Exponential Technology Trends Defining the Next-Gen Manufacturing

Advanced technologies are disrupting the manufacturing industry by out-stating economic prosperity and global competitiveness. It is a clear and compelling scenario is for manufacturers to upgrade with exponential technologies and digitalize all processes of their organization. The fourth industrial revolution is resulting in unprecedented change. The pace of this change is not just incremental. But it is exponential, nonlinear and disruptive. It is evident that manufacturers need to be swift to adapt and transform using exponential technologies for achieving a disruptive change. The more they wait the more they lag.

Leading 21st-century manufacturers are dynamically transforming the fundamentals of manufacturing and are converging both digital and physical worlds with the convergence of sophisticated hardware with advanced software. Analytics and massive amounts of data are enabling the production of smarter products. More efficient processes are enabling the close connections between customers, suppliers, and manufacturers. To chase the rapid growth of manufacturing many companies started the transformation journey to solve the maze of digital challenges and opportunities.

In most of the manufacturing organizations, exponential technologies are highly influencing What, Where and Who aspects. What – Technology and Automation, Where – Workplaces and Physical Locations and Who - Talent and The Open Talent Continuum are focused. In the transformation plan, manufacturers are not just looking at transforming their internal assets, but they are considering broader ecosystem outside their walls, as they are identifying the advantages of being close to where innovation is happening. Besides this, Private Business and Government Research and Development activities along with Venture Capital investments are playing a crucial role in manufacturing companies, country-level innovation channels, and ecosystems. Manufacturers are formulating more of innovation strategies than time to market strategies, to form a strong association within the organization and across the broader innovation ecosystem.

Manufacturers need to develop a receptive culture for change and agility, one culture in which all stakeholders think differently, see differently, and act differently. Everyone needs to adopt the exponential transformation approach, which uses an iterative process. This process starts with determining the company's strategic vision and needs.

Once that process is established, manufacturers can go for the portfolio approach. This approach demands to invest in resources and innovating across the core, adjacent, and transformational areas. To develop an exponential mindset, it is important for every manufacturer to know and define what problems they are trying to solve, develop the culture of innovation entrusting the even the small teams, take operations outside the traditional four walls, and raise the initiatives to gain a cutting edge on system-level competitiveness and innovation enablers.

Understanding Why Industry 4.0 is Unique from Other Industrial Revolutions

This is an era of departure from historical manufacturing practices, based on incremental change and continuous improvement. Manufacturers were considering the linear and one-way connection between suppliers and customers. In contrast, Digital Manufacturing Enterprises (DMEs), started operating much more in ecosystems categorized by multidirectional relationships and goods exchanged inclusive of data, services, and insights. DME's are leveraging the potential of exponential technologies to attain Industry 4.0 transformation. This is enabling them to create efficient opportunities, real-time automated feedback, capabilities to enrich the data and deliver information, ensuring data flows from the physical space to digital. They are providing insights to the physical world, unlocking step-change value. They are also providing proper visibility and insights to solve complex issues and identify unknown opportunities. This smart and integrated loop connecting the digital and physical worlds is where manufacturers are identifying unrealized value and creating opportunities for growth. Adapting to this new reality of digitalization requires a transformation of every function putting technology and digitalization at the core.

Top 10 Competitive Nations Accelerating Manufacturing Technologies

The topmost 10 competitive nations in 2016 are projected to be there in the top till this decade ends. However, meanwhile, the United States and China continue to battle for the top spot in the future of manufacturing. The United States tops as the biggest spender, specifically in foundational areas like basic and applied research, wherein China is quickly closing the gap. In the current scenario, China is expected to exceed the United States in terms of spending on Research and Development activities before the end of the decade. There are many other nations which moved past the United States in terms of R&D investment as a GDP percentage. As manufacturing continues to transform with advanced products and processes, future competitiveness in manufacturing is likely to incline towards the advanced manufacturing nations which have robust innovation ecosystems and not just towards the cost-effective nations.

The GMCI stated that the United States, Japan, Germany, and the United Kingdom were the top 10 most competitive nations in 2016 that invested in exponential manufacturing technologies and innovation ecosystems. They are expected to remain at the top until the end of the decade. With the shift of manufacturing competitiveness to higher-value and advanced products and processes, the demand for exponential technologies increases, both at the company and nation level.

Talent: The Future of Manufacturing Requires Human and Machine Collaboration

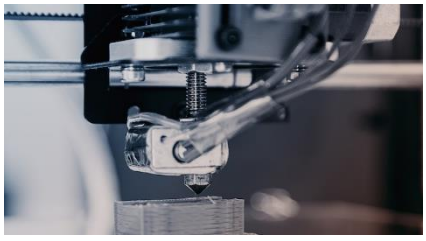
Though advanced technologies are playing a key role in digital transformation, Talent continues to gain a cutting edge in the manufacturing industry. Upgrading the skill set of Talent and shortage of talent remains to be a critical issue across the world. Developing efficiency and retaining top talent and finding new ways to access skilled talent resources is gaining a lot of importance than ever.

