Infosys cobalt

WHITE PAPER

THE SHIFTING SANDS OF MANUFACTURING & ESSENTIAL CAPABILITIES

Abstract

The need for modernization based on digital capabilities is evident in almost all areas of the manufacturing enterprise today – not just on the shopfloor, but also in the sales, planning, engineering, and service functions. Significant shifts are underway in the manufacturing industry driven by world events as well as technology.

This paper discusses these shifts in the industry along with key business and technology capabilities manufacturers need today to navigate this disruption and stay competitive. It also shows how Infosys Discrete Manufacturing Solution can empower manufacturers with these capabilities.

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Introduction

Powerful new technologies such as cloud computing, IoT, big data, analytics, and robotics are converging to bring about huge changes in the business and consumer worlds. Manufacturing is one industry that stands to gain immensely by transforming with these converging technologies. Connected machines and factories, resilient supply chains, product servitization, and sustainable manufacturing present opportunities to manufacturers for both new revenue models as well as optimizing costs – thus impacting both the top and bottom lines.

The fourth industrial revolution is all about technology and manufacturers need a digital platform that will allow them to embrace current technologies and build business capabilities for the future. Forces of disruption such as technological convergence and various world events have resulted in several shifts taking place in the hitherto relatively stable world of manufacturing. Some of the current shifts in the manufacturing industry are shown in Figure 1.

