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Integration of Information Technologies into Production Processes: Challenges and Prospects

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ABSTRACT

This paper touches upon the challenges and prospects of integrating information technologies, specifically MES systems, into production processes. Through a detailed case study at a manufacturing company, the article highlights how MES systems can streamline workflows, automate tasks, and provide real-time feedback to enhance plant floor efficiency and productivity. Key challenges such as data integration, change management, and data security are considered as well. The crucial role of a skilled leader in successful MES integration is emphasized, showcasing how effective project management and technical expertise can drive significant improvements in manufacturing operations.

KEYWORDS: *Manufacturing Execution System (MES), production planning, data integration, process automation, information technologies, challenges, production process, Viralsinh*

INTRODUCTION

In nutshell, MES is partnership/collaboration with people, processes and systems that help early-stage manufacturing companies to become automated factories. MES provides real-time visibility and control over production processes, that enables stakeholders to monitor operations, identify bottlenecks, minimize downtime and make informed decisions promptly. By facilitating optimized production planning and scheduling, MES systems ensure efficient resource allocation, workload balancing and on-time deliveries, leading to higher profitability. They also play a critical role in quality assurance and compliance by enforcing quality control procedures, monitoring metrics and capturing real-time data. With their ability to manage inventory levels, track material movements and help ensure timely availability of materials, MES systems optimize inventory management and minimize production delays.

MES systems enhance plant floor efficiency and productivity by streamlining workflows, automating tasks and providing real-time feedback. These management systems also enable traceability and genealogy, crucial for industries with strict regulations, by tracking the movement of materials and processes throughout the smart manufacturing lifecycle.

ANALYSIS

Viralsinh single handily led the project by converting each process into measurable task and elimination of manual processes communication between the systems.

Even though MES is mainly built for the manufacturing shop floor, it's essential to know the order details before starting the manufacturing process.

Viralsinh has created the design plan and documented communication between Oracle ERP and Factory Systems. It has created factory system database as well as tables and BOOMI processes to first translate IGU glass make up, part numbers and part configuration into MES. Upon successful product transfer into MES, the process to automatic order creation in MES from Oracle has been implemented. These order details are the exact details schedulers used to feed Fenevision in legacy system manually. Since order data is in MES, Viralsinh has created an automatic process that transfers the order data from staging area to Fenevision readable XML format to generate the order in Fenevision. This process removes 1.5 to 2 hours of manual order entry, eliminates user errors as well as the lag time between Oracle and Fenevision, and more importantly a single system of record for the factory. This process itself significantly reduces the manual work done by the planners.

The biggest challenge for the company as the legacy application is that it is not scalable, as they were not communicating with each other in terms of data integration between ERP and manufacturing operations and lack of visibility in use of material, labor & cost against each operation.

One of the main problems faced by companies using outdated or proprietary systems is the lack of a clear understanding of their capabilities. This often leads to the use of inadequate and obsolete technologies for production planning, which can significantly reduce work efficiency. Additionally, the manual process of tracking tasks increases the likelihood of errors and slows down the decision-making process. A lack of data visibility and operation tracing limits the company's ability to analyze and optimize its processes. Management and coordination of suppliers also become more complex without clear and accessible information. Furthermore, the absence of visibility into labor and costs can lead to inefficient resource allocation and increased expenses. All these factors collectively can have a serious impact on a company's competitiveness and profitability.

A MES software system captures real-time data from various sources on the factory floor and uses that information to monitor and control manufacturing operations.

