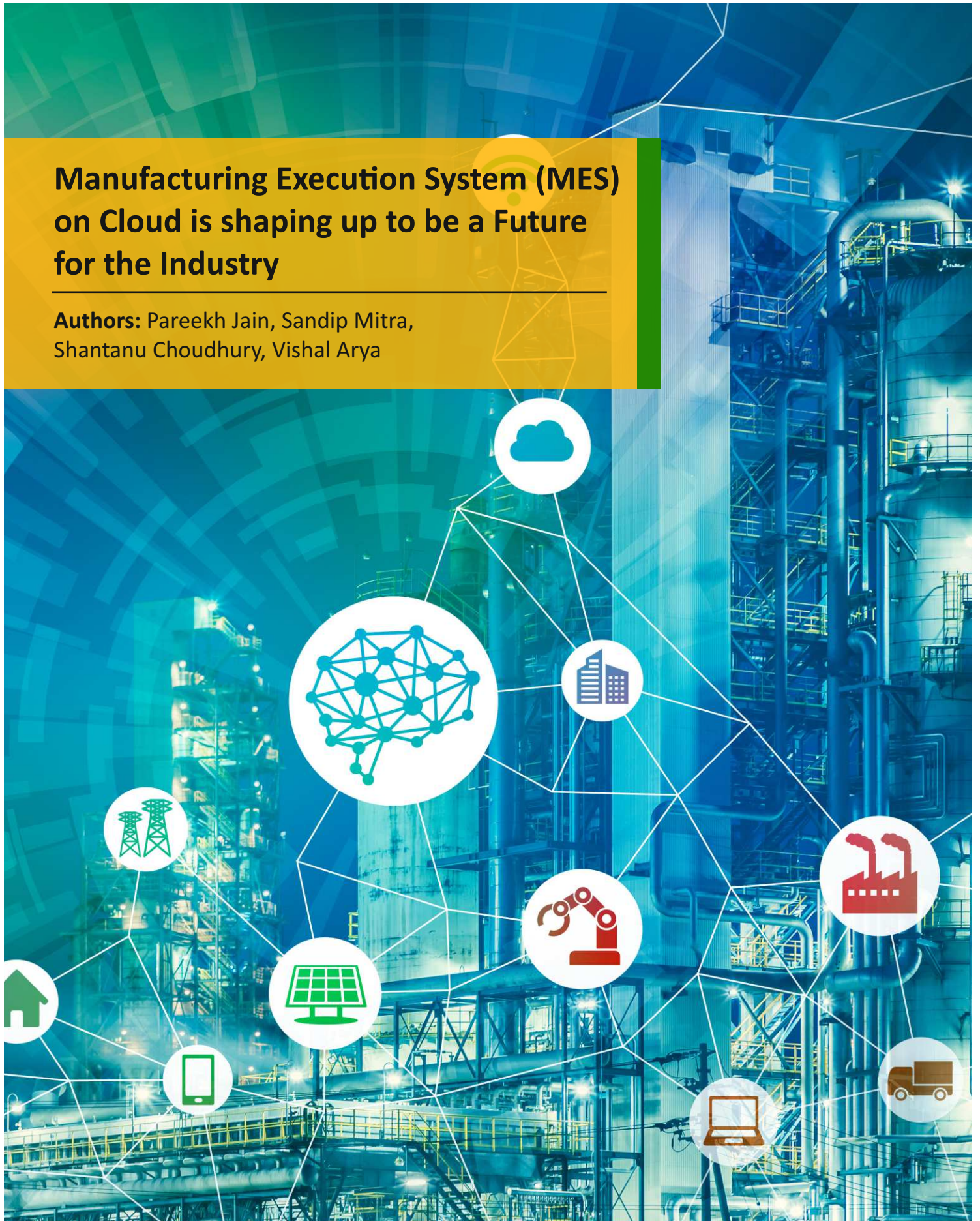


Manufacturing Execution System (MES) on Cloud is shaping up to be a Future for the Industry

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In the past few decades manufacturing companies have invested much time and money in machine and production line automation on one hand and on ERP on the other. Between these two layers lie another called Manufacturing Execution System (MES). MES is associated with activities concerning the manufacturing function that include preparatory activities such as production scheduling, recipe management, quality, data collection, reporting to name a few.

