpoint areas needing improvement. Data Analysis in PowerBI can help uncover the root causes of defects by analyzing correlations between quality data and production parameters. Predictive Analytics, when applied to your quality data – it eventually helps figure out the root cause of the all the defects, allowing for preventative action which can eventually reduce defects rate quite significantly

4. Supply Chain and Supplier Information:

- PowerBI dashboards, drawing data from ERP and supplier management system stored in SQL databases, provides insights into supply chain performance and supplier reliability. Key metrics which usually include on-time delivery rate, order accuracy, cost compliance, and quality performance. Data visualization software like PowerBI enables the objective of the supplier evaluation, helping identify top performers and those needing improvement. Predictive analytics can forecast potential supply chain disruptions or supplier risks based on historical performance and external data. This proactive approach enhances the supply chain resilience and enables better negotiation strategies.

Feature	Traditional Methods	Power BI Dashboards
Inventory Accuracy	80% (high errors)	95%+ (real-time updates)
Data Refresh Rate	Manual, periodic	Automated, real-time
Demand Forecasting	Approximate (historical)	AI-based, predictive
Cost Savings	Limited	Significant (30%+)
Order Processing Time	Slow (manual adjustments)	Faster (automated insights)
Decision-Making Speed	Reactive	Proactive

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Table 3: Comparison of Traditional Vs PowerBI based Inventory Management [1]

The comparison highlights the advantages of using Power BI dashboards over traditional inventory management methods, demonstrating significant improvements across multiple operational dimensions.

Traditional methods typically offer only 80% inventory accuracy, often resulting in errors due to delayed or manual entries. In contrast, Power BI enables 95%+ accuracy by providing real-time updates that reduce discrepancies and improve reliability.

Regarding data refresh rate, traditional systems rely on manual and periodic updates, which limit responsiveness. Power BI, on the other hand, offers automated, real-time data refresh, allowing stakeholders to work with the most current information at all times.

When it comes to demand forecasting, traditional approaches use approximate, historically based estimates, which may not adapt well to changing trends. Power BI uses AI-based predictive analytics, enabling smarter and more dynamic forecasting aligned with current patterns and external variables.

In terms of cost savings, traditional systems provide limited impact, often requiring more labor and manual corrections. Power BI dashboards deliver significant cost savings—often over 30%—by streamlining processes, reducing waste, and enhancing efficiency.

Order processing time is also a challenge in traditional systems, where it tends to be slow due to manual adjustments. Power BI speeds this up considerably with automated insights and workflows, ensuring quicker and more consistent fulfillment.

Lastly, decision-making in traditional environments is often reactive, based on outdated or incomplete data. Power BI enables proactive decision-making through real-time alerts, visualizations, and data-driven recommendations.

In summary, transitioning to Power BI for inventory management leads to higher accuracy, faster processing, cost efficiency, and more intelligent forecasting and decision-making, representing a major step forward from traditional methods.

6. Challenges and Considerations

Implementing data driven decision making in manufacturing using PowerBI and SQL, while offering significant benefits, also presents several challenges that organizations should take into considerations.

1.Data Quality and Integration Issues:

- The primary hurdle is the fractured nature of the manufacturing data, which often residing in disparate systems like legacy ERPs, internal Adaptive Manufacturing and production system, MES, SCADA and IoT devices logging data and various databases, often in inconsistent formats. Integrating these diverse sources into unified views for analysis requires significant effort in collecting the data into one source, then cleaning those data, transformation and standardization of the data in such a way that it can be used in day to data basis to make the important decision-making process. Poor data quality - inaccuracies, inconsistencies or

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incompleteness – can lead to misleading insights and flawed decisions and more importantly it will undermine trust in the BI system. Establishing robust data governance frameworks, process in every production team and data pipelines is essential to ensure data accuracy and reliability. The challenge is particularly acute when dealing with previous legacy systems that may lack modern APIs or standardized data structures.

2.Technical Complexity and Scalability:

- Implementing and maintaining the necessary data infrastructure, including SQL databases, data warehouses, and ETL processes which require technical expertise. Handling volume and velocity of data generated by modern manufacturing operations, especially with the real-time requirements from IoT and SCADA systems, can lead to performance and scalability challenges in both SQL database and PowerBI reports. Hyperparameter tuning of the SQL queries which should be happening in such a way that it quickly loads and transforms all the data present in power bi and analysis run efficiently. As data volume grows, organizations may face latency issues while extracting and running the queries and dashboard very much efficiently if the data infrastructure is not built or designed for scale

3.Lack of Skilled Talent:

- Effectively leveraging PowerBI and SQL for advanced manufacturing analytics requires a combination of technical skills (SQL, PowerBI, data modelling, potentially AI/ML) and domain knowledge makes a huge difference in understanding the business model using data like manufacturing processes, KPIs, industry context). Many organizations often face a shortage of individuals possessing this blend of skills. Hiring or training data analysts, BI developers, data engineers and manufacturing engineers or professionals with data literacy and business mindset is critical for successful implementation and sustained value generation.

4.Change Management and User Adoption:

- Introducing the data driven culture, new data tools and processes require significant organization change management. Employees who are very much accustomed to traditional methods may be resistant to adopting new systems or relying on data driven insights. Building trust in data and the Business Intelligence software is very important. Comprehensive training programs are needed to equip users with skills and confidence to effectively use PowerBI dashboard for the single source of information and understand the underlying data along with the processes with the system which contributes in showing the right numbers within the PowerBI dashboards. Gaining buy-in from stakeholders across different departments is crucial to ensure the Business Intelligence initiative aligns with business objectives and is widely adopted.

