Digital Manufacturing and Design

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The advent of the technology revolution, coined as The Industry 4.0 makes it clear that 15 years ago, the time for obsolescence of the state of art mechanics took about 3 to 5 years. With the introduction of the Internet of Things, Device Sharing Information and Smart Devices and Appliances with embedded decision making have considerably compacted the obsolescence to 14 to 18 months.

Industry 4.0 rests on the pillars of advancements of IT, Material Science, Production Technology, and Supply Chain Management. The core principle is to bypass non-value added products so that at each step the value density gained is enhanced. Instead of making costly prototypes, the trend is to make the product virtually and with repeated reinforced iteration, pass it to production when all the requirements are verified.

This is feasible by the concept of Digital Thread where products share information efficiently across all product life cycles for the efficacy of operational goals. This makes manufacturing efficient and competitive in the global market with a focus on the 3Es, namely, Efficacy of Procurement, Efficiency in Operation, and Effective Production.

The Digital Thread helps almost all tier of the economy as small companies can visualise the final design before starting the process, medium scale industries can simulate and understand the risk associated with design and market leaders have ease of data sharing and version control.

As a result, making companies and workers competitive, agile, and productive with the efficacy of the strategic goals of the organisation.

The application of these ideas calls for an effective product life cycle management, emphasising:

1) planning and designing
2) manufacturing
3) deployment and maintenance
4) removal and disposal

The Healthcare Sector has recently gained tremendous power to share data and information globally to enable faster and collaborative work for the production, testing, and experiments of the recent strategies. This brings people from diverse backgrounds on a common platform to share their knowledge and learn from the experience of an otherwise unreachable community.

In the manufacturing sector, the effect is visualised with the introduction of Digital Twins, which enables the companies to test, analyse, procure and deploy the resources for the efficacy of the Product Life Cycle, thus increasing customer satisfaction and safety.

The current challenges to be answered include the dilemma of income disparity between different sections of society. Moreover, the HealthCare sector would demand user acceptance and accessibility whenever a new technology is introduced. The education of users in terms of product and keeping the product intuitive while maintaining a required level of customisation and features that the development team would suggest is a challenge to be answered for sustainable market share.

The overall blend of the efforts is to increase the efficiency of the product and cycle as a whole, with increased efficiency of operational skills kept aligned with the strategic vision of the organisation. State of the Art research includes advancements in the following domains:

1)   Advanced Manufacturing
2)   Modelling and Simulation
3)   Supply Chain Enhancement
4)   Intelligent Machine
5)   Sensors
6)   Data Analytics
7)   Cyber Security

The major reason and the factors shaping this revolution could be traced to the factors of economy, design and manufacturing integration, and shorter and effective product lifecycle. It is the call of the time to bring together expert knowledge and skills from various domains to a common platform for discussion. This would give solutions to the challenges faced by Industry 4.0 where interconnected machines need to talk machine to machine as well as man to machine too.

The application of embedded systems is no longer restricted to back end as a service, but as an integral decision-making entity where innovation and scenarios need to be optimised provided the velocity, volume, variety, and value of data generated.

The use of technology for the desired results also needs equally motivated management of resources. Just-In-Time Inventory could be the optimum choice for major industries with the advent of 3D printing where customisation can be introduced with ease, efficiency, and economy.

These concepts have fostered the way to rethink the definition of the economy of scale where each customisation can be equally profitable as batch production of a single design. The need for feedback and open loop also needs to be audited with the advancement in methods and changes in requirements.

Procurement, Design, Manufacturing, Analysis, and Deployment are no longer in an open-loop system. The Digital Thread efficiently binds the components with proper feedback channels so that products are more reliable, efficient, profitable, and sustainable.