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Whitepaper

Quality Management
In The Age Of Industry 4.0

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About the Author

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Satya is a Business Consultant with LTIMindtree's Digital consulting and Advisory team. He works with clients to identify and helps them transform their business process through digital initiatives. He has more than 7 years of experience in domains like Project Management, Operational Excellence and Business Excellence. He has keen interest in Supply Chain and Manufacturing. Satya has done his master's in business administration from IIM Calcutta.

In the age of Industry 4.0, the growth of industrial productivity is most likely to be dominated and defined by the growth of new technologies. The rapid advances in mobility, connectivity, analytics, scalability, and data are not only driving innovation, but are transforming how the products are delivered and manufactured. The fourth Industrial revolution has digitized the operations and transformed manufacturing & supply chain efficiencies, while creating new business models by incorporating intelligent cyber-physical systems. As per the Market and Market Report, Industry 4.0 market is valued at USD 71.7 billion in 2019 and expected to grow at a CAGR of 16.9%, with a valuation expected to be at USD 156.6 billion by 2024 [1]. The market growth is attributed to 3D printing, Blockchain, Robotics, 5G, IoT, AR&VR and Artificial Intelligence.

Quality Management Challenges

The decrease in quality levels can be felt in many industries like automotive, industrial goods and many other industries due to the increasing product complexity, complex supply chain and shorter time-to-market. The decline in quality impacts the brand value of the company and now it has become one of the most important aspects for all the firms. The traditional quality management systems must innovate themselves using latest technologies for companies to become more competitive in the global market.

The reasons for the increasing number of quality issues in industries can be attributed to many factors. The product complexity is increasing due to change in customer preferences, mass customization and the type of components required to manufacture the product. The increase in the share of software and electronics component in the product is increasing the product complexity.

The amount of standardization required for each part for hundreds of products puts an additional strain on the manufacturers and supply chains. In addition, the supply chains have become so complex due to the outsourcing of manufacturing units and the presence of multiple suppliers across the globe. The contract manufacturers will have their own quality standards and establishing a standardized quality management system for the organization would be a challenging task.

The product development life cycles have reduced drastically especially for the HiTech Industries and any quality issues will delay the new product launches, causing a significant revenue loss. These factors have posed a bigger challenge for the manufacturing industries with respect to compliance issues and meeting the product development life cycles timelines. These factors have led to a **new world of quality management known as Quality 4.0.**

Need for Quality 4.0

Since the goal of Industry 4.0 is to transform the manufacturing execution systems, the impact of new technologies will be profound. Developing technologies are enabling manufacturing industries to embrace new business models. These technologies can be augmented with traditional quality management systems to bring out innovations in various quality initiatives. The quality initiatives include statistical process control, predictive maintenance, supplier quality, and product quality to mention a few.

Quality improvement will significantly enhance the profitability of the product and will act as a key strategic differentiator in the market. Profitability improvement will make the organization to be more competitive in the global market. Consumers are willing to pay for better quality products, and increasingly becoming quality conscious. This has become one of the key concerns for manufacturers as products are becoming more complex, especially regarding the manufacturing aspects.

At present 16% of companies have started any Quality 4.0 initiatives and 63% of companies have reported that they have not started planning as per the BCG report [2].

Digital Levers for Quality 4.0

Technological advancements have transformed the way in which conventional business are operating. Quality 4.0 combines the uses of new technologies with the traditional quality control processes to drive performance, innovation and achieve operational excellence. The following are the technology enablers for Quality 4.0:

01 Internet of Things

Connected technologies are disrupting the industries and resulting in new business models. IoT enables manufacturers to dive deep into product data that is being generated from the devices to know about the product quality. IoT-enabled connected products provide real-time data about the actual usage pattern of the product. This data can be compared with the actual design data to minimize the risk of product failure. Connected product usage data can be further used for remote diagnostics of the product and reduce the customer service request handling time. This will enhance the customer experience and capture the exact requirements of the customer.

02 Blockchain

Blockchain technology has created tremendous transformation in multiple industries, bringing more transparency and visibility into the way business processes are operating. The secure, distributed ledger has numerous possibilities, which are still evolving but many industries are embracing this new technology. Blockchain technology has a lot of potential in Quality 4.0 initiatives.

The technology can be used for better handling of product recalls which can be time-consuming, and more importantly, hamper the image of the firm. In certain factories like automobiles or food products, a single system to handle product recalls by identifying the origin of faulty parts saves time and money. Warranty Management in automobile industry involves multiple stakeholders and multiple transactions making it a more complex process to handle. The distributed ledger would provide secure transparency to various stakeholders and can be a better business opportunity for manufacturing firms.

03 Mobility

Mobility has disrupted the traditional manufacturing patterns and created new business models for them. Mobility has reduced the boundaries that existed and connecting various stakeholders present in the supply chain in real-time. Mobility is also transforming the traditional quality systems towards digital quality control systems by means of mobile-based applications. Mobile apps can be used to create notifications for the operation personnel, or can be used to create digital quality control instructions.

04 Social Media Analytics

Social media has become inevitable for any customer and companies have used this opportunity to enhance their customer outreach. Social media platforms capture the voice of the customer in terms of the product performance and can be used to determine the product success. These platforms are huge sources of unstructured customer feedback and can used to draw useful insights. Analytics can be used to establish patterns among the data and correlate the data with similar situations to accelerate the root-cause analysis. The same platform can be used to make the customers understand the existing and expected problems of the product.

05 Data Analytics

The amount of data generated across an organization is huge, but utilizing the data effectively is a challenge for them. With improvements in advanced computing and intelligent algorithms, valuable business insights can be obtained from the data, which act as a key competitive advantage for the firms. Modern quality management systems can utilize data analytics to predict failure rate of the product which is a challenge for any of the manufacturing firms. Predictive quality and Predictive maintenance are some of the important use cases with data analytics.