The adoption of MES has been growing in the last decade or so and it is accelerated further with Industry 4.0 initiatives. However, there are many challenges faced by enterprises during the MES journey which are restricting MES proliferation in many enterprises. MES on Cloud should help in overcoming the challenges and increase MES's value proposition and growth opportunities. But enterprises should navigate carefully to get MES Cloud right. This PoV discusses value proposition of MES, proliferation challenges, MES cloud advantages, and ITC Infotech MES Cloud approach.

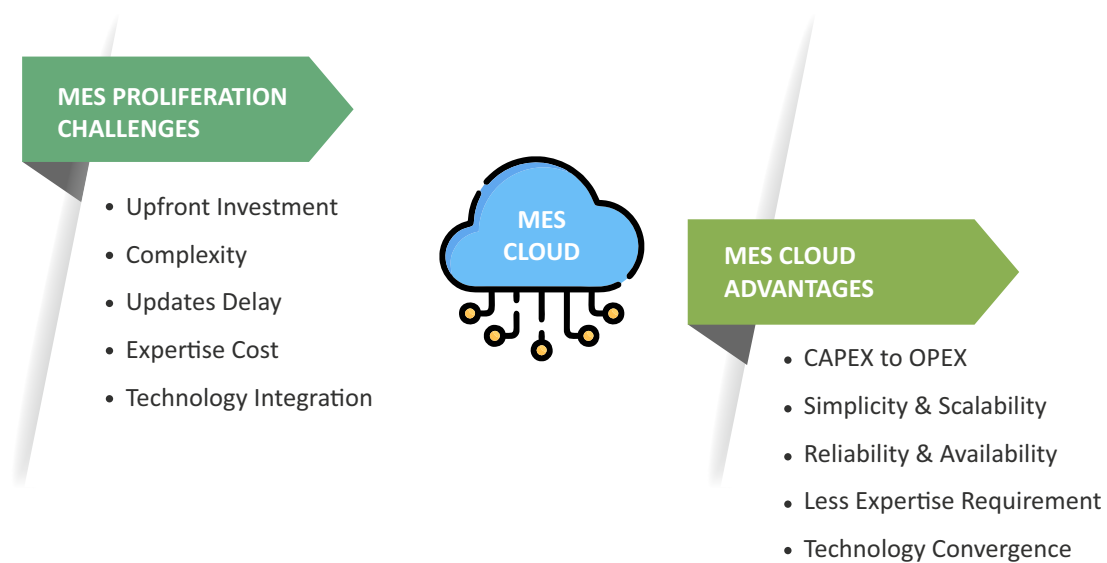


Figure 1: MES Proliferation Challenges and MES Cloud Advantages

MES has been evolving & seeing significant adoption

MES platforms have been transforming industry to the next level by making them efficient and flexible for manufacturing operations. MES has evolved over the decades to contribute to the evolving manufacturing world, from being a simple data collection tool to a modern system that can provide real time data/ information and transform it for end user in a more meaningful format, thereby enabling fast decision making to achieve targets in today's increasingly challenging and competitive manufacturing environment. Key functional areas where MES has evolved over the decades include **Production Management, Quality Management, Warehouse and Logistics Execution & Maintenance Management**.

