Edge transformation in the manufacturing industry

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The global manufacturing sector is still recovering from the impact of the pandemic. The manufacturing industry exhibited a slow growth rate of about 3.9% in 2022[1] compared to the production growth rate of 9.4% in 2021.[2] Manufacturers have already realised that transforming their digital strategies can help them bounce back to their pre-pandemic growth rate. Therefore, as a part of the post-pandemic transformation, manufacturers are leaning towards edge computing to improve their overall efficiency levels and thrive amidst the crowd of competitors.

Edge computing is a distributed information technology architecture that enables the processing and storing of data in the vicinity of the origin of the data. According to a recent market research by IDC, the global investment in edge computing was going to reach USD 176 billion in the year 2022, which represented a steep rise of about 14.8% compared to 2021.[3]

Factors driving manufacturers towards edge-adoption

There are several challenges which manufacturers may overcome if they embrace edge computing. For instance, edge computing can minimise the time consumed for gathering, processing, filtering and analysing large volumes of unstructured data which is essential for:

- predictive maintenance and yield optimisation
- overall equipment effectiveness
- condition-based monitoring
- production quality control
- manufacturing-as-a-service (MaaS)
- AR/VR in manufacturing.

However, with the existing cloud-based strategy, manufacturers find it difficult to manage a large volume of unstructured data sent to the cloud, as it requires a long response time and huge bandwidth. This makes it difficult to detect and prevent capacity bottlenecks in advance. Minimising downtime and plant emission rates are other significant issues that manufactures cannot address with the existing proprietary systems within the plant.[4]

A shift towards the technologies of Industry 4.0 like edge computing can be a way out. Edge computing allows the deployment of devices and storage resources closer to the source of the data and therefore allows the gathering and processing of huge data with minimal response time and low bandwidth. Thus, the edge ecosystem contributes substantially towards eliminating the existing capacity restrictions of a manufacturing plant.

1 https://www.controleng.com/articles/global-manufacturing-output-growth-at-3-9-in-2022 /

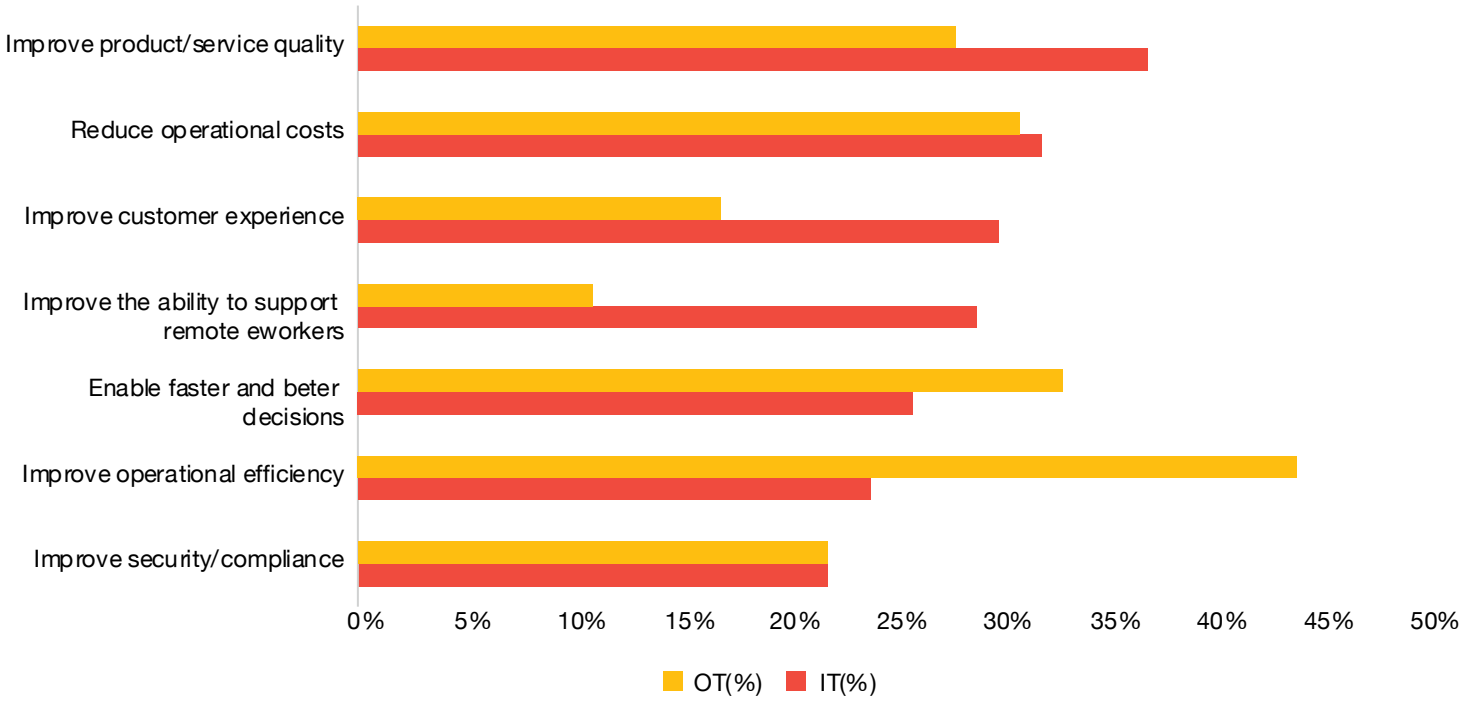
2 https://www.unido.org/news/manufacturing-sector-recovery-continues-future-unpredictable#:~:text=The%20complete%20annual%20data%20confirms,4.2%20per%20cent%20in%202020 .