Table 1. A general overview of the process

Data collection	The system collects data from multiple sources, including machines, sensors, operators and other information systems such as ERP systems or product lifecycle management (PLM) systems. This data can include production rates, machine statuses, inventory levels, quality measurements and more.
Data integration	The collected data is processed and integrated within the MES system, creating a comprehensive view of the manufacturing environment. This integration helps ensure that the MES has accurate and up-to-date information to work with.
Production scheduling	Based on the production orders received from higher-level planning systems, the MES generates a production schedule. This schedule considers factors like ordering priorities, available resources, machine capacities and laboring availability.
Work order management	The system assigns work orders to operators or workstations based on the schedule. It provides operators with instructions, specifications and necessary documentation to help them carry out their tasks. The system tracks the progress of each work order and updates the work-in- progress status in real time.
Machine and equipment integration	The system interfaces with machines and equipment on the shop floor to monitor their status, collect production data and exchange information. This integration can be achieved through various means such as machine sensors, programmable logic controllers (PLCs) interfaces or communication protocols like OLE (object linking and embedding) for process control (OPC).
Quality management	Quality data is captured during production, such as measurements, inspections and test results. It enforces quality control procedures, triggers alerts or notifications for quality issues and records quality-related information for analysis and traceability.
Material and inventory management	The MES tracks the movement of materials and components throughout the production process. It monitors inventory levels, initiates material requisitions or replenishments and helps ensure that the correct materials are available at the right time and in the right quantities.
Data analysis and reporting	The collected data is analyzed to provide real-time insights and performance metrics. It generates reports; dashboards and visualizations that help management and operators make informed decisions and identify areas for improvement.
Integration with higher-level systems	The system interfaces with other systems such as ERP, PLM or supply chain management (SCM) systems. This integration allows for the exchange of data, synchronization of information and alignment of manufacturing processes with overall business operations.

As the company is growing and facing numerous IT challenges due to limitation of legacy systems and an enterprise system is needed to make a robust and scalable one in future. Figure 1 shows how introduction to MES helps.