MES can help achieve several objectives: maximizing throughput & resource utilization, reducing manufacturing cycle time, reducing scrap & rework, improving ability to achieve quality targets, reducing inventory costs, and conforming to regulatory compliance standards. MES also makes life easier for plant employees in terms of fewer last-minute rush to allocate resources or meet unexpected demand – this translates to workers being more satisfied and less stressed.



| Productivity & Efficiency | Quality | Inventory & Warehouse | Maintenance | Customer Focus |
|--|--|--|---|--|
| Core KPIs Improved through MES Implementation | | | | Resultant KPI Improvement |
| <ul style="list-style-type: none"> Cost of Goods Sold Manpower productivity OEE Throughput | <ul style="list-style-type: none"> Right First Time Rework & Rejection COPQ Traceability & Genealogy | <ul style="list-style-type: none"> WIP reduction Inventory Carrying Cost | <ul style="list-style-type: none"> Equipment uptime Repair & Maintenance Cost | <ul style="list-style-type: none"> Customer Satisfaction Score Delivery Adherence Order to Delivery Lead time Customer Complaints Response time |
| 2-6% Improvement | 8-10% Improvement | 5-15% Improvement | 5-10% Improvement | |

Manufacturers are also adopting MES due to its scalability and with recent trend of several providers bringing low-cost accelerator solution as a value proposition. With solutions capable of accommodating small, medium, and large-scale manufacturing operations, the efficiency and control MES software can offer is driving manufacturers to invest in platforms that allow them to keep up with the competition. Government regulations in manufacturing industry is also driving the need for safe, automated solutions in industries like pharmaceuticals, pushing manufacturers to employ MES to help coordinate automated tasks.

Digital Transformation initiatives and drive towards Industry 4.0 is adding a significant tailwind to MES adoption. MES is at the heart of manufacturing and so are the propositions around Industry 4.0 (includes Manufacturing, Engineering, Supply Chain & Maintenance and Service).

There are challenges in proliferation of MES inhibiting its growth

All these decades MES was on premise, installed on a company's own servers and behind its firewall – was the only offering for organizations. This has limited the rapid adoption of MES even though its importance is well understood and there are good reasons for that and detailed below with solutions to overcoming the same in subsequent section.

Investment Requirements: MES is digitally transforming manufacturing operations & its importance has grown over the past few years where people have understood its value, but at the same time industries are asking for Return on Investment (ROI) and Break-Even Point for such implementations.



It's been observed through our various engagements with clients that break-even point for MES implementation (All Modules) typically exceed 2+ Years per plant and one of the key reasons for it is the complex hardware architecture & cost involved in implementing the system (On premise) and then managing it further create a delay in implantation of MES. To implement MES, in addition to various hardware, which is used for integration of machines, people cost, software, customer must also bear the ongoing cost of server hardware, power consumption and space. It is a combination of significant CAPEX & OPEX. With covid-19 impacting many economies companies have tightened their investment.



Complexity of Implementation: The myriad touchpoints that MES solution has with the enterprise ecosystem, be it ERP or the lower-level integration layer as well as configurations within the application makes it one of the most complex implementation and effort & time intensive. A successful implementation at a single plant can take anywhere between 1 to 3 years depending upon the complexity. Proliferation to multiple plants is typically done in waves and using template created from initial implementation.



Deployment & Updates: Deployment / rollout of MES solution timeline also get impacted due to on prem implementation, some time it may extend to additional 3 – 4 months of time span of rollout. In MES on premise, resources are deployed in-house and the organization's IT infrastructure. This adds up lot of cost to the organization as discussed above, additionally enterprise is fully responsible for maintenance of the solution, which calls for a high skilled staffing, that should handle all the related and dependent processes. For most companies where multiple plants are in scope, it tends to be difficult to maintain due to various reasons like process difference, definition difference etc., hence it requires substantially high time to fix. Usually this leads to less utilization of the MES solution. For small and medium sized company this becomes infeasible due to complexity in sustaining the solution.



Cost of experts: Inefficiencies in current day process often led to sub-optimal distribution of resources across geographies and hence an impediment to optimizing cost of MES resources to support the diversity of application touchpoints which are often high due to the specialization involved.