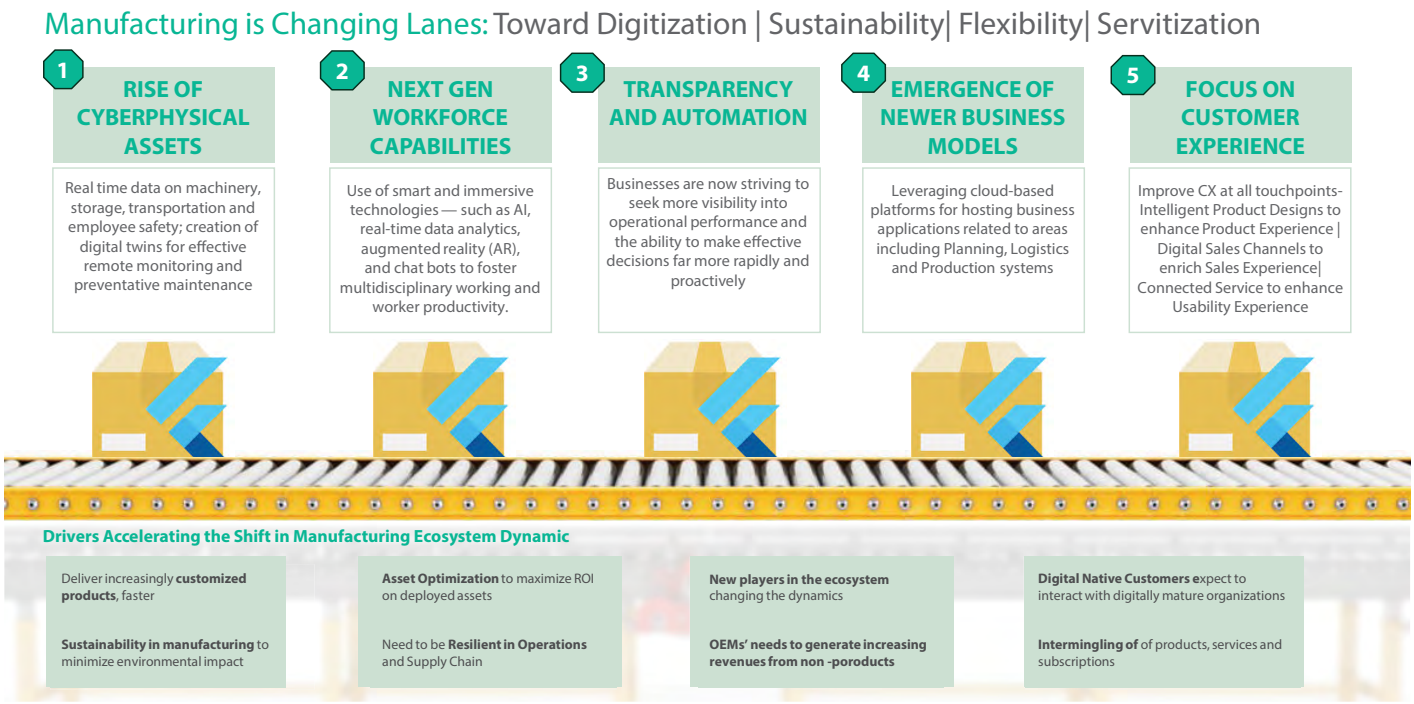


Figure 1 – Key shifts in manufacturing

1

In today's business world, sensors have become all-pervasive owing to their decreasing costs as well as reduced costs of telecommunication and networking. Modeling of physical assets using digital twins and then digitally monitoring and controlling the behavior of physical assets are approaches that are fast becoming mainstream. In manufacturing, the digital footprint of physical assets has led to a rise in cyber-physical ecosystems of assets in various areas such as product design, manufacturing, storage, transportation, and asset maintenance.

2

The rise of cyber-physical systems is changing how the workforce interacts with such assets. The points and nature of interactions of the workforce with machines, products, and systems are changing rapidly. The need for manual labor is either changing or being reduced in certain areas. Such shifts require careful change management and retraining of today's manufacturing workforce

3

The volume of data being collected from every corner of the enterprise is creating greater opportunities for transparency, automation, and analytics across the manufacturing enterprise. Equipped with the right tools, manufacturers have the data needed to easily identify areas for improving the efficiency of processes and people, as well as tasks that could be done differently or automated.

4

Today's customers want more for less, and this is forcing manufacturers to develop new business models such as servitization, equipment as a service, data monetization, and bundled subscription and products. The demand for products built to suit each customer's individual specifications is also on the rise.

5

Industrial buyers today are demanding new age customer experiences at all touchpoints – sales experience, product experience, and service experience. This is forcing manufacturers to focus on improving the digital experience of their customers during sales and service – areas that manufacturers have not focused on for digitalization.

Business Capabilities Needed To Navigate These Shifts

The fourth industrial revolution has brought with it several changes in the way the manufacturing industry views and works with its assets, business models, employees, and customers. The industry needs to build business and technological capabilities to keep pace with and ensure success in these changing times.

Figure 2 represents the business capabilities that manufacturing enterprises need to build to ride the current technology wave successfully. This list is based on conversations with our customers and our analysis of the current state of the industry in terms of capabilities.

Prioritizing new Business Capabilities

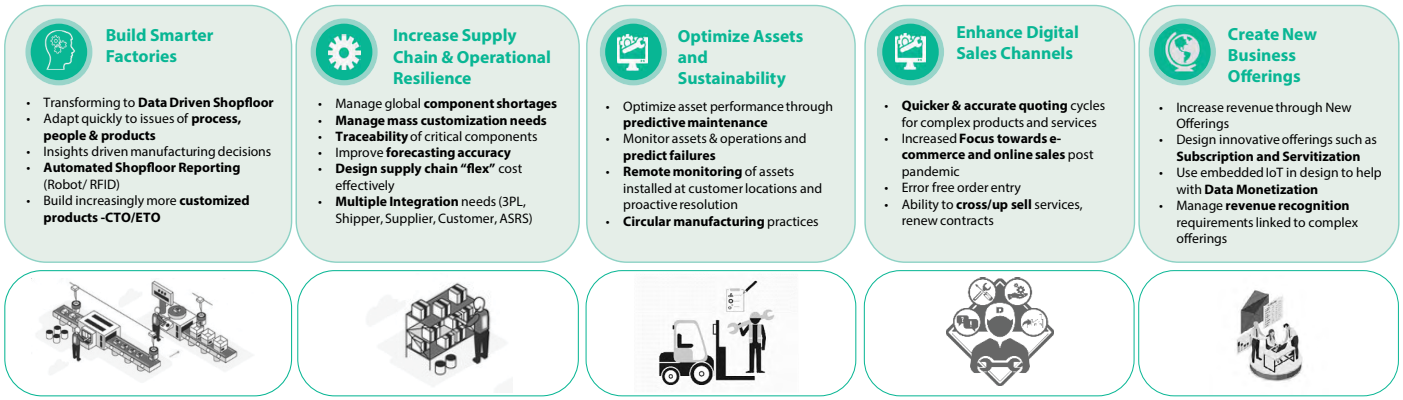


Figure 2 – Business capabilities needed to navigate key shifts in the industry

Build Smarter Factories

Building smarter and data-driven factories involves two major components:

- Driving convergence between the operational technology (OT) data generated from machines, equipment, and processes on the shop floor and the information technology (IT) data generated from business applications such as ERPs and MES
- Generating actionable insights in real time through analytics

Key Components to Build Smarter Factories

Some of the key components needed to implement smart factories are listed below.

Integrating data from sensors

The shop floor generates a lot of data from machines, operators, surroundings, and products. This data comes from machines and processes that are of different types, ages, and protocols. Capturing and transmitting such data is an essential first step towards building smart shopfloors.

Data contextualization

Data collected from shop floors is usually time series data of various parameters. This data needs to be viewed in conjunction with the data contained in the ERP systems to add business meaning to it. This data contextualization is essential to build the data foundation for a smart factory.

Analytics and insights

Data contextualization provides the base for the smart factory. Such data can then be used to meet different needs of the manufacturing organization such as:

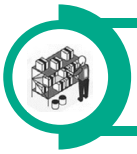
- **Shop floor visibility:** One of the foremost benefits that shop floors will derive from smart manufacturing is the answer to the question "What is happening on my shop floor?" Machine data collected and analyzed in silos deliver limited additional value. However, when the data collected from machines and production runs are brought together, contextualized, and presented, a comprehensive picture of the shop floor is available across various dimensions and KPIs.
- **Production monitoring:** Mapping factories and machines, monitoring machine performance, and machine status, and measuring manufacturing metrics and KPIs relevant to the shop floor in real time or otherwise constitute production monitoring. Parameters can be monitored for real-time actionable purposes such as collecting temperature data to trigger a cooling action when a boiler crosses a threshold. Data such as daily throughput and OEE trends can also be collected for benchmarking purposes.
- **Maintenance monitoring:** Keeping track of equipment health and triggering maintenance actions proactively constitute maintenance monitoring. For example, if sensor data collected from an equipment shows that a low voltage is reached, maintenance work orders are triggered automatically. Simultaneously, logging a quality issue and sending notifications can also be triggered automatically.
- **Predictive analytics:** Proactive identification of issues saves both cost and time. Using AI/ML-based capabilities to analyze manufacturing data and identify patterns and correlations helps predict outcomes accurately. For example, the workmanship of a particular operator in an upstream operation can influence defects in a downstream machine. The ability to identify such patterns in real time and flag a production batch for likely quality issues early will help supervisors to take corrective actions quickly.

Cloud-enabling your MES

For manufacturers, MES is a central IT system that controls manufacturing execution on the shop floor. While manufacturers move other business functions to the cloud, the 'cloudization' of manufacturing is challenging due to industry-specific functions and shop floor level integrations these MESs provide. For global corporations, the MESs used in different factories vary, and integrating them to build a common manufacturing platform is essential for a smart factory.

Automation

Shop floor automation is one of the fundamental requirements for building and running a smart factory. This can be achieved in multiple ways such as integration with RFID devices to report quantity and labor hours automatically to business applications, automatic test data collection, and certification printing leading to a paperless shop floor.



Increase Supply Chain Resilience

The global and complex nature of today's supply chains means that the interdependencies of various links are very high. Hence, even a minor issue in one isolated region can compromise an entire global supply chain. So, when major worldwide events such as wars and pandemics take place, the potential for widespread supply chain disruption is enormous and can have a knockout effect due to material and labor shortages.