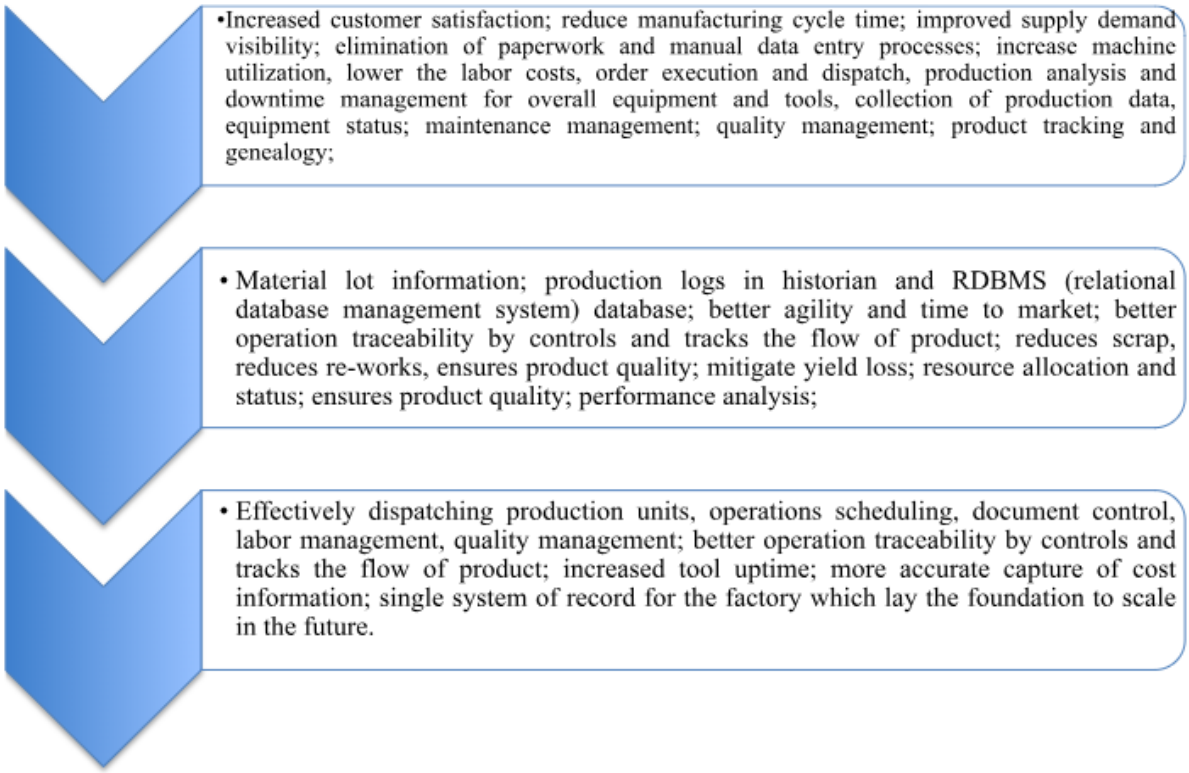

Figure 1. The way introduction to MES helps

Implementing and operating an MES system can come with certain challenges.

Integration with Existing Systems: Running Legacy systems and MES together on the floor. Upon all the validation on the shop floor, the decision has been made to go live with MES but the orders that are started in legacy systems and already in WIP (Work in progress) cannot be transferred into MES as the manufacturing history in the legacy systems and database for both Legacy and MES are totally different. It has been a collective challenge for all the departments in the company, especially Operations and IT. Operators must use both systems for a period and IT must manage both systems of records. Viralsinh has played a critical role, as it is the brain behind the modeling, configuration and leading the implementation. Viralsinh has not only led the implementation team and 24/7 IT support team but it has also been training the supervisors, managers and area leaders to use MES. After deploying MES to shop floor, first 6 months are very challenging because of running two systems on the floor and encountering multiple issues but the way Viralsinh has led and delivered contingent planning of every issue helps the company to achieve normal operations and execution in 7th month.

Complex implementation. MES system procurement and implementation can be complex and time-consuming. It requires significant planning, configuration, integration with existing systems and customization to align with specific manufacturing processes. The complexity of implementation can lead to delays, budget overruns and potential disruptions during the transition phase. The Manufacturing Enterprise Solutions Association (MESA) is a global not-for-profit community dedicated to helping member companies successfully implement and apply MES systems and related methodologies.

Data integration: Integrating an MES system with other systems such as ERP can be challenging. Helping to ensure seamless data exchange and synchronization between different systems might require extensive customization, data mapping and integration efforts. Data inconsistencies or errors during integration can lead to inaccurate information and hinder effective decision-making.

Change management: Implementing a paperless MES system often involves changes in business processes, workflows, and roles within the organization. Resistance to change from employees or stakeholders can pose challenges and affect user adoption. Proper change management strategies, including training and communication, are crucial to overcome resistance and help ensure a smooth transition and acceptance of the MES system.

Data security: MES systems handle large volumes of sensitive production data, including intellectual property, process parameters and quality information. Helping to ensure data security and protecting against unauthorized access or cyberthreats is paramount. Robust security measures, such as data encryption, user access controls and network safeguards, must be in place to mitigate risks.

Major system in any high-tech high-volume manufacturing facilities focus on the flow of material through different areas within the org. Being a startup in the beginning

company had limited resources and funding and hence the need to arise standalone systems were developed. These standalone systems had limitations and as the company was growing there was need for a single system. Viralsinh played a critical role in transitioning from older systems to the new ones. His deep-rooted understanding of each unit process on manufacturing plant played a critical role in effective transition. Here are the benefits the company has observed because of Viralsinh's critical role and excellent leadership to execute the project:

Work order creation process in Legacy vs MES: Schedulers save 2 hours per day using MES enterprise system with automated order creation. In Legacy system, it takes 2 hours of manual order entry, which can lead user entry errors in order and lead a lot of issues unnecessary in factory and in field.

Data Integrity: With the help of MES, the company has achieved a single 'system of record' which helps across the factory tremendously. In legacy, just because of this issue we have shipped wrong products many times, which directly implies costs to the company.