3 https://www.idc.com/.

4 https://hbr.org/1985/09/mrp-jit-opt-fms

Benefits of implementing edge computing

Expected IT/OT benefits from edge computing[5]



Benefits of implementing edge computing

Edge computing devices with processing capabilities bear considerable CapEx. Sometimes manufacturers must bear an additional OpEx for the equipment required to maximise the utilities of an existing system. Therefore, costs related to the configuration, deployment and maintenance of an edge computing framework can be a major barrier to its implementation. Manufacturers need to conduct a cost-benefit analysis and risk analysis prior to implementing edge computing. They can also depend on companies providing MaaS to find a feasible solution for them.

Edge computing systems use a data subset to process data. Issues like wastage of a large volume of data may occur during data processing. Inappropriate segregation of critical data can lead to the loss of important data causing an implementation failure for the entire system. Hence, manufacturers need to segregate their data for optimal categorisation which is essential to restrict the loss of critical data and to improve the efficiency of the process.

High-power processors are essential for edge implementation which end up consuming high voltage. Manufacturing plants in remote areas can face issues in developing the required infrastructure and making provisions for high-voltage, three-phase electricity, or alternative sources of power to implement edge computing successfully. The problem of raising funding to develop a hybrid cloud infrastructure is another major bottleneck.

Often edge solutions with a mismatched variation of hardware and limited scope for expansion can increase the complexity and create substantial barriers to proper implementation and utility maximisation of the system. Thus, prior to the installation of the edge system, manufacturers need to be aware of the configuration process, the capacity of the hardware and future scope for expansion. However, manufacturers can eliminate these issues by asking consulting service providers to design infrastructural development and investment management strategies for them.

5 IDC survey of 128 decision-makers at manufacturers in partnership with Lumen and Microsoft https://assets.lumen.com/is/content/Lumen/lumen-idc-edge-infographicpdf?Creativeid=289c93c0-62fa-4c47-8dbc-38d223d9e7cb

Edge computing for smart manufacturing

As a futuristic and innovative solution, many manufacturers have started implementing edge computing and many are planning to implement it. The following are some areas where edge computing has already been applied:

Predictive maintenance and yield optimisation

Predictive maintenance is crucial for preventing any kind of pause or failure in the manufacturing system. Many manufacturers worldwide have already implemented edge systems for gathering data from assets equipped with smart sensors, normalising the data, and sending it to the cloud or core for in-depth analytics and ML. This in turn supports real-time tracking of the performance, health and status of the assets at the manufacturing plants. Hence, the operational technology team does not have to be concerned about the latency and data security issues that may occur while transferring a large volume of operational data from the factory floor to the public cloud for predicting the current health status and the performance quality of the assets.

Edge-enabled predictive maintenance further facilitates yield optimisation. Edge computing enables consistent and real-time tracking of data related to the optimal flow of a product during the assembly process and analysis of the same while maintaining strict latency and security guidelines. As a result, the detection of anomalies becomes possible before they can halt production. Further, a substantial reduction in the downtime of the equipment and processes paves the path for yield optimisation.

Automation in maintenance

IoT enables the amalgamation of radio frequency identification (RIFD) tags, smart sensors and other software within the industrial system. This makes it possible for manufacturers to gather real-time data about the condition of the machines and their performance. However, in this process, IoT devices end up generating large and unwieldy data sets, the processing and analysis of which are time-consuming and can decelerate the process of automation. The integration of the edge computing with Industrial IoT eliminates the processing and communication time lags and accelerates the process of automation.