Effective supply chain management means being able to respond quickly to operational disruptions and having a flexible contingency plan in place. But to be truly resilient, a supply chain must be able to forecast and anticipate disruptions, and where possible, avoid them altogether. Key aspects of managing supply chain resilience for manufacturers include the following:

- **Resilience through supply chain visibility:** Strategic planning and visibility of demand/supply through the entire supply chain (including Tier 2 and Tier 3 suppliers and partners) is essential. This enables synchronization with all components of the supply chain to harmonize the production process, ensure better delivery dates for customers, manage the workforce, and aid financial planning.
- **Resilience through supply chain risk forecasting:** Risks to global supply chains vary from known-unknowns and controllable risks to unknown-unknowns and uncontrollable risks. In today's world, various risks are at play such as material prices, environmental problems, geopolitical situations, and logistical hurdles. For a resilient supply chain, companies need to develop a strong framework to predict risks to their supply chain. This can be achieved using existing analytical processes as well as big data and artificial intelligence (AI) to curate disparate data sets from across the business and around the world. This can help businesses better anticipate supply chain disruptions and respond proactively on the operations and IT front.
- **Resilience through building of "flex":** Supply chain profitability depends on minimizing surplus and keeping inventories as lean as possible. However, disruptions such as the pandemic have highlighted the need to move from just-in-time to just-in-case and design additional flexibility in the supply chain. Strategies deployed can include multi-sourcing of key components, spreading the supply base geographically, contract manufacturing, a differentiated buffer/strategic stocking policy for different categories of items, order transferability across factories, review of product design through alternate BOMs, and substitute items.

Optimize Assets and Drive Sustainability

Sustainable manufacturing is a key part of the green goals for manufacturing organizations today. Sustainable manufacturing is the process of creating products while minimizing any negative impact on the environment. The U.S. Environmental Protection Agency (EPA) defines sustainable manufacturing as the creation of manufactured products through economically sound processes that minimize negative environmental impact while conserving energy and natural resources.

Sustainable manufacturing rests on three main pillars:

1. Remanufacturing and waste reduction
2. Use of digital tools to proactively track and trace with closed-loop systems
3. Process optimization with efficient and cleaner alternative technologies

By adopting the remanufacturing strategy, companies achieve two broad objectives:

1. Going green through reuse of salvaged components and reducing waste
2. Increasing market share by targeting a lower price-point segment with remanufactured units that cost less

Another aspect of sustainability is the reduction in materials wasted as part of the manufacturing process. As an example, industrial manufacturing companies typically use wires/bars of different diameters as raw material. Raw wires/bars are procured from suppliers in bulk in spools or full-length bars and are then cut down as pieces of pre-specified lengths and stored in inventory in ready-to-use form. However, during manufacturing, ad hoc lengths or pieces of non-standard length may be required, which are then cut from the stored full-length pieces. This leads to over 20% wastage of such materials. There are other similar examples of material wastage. Manufacturers need to design processes and systems starting from part definition to procurement, planning, and manufacturing in order to reduce material waste, thereby lessening the impact on the environment.

Enhance Digital Sales and Services Channels

Manufacturing, particularly in the industrial space, has usually relied on traditional face-to-face sales channels to sell products and services. Often these products are complex, configurable, and built to customer specifications. This makes face-to-face selling and site visits the most convenient means of selling these products and associated services. However, the pandemic posed a major challenge for this sales model.

With changes in user experience in all spheres of life, even industrial and commercial buyers today expect better means to interact with their suppliers. This requires manufacturers to move beyond the traditional systems of emails and calls for quoting and taking orders.

Apart from the customer experience, manufacturers are looking at improving their ability to provide accurate quotes and increase the proportion of wins. Configuration, pricing, and quotation tools are used to configure and quote digital models of products and services. Integrating such tools with fulfillment systems helps OEMs to accurately commit delivery dates to their customers, while also being able to simulate the gross margins at various price points. Usage of AI to predict the winning price is an added input for OEMs while deciding on a quote.

These aspects have pushed manufacturers to invest in building capabilities for digital quoting and sales.

Service Transformation

The contribution of services to overall revenues has been steadily on the rise for most manufacturers. These services include subscription-based services, preventive maintenance contracts, and extended warranty, along with a few relatively newer services such as remote monitoring and data analytics. With the increase in revenue, the model of delivering services has also undergone significant changes. Omni-channel customer support, bundling of services and contracts, automated technician scheduling, service parts optimization, and knowledge management are some of the things that have become mainstream in the manufacturing industry.