Technology integration: For Industry 4.0 journey MES needs to be integrated with different enterprise platforms & also emerging technologies. MES need to be integrated with ERP, IoT, PLM, SCM platforms as part of digital thread. Also, MES need to be incorporate and facilitate latest technologies be it analytics, AI/ ML AR/VR on the shopfloor. This technology integration on premise is complex to achieve, maintain and upgrade.

The above challenges are an impediment to widespread adoption of MES especially by the SMBs.





Cloud can address MES proliferation challenges and make it pervasive

Cloud solves many of the challenges delineated earlier that are inhibitors to MES adoption. Some of advantage of MES Cloud are:



Zero/ Minimum upfront Investment & shift to OPEX: In IaaS/ SaaS Models for MES, customers only pay for what they require, without any big upfront investment for hardware. Company pays for the resources, maintenance cost is optimized and no separate hardware cost is involved. This drives a definite shift from CAPEX to more of OPEX.



Lesser need for Expertise to Maintain MES On-Premises: When it comes to periodic software updates, enterprises with On-Premises MES must keep updating the software with its own efforts leading to downtime or unintentional events resulting in ineffective operation. In SaaS scenarios, software updates and maintenance are taken care by provider. So, there is minimum need for those expertise inhouse for customers. Small & Medium Businesses in most cases will not have IT resources and additionally the software update cost and maintenance cost can be prohibitive which through SaaS can them achieve excellence through MES.



Flexibility & Scalability: The system can be scaled up much faster on Cloud relative to On-Premises implementation with greater flexibility and this also helps in managing the size of the environment in much more effective way rather than dependent on fixed on prem architecture. The cloud brings a standardization of processes where all users rely on the same version of the software; this is reasonable given the maturity of the technology achieved with standards like ISA/S95. This means that the need for customization will reduce. With this type of system, scalability can occur naturally, and the system can be scaled up much faster on Cloud relative to On-Premises implementation. Managing the data in much more effective and optimized way, it also helps in resolving some basic infra issue which impact the performance of solution and response time. MES on Cloud is a much leaner approach, but it is to be stressed that MES implementation does not remove all the on prem instance. Any system which are Level 2 or Level 2.5 still need to reside on prem, because of multiple factors involved.



Availability & Reliability: For SaaS situations, AWS & AZURE provide impressive metrics on availability and reliability of the system. This gets reflected in corresponding Metrics for MES.



Convergence: Cloud MES enables customers take advantage of the latest IoT technologies and offers better scalability than on-premises MES systems. Capabilities of key manufacturing software (MES, ERP, IOT) are increasingly overlapping & more so for interfaces of MES with ERP and IoT Platforms especially when hosted on cloud. IoT platforms were initially optimized for handling a variety of IoT data from connected factories. MES tools have recently also developed new functionality to handle similar functions. The ability to handle IoT data is just one of many ways in which MES platform functionalities and IoT platform functionalities are converging in manufacturing context.



Unlocking Intelligence at all Levels: Because Cloud integrates data from all factories, the visualization on data analytics can be across factories, for a factory or down to the line or equipment level depending upon the user role.



Better Integration with Artificial Intelligence (AI) Tools: Because of the possibilities of higher computation on cloud, software vendors are increasingly integrating machine learning and AI-based tools. These integrated with MES can have far-reaching possibilities.

ITC Infotech MES Cloud Approach

ITC Infotech has more than a decade experience in MES Solution implementations and strong Cloud Expertise. These two capabilities combined provide the right synergies and help put customers in their journey to moving MES Solutions on Cloud. The Services range from Consultation, Design, Development, Deployment & Support.