5.Security and Governance:

- Manufacturing data, including production volumes, supplier information, products information, intellectual property related to processes, supply chain inventory information can be very much sensitive. Ensuring data privacy, security and compliance with industry

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regulations is paramount. Implementing robust security measures, including access control, data encryption and authentication is necessary. Governance plan is needed to define data ownership, ensuring data accuracy, building different processes in different department which eventually makes a controlled governance, manage access permissions and maintain consistency across reports.
Addressing these different challenges requires a strategic and holistic approach that goes beyond implementation of the different BI tools but it also involved in investing in data infrastructure, developing internal capabilities, fostering a data driven culture and ensuring strong leadership support and cross functional collaboration.

7.Future Trends:

Cross functional collaboration of data analytics, business intelligence and artificial intelligence is rapidly evolving, promising further advancements in inculcating data driven culture within the manufacturing plant. Now a days, there is an increasing trends of implementing AI/ML, BI tools in day to day life for increasing the productivity within the manufacturing plant like PowerBI, SQL, Machine Learning and Artificial Intelligence.

1.Increased AI/ML Integration:

- The Integration of Machine Learning and Artificial Intelligence capability directly within the Business Intelligence tools like PowerBI is becoming more sophisticated. This means more powerful built in predictive analytics, automated outlier detection and ability to generate insights from data with less manual effort. AI is also being integrated into ERP systems and data platforms, enhancing capabilities across the data lifecycle. This trend will enable manufacturing plant's executive to make a lot more automative decision making processes.

2.Real time and Streaming Data Analytics:

The demand for immediate insights from the high velocity data sources with respect to the total cost of building the products like IoT sensors and SCADA systems is driving advancements in real-time and streaming analytics potential. Power BI's ability to connect to streaming datasets and visualize live data will become increasingly critical for monitoring dynamic manufacturing processes and responding instantly to events.

3. Integration with IoT and Digital Twins:

Tighter integration between BI tools, SQL databases, IoT platforms, and digital twin technologies will provide manufacturers with a more comprehensive and dynamic view of their operations. Digital twins, virtual replicas of physical assets or processes, combined with real-time IoT data and powerful analytics, will enable advanced simulation, scenario planning, and predictive maintenance.

4. Advanced Data Governance and Security

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As the volume of the manufacturing data grows, it is important to implement and train everyone about the process within the system, so that the focus on the robust data governance and security will intensify. Future trends include more granular access controls, enhanced data lineage tracking, automated compliance monitoring and advanced security features within the BI platforms and underlying data infrastructure.

5. Democratization of AI and Analytics:
Low Code/no-code solution will eventually provide more access towards implementing various advanced versions of tools within the manufacturing system. And it will also make user-interface a lot more accessible to wider range of users within manufacturing organizations. Natural Language Query (NLQ) has intense amount of capabilities which will eventually lead to learning more about the prompt engineering , so that everyone will be able to extract every type of information and it will also become more prevalent, allowing non-technical users to interact with data using conversational language.
These trends suggest a future where data driven capabilities are deeply embedded within manufacturing processes and operations, enabling greater automation, better and accurate predictive power and agility. The foundational roles of SQL for data management and PowerBI for visualization and analysis will essential, evolving alongside these emerging technologies.

8.Conclusion:

The cultural change in inculcating the data driven decision making manufacturing plants is no longer a strategic option but a fundamental requirement for manufacturers seeking to thrive in today's complex and volatile global market. Leveraging the capabilities of Microsoft PowerBI and SQL provides a robust framework for achieving this critical transformation. SQL and PowerBI serve as essential engines for managing, querying, building different data tables and models and preparing the vast amount of data generated across manufacturing process from the ERP system, internal adaptive internal manufacturing system, and many other IoT devices to the factory floor. PowerBI also complements building visualization of the collaborative nature through interactive dashboards and reports.
The scenarios and tools available within the manufacturing space eventually help gain unprecedented real-time visibility into their production process, inventory levels and valuation, quality control metrics, materials usage and supply chain performance. The enhanced visibility that SQL and PowerBI provides directly translates into improved decision-making capabilities, enabling faster, more informed responses to changing conditions. The applications of data analytics, facilitated by PowerBI and SQL, leads to tangible enhancements in operational efficiency , including optimized production schedules, reduced downtimes which can detected by IoT devices so the team knows when there is also need to evaluate the machines so that throughput in each department will not reduce otherwise it will follow a domino effect., it will also help in optimized production schedules, reduced downtime, and more streamlined workflows. Furthermore, along with AI/ML , PowerBI and SQL tools will help in optimizing inventory management, improving quality control by identifying root causes of defects, and enhancing supply chain and vendor diversification which will eventually reduce total cost of

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the products and gain few ore extra margins which will eventually help in the bottom line of the Balance sheet and the profit and loss statement. There are even more demonstrated application which is underscores the significant of the increasing the value proposition and chain for the customer.
While the path to becoming a truly data driven manufacturing organization involves navigating and implementing various controls, process in place so that there is workflow for ensuing the data quality and integration, managing technical complexity, addressing the need for skilled talent and implementing effective change in management, these obstacles can be overcome with strategic and sustained approach. The future of manufacturing data analytics points towards deeper understanding of the AI/ML and how it can be implemented in company wise which eventually helps in increasing productivity and automating the decision making processes for the management will have a great potential benefits in the longer run for the company. By strategically investing in and effectively utilizing PowerBI and SQL within an integrated IT landscape, manufacturers can unlock full potential of their data, driving continuous improvements, increasing resilience and securing a competitive advantage in the evolving industrial landscape.

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