With technological convergence, opportunities for a service transformation are now available to manufacturers. New capabilities include remote monitoring and fixing of problems, AI/ML-based guided assistance for field technicians, geo-tracking of technician locations to optimize routes and ensure faster response, contextualized knowledge mining to fix right the first time, offering equipment as a service (EaaS) instead of an outright sale, and usage-based billing.

Design New Business Offerings and Models

With the revenues generated from traditional product businesses flattening and margins in those businesses coming under constant pressure, manufacturers are looking for alternate ways and models to generate sustainable revenues and profits. This has forced them to consider new offerings and revenue models. The ability to embed sensors in their products has allowed manufacturers to generate data from these products in the customers' environment. The ability to collect such data wirelessly using IoT and cloud has opened avenues for providing new data monetization offerings. For example, equipment analytics involves sharing data regarding how the equipment is used in the field, peak hours, peak load, power consumption, and ambient parameters.

IOT devices and sensors provide the ability to collect data from hardware and complete the feedback loop by changing the settings of the equipment when certain conditions are met. For example, when the temperature of a boiler exceeds a threshold, the cooling system can be switched on automatically using IoT. Maintenance is an area where a lot of new service offerings are being designed by manufacturers. These include remote monitoring services, remote configurations, and AI/ML-based preventive maintenance to predict and prevent equipment downtime.

While EaaS is not new to the manufacturing industry, more OEMs are exploring it as a revenue model. In this model, customers pay a periodic subscription instead of buying the equipment from the OEM. The OEM owns the equipment and is responsible for its upkeep and maintenance. This business model shifts the risk to the OEM from the customer, since they will incur the cost of making the equipment, its maintenance and SLAs, product obsolescence, and inflation rates. Instead of immediate revenue, their cash inflows will get pushed to the future. As part of the EaaS model, several newer billing models are emerging such as charging customers based on usage of the equipment instead of a flat fee, billing that is linked to business outcomes, or billing linked to SLAs.

Banks and insurance companies have a key role to play for this model to work. Banks need to finance the additional working capital required and insurance companies need to cover the OEMs against the various risks. Despite all these factors, EaaS is fast gaining popularity. For customers the capital expenditure to buy any equipment is converted into operational expenditure, freeing up cash to finance business expansions.

Enhance Processes to Deliver Customized Products

Today's discerning customers want products that are custom-built for them. Manufacturers are facing an increasing volume of orders that need to be built and engineered to customer specifications.

The engineer-to-order (ETO) environment is more complex compared to a make-to-stock or configure-to-order. In configure-to-order, once an order is received, products are either picked or assembled and shipped. However, in an engineer-to-order scenario, each customer requirement must be understood, quoted for, priced, and then engineered before it can be manufactured. This puts a load not only on manufacturing, but also on the supply chain, as this requires sourcing the specific materials needed, checking for manufacturability, and involves coordination between different departments. Engineer-to-order products need a lot of coordination thus increasing the overall go-to-market time. This involves multi-departmental interactions such as between:

- Sales team and the customer to understand the requirements
- Sales and engineering teams to validate the requirements
- Engineering, sales, and customers to clarify and finalize the requirements
- Sales team and product engineers to assess feasibility of the requirements
- Engineering, procurement, and suppliers to consider sources for supplies as new material or design might be needed from suppliers
- Engineering and manufacturing to validate the manufacturability of each new design
- Manufacturing, purchasing and outside supplier to ensure feasibility of outside processing required in new design
- Planning and procurement to ensure suppliers for long lead time items
- Various departments to define the attributes for each new ETO part being designed for each order

These iterations and cross-departmental interactions make the ETO process vulnerable to delays and errors. This leads to an increase in the go-to-market time for such products.