MES Cloud Construct: There are a few alternate ways in which MES, and cloud can come together and that involves Application hosting & Data storage. The choice made would be contingent on/ influenced by the following factors:

- **Vendor selected** – Support of the MES Product for Cloud
- **IT infrastructure** – Cloud Readiness of the Organization
- **Organizational Strategic fit** – Alignment with broader Industry 4.0 Strategy as well as Tactical & Operational needs

MES application that fully reside on cloud, will have the entire application stack including its functionality, data storage/ processing entirely on cloud. If the imperative is more of real-time performance, the more likely an on premises or Hybrid hosting will need to be selected. MES Platforms based on hybrid cloud/ edge architecture enable manufacturers to flexibly run control,



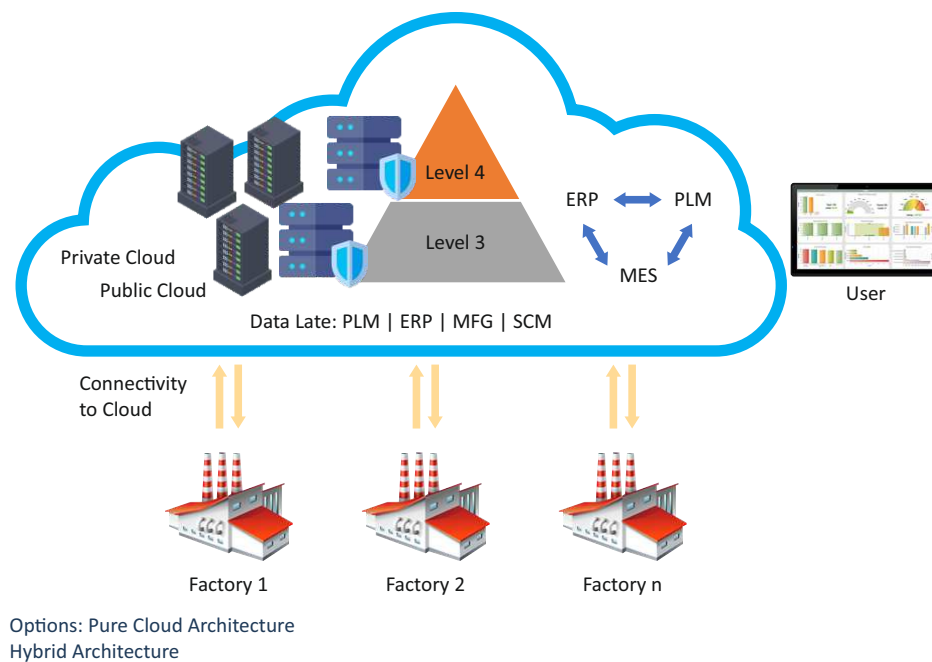
computing, analysis & data visualization tasks where it is most suitable. That means production execution can be effectively run-on edge while longer term storage & data analytics heavy lifting is on cloud. This architecture reduces local infrastructure footprint while minimizing maintenance needs. The choice depends on multiple factors as availability, real-time performance, transaction volume, data/IP security, and overall performance of the application.

With MES fully on cloud, the application deployment and related costs may be lower than traditional on-premises deployment, but there may be concerns regarding latency, lack of real-time performance and data security. Alternately critical MES functions could be hosted on-premises, thereby facilitating better control and security as compared to public cloud-based application deployment. Capabilities as scheduling, manufacturing process execution, dispatch, data collection and edge data analysis can be kept local whereas other functionalities, such as advanced analytics, compliance data may be hosted on cloud. Such an arrangement ensures that the critical functions of MES are always up and data that are considered critical/ sensitive is within organization's control.

Thus, the choice really depends on the organization's need on availability, security, network latency, scale of deployment, & cost constraints to name a few.

MES on Cloud can be conceptualized and implemented in various architectural topologies that include (representative but not exhaustive):

- *MES, PLM & ERP all on Cloud (depicted in Figure below)*
- *MES on Cloud but PLM & ERP on premises*
- *MES completely on Cloud: Control, Computing, analytics/ visualization all on cloud*
- *MES with Hybrid Architecture: Enables manufacturers to flexibly run control (production/ quality/ inventory/ maintenance), computing, analytics/ visualization activities where it is most optimum. This means production execution can be effectively run at the edge (on-premises) while storage and analytics is on cloud. This is a very good use of the cloud because it does not pose risk to production yet utilizes cloud to help reduce hardware footprint.*





In Process Industries typically the volume of data generated will be significantly more on a relative basis with respect to Discrete Industries. A Hybrid architecture with some amount of aggregation on premises (edge) before it is sent to cloud suffices well in many cases and need to be factored in during system design phase of the solution.