06 Augmented and Virtual Reality

Traditional quality management systems are more paper-based and require human intervention. Specialized skills of shop floor people are required during manual quality inspection in a shop floor. The operating people must manually inspect the product from a lot and then must identify whether it conforms to the quality specification or not. The amount of time consumed, skill level of the operators and the number of operators required are huge, which are the bottlenecks in this process. Augmented and Virtual Reality can make these operations smooth by guiding operators sequentially about the process. This will reduce the dependency on the highly skilled operators and reduce the time for operation.

Quality 4.0 Opportunity Spectrum

Quality Management standards have remained unchanged for decades. The environment in which they are operating now are rapidly changing due to changes in customer requirements, compliances owing to the global supply chains and new quality standards. We need to align the Quality Management Strategy in line with the Industry 4.0 strategy to reach a new frontier in Operational Excellence. Now, let us explore some of the use cases of Quality 4.0.

Predictive product failure

Previously, quality was usually associated with the production process, but now the focus has shifted towards product development phase. By shifting towards product development in early phases, manufacturers can reduce the number of defective products.

Product failures are some of the key challenges encountered by manufacturers. Smart or connected products are embedded with sensors providing a communication link between the customer and product design team. Sometimes these may relate to external suppliers or customers also depending on the requirement. The sensors attached to the product generate huge volume of real-time data which contains usage data of the product. The data generated is mostly unstructured and with the help of analytics, specific usage patterns of the customer can be examined. This data can be compared with the actual design data to predict the failure rate of the product proactively. Minimizing the risk of product failure and shortening the new product development time are some of the benefits as a result of predictive product failure.

Image analytics-based sampling

Many manufacturing firms use the conventional manual sampling techniques to check for the quality of the product. They randomly pick up a sample from a single lot and inspect the quality of the product at various points in assembly line. With the help of Image analytics-based inspection methods, we can identify the defects of the product in the production line and automate the defect capturing process. The defects captured can be quantified using the automated defect capturing software tool and with the help of Artificial Intelligence-based algorithms, the patterns can be recognized among them. The patterns recognized will be fed to the production process and with the help of quality data, a feedback loop is created. The feedback loop combined with process simulations and process parameters will try to optimize the quality of inspection process. The benefits of the process are reduced rework and minimized the amount of waste. Secondly throughput of the system can be improved, making the system more efficient. Finally, image analytics-based sampling method makes the sampling process 100% perfect and more intelligent.

Remote diagnostics

Manufacturers can remotely diagnose the quality issues with the help of senor data that is available from the products. The product data has become very important due to the increasing complexity in product manufacturing and the number of components that are used. We know that in the products parts, the share of software and electronic components are increasing. Remote diagnostics are software patches, which can be installed remotely and can significantly reduce the customer complain handling time. Manufacturer can capture this data and store it in a database. The data stored when combined with analytics will predict the failure of the product before the customer registers a complaint. This will reduce the expensive product recall costs and greatly improve the customer experience.

Challenges in implementing Quality 4.0

Manufacturers implementing Quality 4.0 need to focus on the three aspects – people, process, and technology . The lack of digital quality skills can act as a barrier in implementing Quality 4.0 initiatives. The implementation of Quality 4.0 requires understanding of many modern technologies by operators at the shop floor level, who drive the quality initiatives. A clear digital quality strategy is necessary at the firm level for successful implementation. The lesser the clarity on the strategy, there are more chances of failure in implementation.

Fragmented and siloed quality data results presents another barrier in implementing. We know that in certain manufacturing units the quality management systems are outdated and/or exist in silos. Data quality can be another significant roadblock during implementation. The amount of data generated in various stages of product lifecycle is huge. The manufacturing data is present in different formats and spread over the enterprise. Such a huge amount of data raises data quality issues. Data ownership can be another serious concern in the case of smart connected products and

question of who owns the data arises. Hence, data ownership poses a serious concern for Quality 4.0 initiatives for the manufacturers.

Data security is a very serious issue in the implementation of Quality 4.0 and may put the firms into non existence in case of security threats. A comprehensive digital strategy involves well-crafted Change Management strategy focussing on People, Process and Technology is needed to implement Quality 4.0 initiatives successfully. The better we build the Quality Culture in the organization, the more we will succeed in the Quality 4.0 initiatives at the enterprise level.

Conclusion

In the coming years, Industry 4.0 will transform the way in which Quality Management Systems function and will become an integral part of the top management agenda. The quality management systems will transform the companies to qualify for quality champions and make them more competitive. There is a huge scope for companies to invest in transforming their quality management systems and becoming quality leaders.

The benefits associated with digital levers are improving the brand reputation of the firms with more focus on resolving quality related issues like product failures, product recalls and reducing the costs associated with the handling of warranty claims. Secondly, to reduce the cost of poor quality and improving the operating revenues for manufacturing firms. Finally, to engage directly with customers and transforming the business models towards B2C.

The combination of various digital levers with traditional quality management systems will entirely bring new quality initiatives for the companies. The benefits of Quality 4.0 will help the manufacturers improve their quality performance. If quality is company-wide strategy, then everyone wins.

At present, there is a need for companies to do a SWOT analysis on the quality issues and find ways to improve on the aspects specific to them. Also, the firms which have already established quality management systems can improve their quality systems by innovating the existing quality processes using the Industry 4.0 technologies.

Quality 4.0 has a significant role in viewing the way quality is perceived in the age of Industry 4.0. Quality 4.0 can be used to strengthen the core competency of the enterprise, thereby bringing revolutionary changes to business operations, making them future-ready.

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