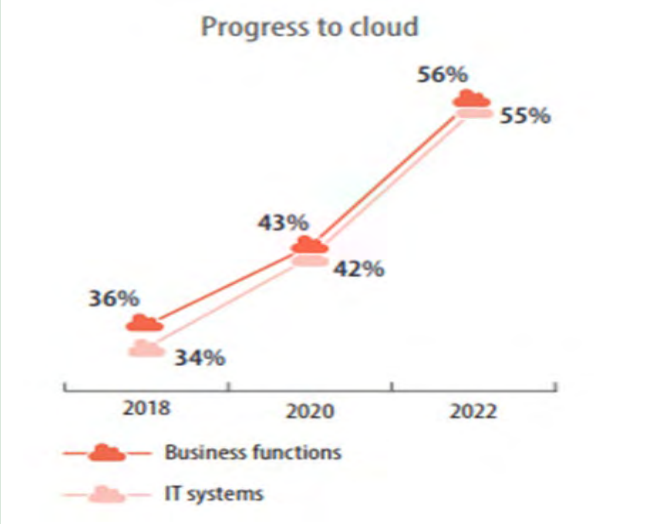
Additionally, long lead time parts are often required as part of ETOs. It is essential to provide the visibility to purchasing early in the design process about the need for such long lead time parts so that POs can be sent early. If such POs are sent at the end of the design process, additional delays occur in the ETO cycle.

Today's customers want their built-to-specification products delivered quickly, and unreasonable delays lead to cancellation and moving to a competitor product. To meet this challenge, manufacturers are looking for ways to make their ETO processes more efficient, quicker, better coordinated, and error-free. Automation, workflows, and data dashboards help make the processes smooth and fast and provide visibility to an ETO product throughout its lifecycle from quoting to delivery.

Creating a Digitally Modernized Manufacturing Enterprise

The Infosys 2021 Cloud Radar study found that cloud adoption rate is highest for the manufacturing and hi-tech industry cluster. The study states:

"Owing to the recent pandemic and other disruptions, manufacturers felt the impact across areas including dispatching technicians to repair machines, finding alternate suppliers in the event of shortage and engaging with customers spread across regions and geographies. Manufacturers have taken the lessons seriously and have doubled down on digital transformation leading to greater cloud adoption across areas. Enterprises were forced to shift initiatives and restructure their business to combat the challenges brought on by the pandemic. Their top objective in 2020 was to speed up cloud deployment."



In short, all the data and sentiment in the manufacturing industry is pointing towards the cloud as the next big wave for manufacturing growth and innovation.

Infosys Discrete Manufacturing Solution

Infosys Discrete Manufacturing Solution is a platform built on Oracle SaaS with Infosys Live Enterprise Suite platform, and includes AI/ML-based analytics and prediction solutions, RPA solutions for automation, and preconfigured processes and integrations. The platform is aimed at making cloud transformations focused, quick, and predictable to help manufacturers initiate or strengthen their digital transformation on the cloud,

Key Features

- Covers all key processes such as sales, engineering, supply chain planning, manufacturing, purchasing, logistics, shipping, service, compliance, projects, finance, and HR
- Available for all manufacturing environments such as make-to-stock, make-to-order, configure-to-order, and engineer-to-order
- Provides preconfigured and ready-to-use instances of end-to-end and key processes to give customers a head-start
- Includes Infosys IP solutions to address emerging needs of the manufacturing industry such as engineer-to-order, automation, remanufacturing solution, material waste reduction, smart manufacturing, solution for resilient supply chains, servitization, and smart quoting
- Provides reusable integration adapters for common satellite systems such as PLM, MES, and banks
- Integrates Infosys Live Enterprise Suite platform that hosts key dashboards and productivity solutions (such as workbenches, dashboards), and pre-built analytics including AI/ML insights. The solution also contains chatbots and RPA-based automation solutions in different functional areas