Processing time at operation: Due to automation in MES, processing time increased by 5% compared to legacy systems. At some operations it was observed that it went up by 10% due to full automation in MES compared to manual in legacy.

Reworks: Because of better data visibility and data collection at every operation, rework loops have been significantly reduced especially in metrology area of the factory, which implies the throughput. There is about 4% decrease in re-work loop compared to legacy systems.

Yield improvement: In MES, every tool and equipment in the factory is modeled and configured, data collection plays the critical role for quality assurance department which help them to define tight threshold limits which reduces scratches on the glass in the production area. There is 7% yield improvement just thanks to the effective data collections at the upstream, which has helped Quality assurance team to make better decisions.

Visibility on Labor and Material consumption: One of the major items for growing companies to estimate the cost of production and that was the biggest challenge in the legacy system. In MES, labor and material consumption is calculated in real time as Oracle ERP and MES are tightly connected and proper Bill of Materials (BOMs) and Stock keeping unit (SKUs) structure are configured to begin with.

CONCLUSION

Viralsinh has created functional specifications for each requirement with detailed instructions into technical terms. Functional specification documents include user interface, data flow, source and destination of data, any integration with other systems, validation, and evaluation to either pass, or fail, or rework, or hold etc.

Viralsinh successfully implemented a comprehensive project plan that began with the collection of requirements and continued until the user acceptance sign-off stage. The project was meticulously planned and included the following key stages: after receiving approval from management, pre-launch IT activities were conducted, ensuring a smooth transition to subsequent steps. A code repository was defined and prepared for safe and efficient deployment from the User Acceptance Testing (UAT) environment to the production environment. A special attention was given to aligning integration with ERP systems, including Oracle and Fenevision, which ensured uninterrupted business process operations.

In addition, both contingency and rollback plans were developed in case of unforeseen situations, which increased the project's resilience to potential risks. Continuous IT support 24/7 after the launch guaranteed that any technical issues could be promptly resolved, minimizing system downtime. Regular weekly meetings with Viralsinh, business owners, and IT leaders provided ongoing monitoring of the system's status and collection of feedback, which contributed to the timely identification and resolution of potential problems, as well as improving overall performance and user satisfaction. The high-level project steps are shown in the figure below.

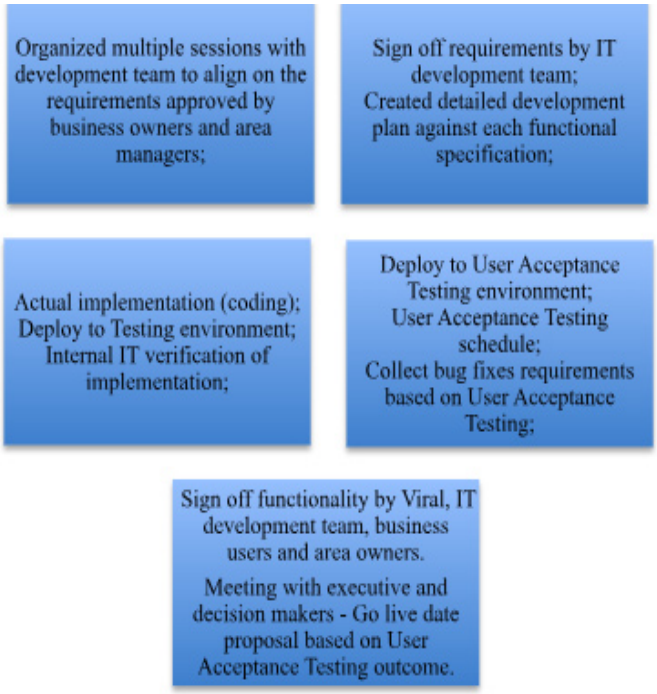

Figure 2. The high-level project steps

Viralsinh has presented a detailed level of the project plan to executive team and business owners that defines the timeline to complete against each component even before starting the implantation. The total time it takes from start to finish is 14 months of focused, dedicated efforts and intelligent planning.

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