Methods to Migrate to Cloud: Both MES with Software-as-a-Service (SaaS) architecture as well as Lift and Shift are expected to grow. Because of the limited upfront investment and little/ no IT Infrastructure requirements, SaaS deployments for manufacturing software and increasingly also MES are often preferred by small and medium sized companies wanting to digitize their operations.

Lift and shift method is about moving existing on-premises MES software to off-premises cloud infrastructure. Large companies usually prefer this method for moving existing MES systems to cloud. Private cloud-based lift and shift migration for deploying MES provides complete control and ownership of infrastructure, data, and operations to a company.

Thus, approach of moving MES to cloud depends on several considerations as CAPEX, OPEX, scalability & data ownership.

Addressing Challenges to Migrating MES to Cloud : Many of the challenges that we find in moving MES customers to cloud are synonymous with typical IT challenges in cloud movement. The three important one are

- **Adoption:** People are often the ones that poses the biggest challenge. People tend to resist change and especially those that have spent decades in factory environment and accustomed to OT ways of doing things. Cloud migration brings in a lot of change and disruption—often with significantly new systems (IT/ OT integrations in a seamless manner), processes, and even leadership. If the human element is left unmanaged, it will be a struggle to implement a successful migration.
- **Cloud Readiness:** The biggest challenge is that many manufacturing companies do not have proper infrastructure to embark on a cloud journey and no business strategy in place. Organization's IT department should work on making proper environment so that the organization starts innovating. The success of a cloud migration depends on the organization's digital legacy and how much investment is done on the training
- **Security:** One of the biggest concerns to cloud movement are security related in the OT Layer. This needs to be addressed with the customer business and IT Teams through consultative approach as in modern day the cloud architecture supports very strong security protocols.

ITC Infotech along with MES product vendor and cloud platform addresses these concerns and ensure enterprises get value in their cloud Migration.

Bottom Line: MES on Cloud Solution addresses many of the existing shortcomings & can help faster adoption but it needs right implementation partners



MES on Cloud can help faster adoption and enable enterprise to proliferate their digital transformation activities. Specific value areas include:

- **Optimized upfront Investment:** MES on Cloud and with a SaaS model can help customers optimize their investment needs turning from CAPEX to a more OPEX model.
- **Lesser need for Inhouse Expertise:** With a SaaS model, the infrastructure, software, and upgrades are taken care by the specialist team of provider thus significantly reducing the inhouse expertise needed for clients.
- **A More Scalable System:** With proliferation of digitalization and need to connect multiple factories and devices/ equipment in those and to obtain a required level of rolled-up view of KPIs/ Metrics, MES on Cloud together with IOT opens new frontiers and possibilities.

But to achieve value, enterprises need to select right implementation partners which have experience in both MES technology solutions and also on cloud. MES on Cloud is real, happening and here to stay with momentum expected to pick up further in coming years. Enterprises need to start their MES cloud journey sooner rather than later.

About ITC Infotech

ITC Infotech is a leading global technology services and solutions provider, led by Business and Technology Consulting. ITC Infotech provides Business-friendly Solutions to help clients succeed and be future-ready, by seamlessly bringing together digital expertise, strong industry specific alliances and the unique ability to leverage deep domain expertise from ITC Group businesses. The company provides technology solutions and services to enterprises across industries such as Banking & Financial Services, Healthcare, Manufacturing, Consumer Goods, Travel and Hospitality, through a combination of traditional and newer business models, as a long-term sustainable partner.

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