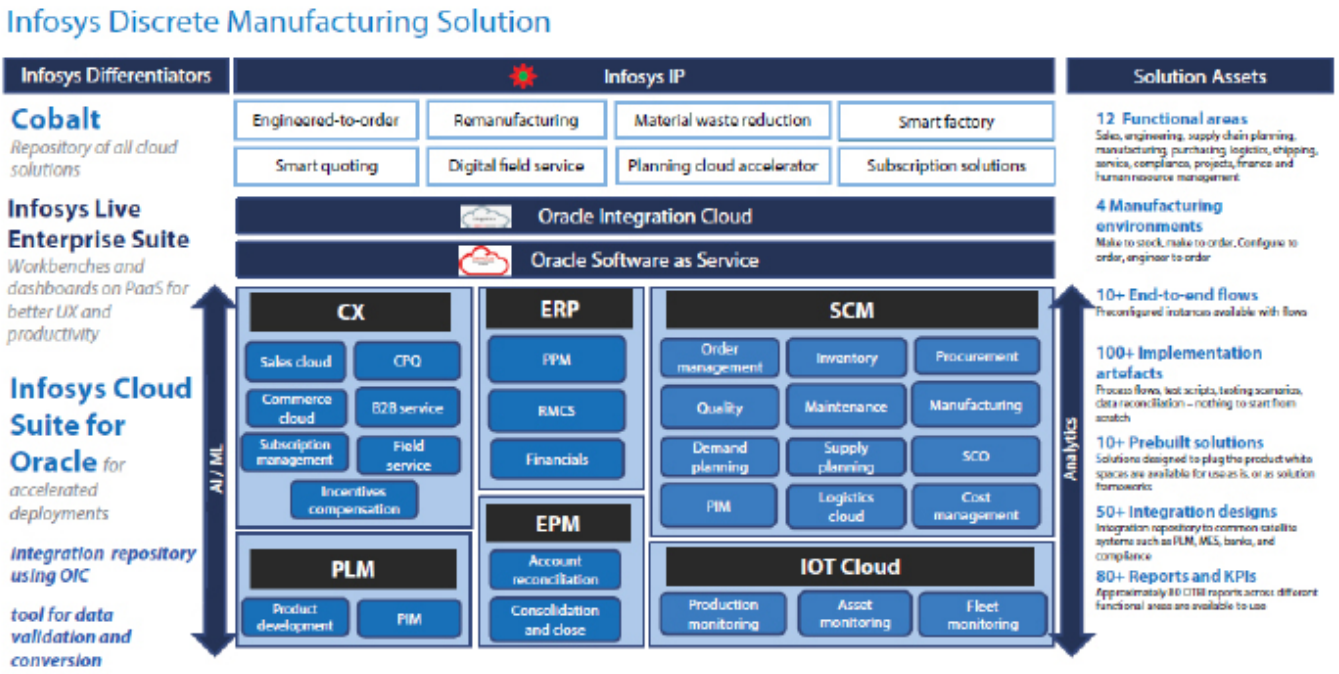


Figure 3 – Infosys Discrete Manufacturing components

Infosys Discrete Manufacturing Solution helps businesses jump-start their manufacturing modernization by:

- Helping develop business capabilities essential to compete today such as smart manufacturing, resilient supply chains, and ability to mass customize products
- Enabling manufacturers with digital sales and services and deploying newer business models such as servitization
- Accelerating the manufacturing modernization journey on cloud
- Facilitating the shift to Industry 4.0 with a manufacturing platform that promotes innovation
- Leveraging existing investments by blending legacy on-premises and new cloud applications
- Allowing a modular architecture while delivering an end-to-end solution
- Driving continuous improvements through analytics-driven insights and automation

Conclusion

Changes in the business environment as well as the powerful convergence of multiple technologies have led to tremendous shifts in the manufacturing industry. We are well into the fourth industrial revolution, and a digital transformation is essential to meet the competitive challenges that have been presented by Industry 4.0. Manufacturers need to acquire various new age business capabilities while establishing a solid technological platform that can scale easily as needed. Studies have shown that most manufacturers are making a move to the cloud to enable their digital transformation and build a scalable platform not just for the present, but for future business needs as well. Infosys Discrete Manufacturing Solution helps manufacturers accelerate their digital transformation on the cloud with pre-built industry solutions, preconfigured processes, and an entire suite of project tools and artefacts.

About the Author

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Rupam Das is a Principal at Infosys, and manages Manufacturing and Supply Chain transformations for large customers. Rupam also leads the Infosys Discrete Manufacturing Industry Solution which accelerates cloud adoption for manufacturers using prebuilt Infosys solutions and processes. Rupam also has a keen interest in Industry 4.0 and how the convergence of multiple technologies is shaping the future of shopfloors and manufacturing enterprises in general. He could be reached at rupam_das@infosys.com