Overall equipment effectiveness (OEE)

OEE estimates the manufacturing quality considering the metrics of performance, availability and quality. The use of edge devices at the manufacturing plants allows manufacturers to use prescriptive, diagnostic analytics and enables intelligent asset optimisation. As a result, manufacturers can minimise their unplanned downtime, improve the product quality, and enhance their asset utility maximisation. Eventually, an upliftment in the performance, quality and availability of assets leads the factory towards 100% OEE. Furthermore, edge-enabled smart manufacturing models support the seamless streaming of analytics solutions from an increasing volume of real-time data related to asset health, performance, the optimal flow of products and help in predictive maintenance and yield optimisation. Many European manufacturers are able to conduct intelligent asset optimisation and reduce the unplanned downtime which helps them achieve 100% OEE.

AR/VR in manufacturing

For repairing equipment remotely and for training the staff across locations, manufacturers can use AR/VR equipment within the plants. Efficient implementation of AR/VR can be possible using edge computing as it can reduce the latency of IoT sensory applications. Moreover, edge computing nodes enable the processing and display of large volumes of data which will not be possible merely with the use of VR headsets.

For instance, many leading manufacturing companies in Europe have already deployed edge computing and established an enterprise-focused, end-to-end platform enabling the application of AI and IIoT integrated models. Manufacturers are now able to use edge computing nodes for processing and for displaying a vast amount of data which is helping them integrate AR/VR in manufacturing easily.

Condition-based monitoring

Edge computing allows the extraction and management of the data nearer to the endpoints, hastens the response time, conserves network resources, reduces latency and network traffic. Thus, faster observation of exceptional patterns of the machines and detection of anomalies in the machines becomes possible with edge computing. This enables manufacturers to perform condition-based monitoring and identify the real-time deterioration rates of machines.

Production quality control

Under the edge system, advanced vision capabilities automate and accelerate real-time monitoring of working processes during the entire production cycle to enable the identification of defects in parts, products, and packaging. As a result, liability is decreased, both safety and efficiency are enhanced and quality standards can be easily met for the final products which increases the customer satisfaction rate for the product.

For example, leading MNCs in the manufacturing sector have started taking assistance from edge-service providers to establish edge ecosystems enabling a robust connection between high-capacity thermal cameras as well as acoustic devices. Depending on these edge-empowered devices, manufacturers can perform condition-based monitoring for robotic welding machines and parallelly leverage AI for interference and perform real-time adjustments for quality control and predictive maintenance.

Manufacturing-as-a-service (MaaS)

With the implementation of cloud computing and the combined usage of 5G, omnipresent sensors, IoT, and data mining, companies have moved to MaaS. MaaS companies are suppliers for several other organisations that share software, facilities, and services attached to manufacturing and maintenance. The use of edge computing can bring more flexibility to MaaS by making the entire system available irrespective of where the site exists (cloud-like). Further-more, edge devices used for MaaS create ample sharing models while maintaining strict requirements for low latency where different companies can utilise the same facility. The amalgamation of 5G and edge computing can enable potentially temporary sites to enjoy the facilities of a ‘pop-up’ network infrastructure.

How can PwC help?

Technology consultants prioritise the clients' needs of switching to a smarter manufacturing process and establishing a collaborative and transparent environment where technical and business teams provide valuable industry insights and technical specifications to the clients to come up with the most feasible solution for IT/OT integration. Some objectives of technology consultants while helping manufacturers become edge-ready are:

- creating hybrid cloud infrastructure enabling edge transformation
- analysing parameters related to a physical operating environment to accelerate edge adoption
- empowering manufacturers with autonomous and condition-based decision-making capabilities
- providing strategic solutions for cost optimisation and maximising business value.

PwC aims to provide strategic and technical guidance so that manufacturers can develop edge ecosystems by going beyond the infrastructural roadblocks and managing the risks for edge implementation. PwC's solutions include readiness assessment which will evaluate the enterprise across distinct levels, dimensions and associated categories to demarcate the current state of its capabilities, an enterprise maturity framework evaluation based on dimensions and maturity parameters to identify gaps, analyse the areas of improvement and provide recommendations to help the clients reach the desired edge computing adoption milestones and lastly, assessments based on prioritisation of use cases between multiple domains where enterprises will be evaluated based on multiple adaptation levels for major verticals such as technology, strategy, innovation and governance, risk and compliance (GRC). The underlying processes of the above-mentioned evaluations will be based on a strategy-through-execution approach that involves evaluation, selection and designing of the roadmap of edge computing-based technologies for clients to transform their operating model and deliver internal and external business solutions.

Conclusion

Transformative thinking and forward-looking strategies of manufacturers can help them develop the foundation for edge adoption. Charting the strategic roadmap is essential for them to evade the existing gridlocks which can be possible with custom-made edge solutions that managed service providers can bring to the table. Managed service providers can accelerate the journey of manufacturing enterprises from cloud adoption to edge adoption by meeting their needs for enterprise evaluation, development of cost-effective strategies, and a suitable physical environment for embracing edge computing.

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