In the era driven by exponential possibilities, as manufacturers are transitioning to an agile and technology-powered culture, organizations are counting on their most important asset – People for gaining the competitive advantage. To achieve the goal of transformation, it is important for individuals to quickly adapt to new innovations than businesses. To turn future talent-related challenges into opportunities, it is necessary to motivate talent resources to seek change rather than resisting the change. As the technology change evolves from routine processes and tasks, it is needed to educate and train employees on new advanced problem-solving skill set to unlock the opportunities and new forms of economic value. This proactive approach helps manufacturers to leverage employee capabilities in a more advanced way which helps in building more advanced exponentially oriented digital products and services.

Talent is the key driver of manufacturing competitiveness in an exponential era, the next industrial revolution will be focused on new collaborations of humans and machines, but not the replacement of one with the other. Machines are no way going to replace humans in the manufacturing sector, in fact, they both are going to take up more valuable approach as they are going to complement each other as each of them contributes their unique strengths to the equation.

Exponential technologies are transforming the global manufacturing companies to best fit into a disruptive shift, supporting them to evolve, grow, and thrive through digitalization. These technologies accelerate transformation at a nonlinear pace facilitated by substantial progress and cost-saving in areas such as data storage, bandwidth, and computing power. The most popular exponential technologies accelerating transformation are:

3D Printing and Additive Manufacturing



3D printing is an additive process, which saves a lot of time during product designing phase and development stages by eliminating scrap. It builds objects, layer upon layer, right from 3D model data in contrast to subtractive manufacturing methods like machining. This technology helps to create intricate designs which are difficult to design through the traditional approaches.

Internet of Things (IoT)

Internet of Things (IoT) is a consolidation of advanced software, cost-effective sensors, and network connectivity which enables digital interaction of the objects. It includes connecting various factors like machines, fleets, facilities, networks, and people to sensors and controls. It feeds sensor data into predictive algorithms and advanced analytics applications. With IoT, machine operations can be automated, and the maintenance of machines can be improved, and human health can be enhanced.

Interface of Things

The interface of Things includes Augmented Reality (AR), Virtual Reality (VR) Mixed Reality (MR), gesture recognition and wearables. AR connects digital content with the user's real-world environment, VR creates immersive three-dimensional digital environment replacing the user's real-world environment, wherein MR combines both user's real-world environment with digitally created content. With MR, both the environments coexist and interact with each other. Wearables are meant for real-time tracking by providing contextual information. Gesture recognition technology helps humans to interact with machines naturally without any devices.

Blockchain

It is a distributed ledger technology which provides recorded information and is shared by a community. It is used to structure and distribute data and centralized authority is not needed. The data recorded and communicated through the blockchains are immutable, safe & secure, and cannot be tampered. Blockchain is mainly used to build and manage a distributed database and to maintain digital transactions records in different industries.

Advanced Robotics

They are machines or systems build to perform complex tasks in a semi-structured environment with minimal human intervention. They are capable of accepting high-level mission-oriented commands. They are controlled and guided autonomously and remotely. Drones are the most used technology systems on land, sea or air. They are highly efficient replacing most of the human efforts and errors.

Artificial intelligence and Machine Learning

It is the theory of developing computer systems that can perform tasks which require human intelligence. Technologies that are originated from AI are called as cognitive technologies. They are like machine learning, natural language processing, computer vision, speech recognition, rules-based systems, and robotics. Machine learning refers to the ability to improve the performance of computer systems with data exposure, without the need to follow the programmed instructions explicitly.

Advanced Analytics

This technology goes beyond generic data intelligence and examines and analyses data statistically. It gathers actionable insights and makes predictions on an autonomous and semi-autonomous basis. It uses statistical methods such as pattern recognition, cluster analysis, text analytics, factor analysis, multiple regression, forecasting, multivariate modeling, machine learning, neural networks, and simulation.

Advanced Materials

These are lightweight materials, advanced ceramics and composites, high-strength metals, high-performance alloys, critical materials, nanomaterials, and bio-based polymers. These materials are used to have excellent thermal, optical, magnetic, structural, luminescent, catalytic and electrical properties. They are designed to display high dimensional stability, chemical resistance and temperature, relatively easy processing and flexible performance. This enables lighter components helping other functional designs and addresses manufacturing challenges, unlocking the new opportunities for manufacturers.

Next-Gen Computing or High-Performance Computing

High-performance Computing (HPC) is a practice of accumulating computing power to deliver much higher performance. They support systems that typically operate above a teraflop or 1012 floating-point operations per second. Used to solve critical problems in business, science, and engineering. Next-generation computing comprises cognitive computing, DNA computing, neuro-synaptic computing, and quantum computing.

Biotechnology

Biotechnology deals with technological applications for biological systems and living organisms. They are derivatives used to modify products for a specific use. They are Inclusive of any technologies used to investigate and manipulate the living organisms.

Biomanufacturing

Biomanufacturing is designed for manufacturing biotechnology products using biological systems. This type of manufacturing produces commercially important biomaterials which are used in medicines, food and beverages and industrial applications.

Cybersecurity

In this digital society, cybersecurity plays an essential role to deal with significant operational risks for connected, digital supply networks, smart manufacturing, and entire manufacturing ecosystems. Risks are anticipated at the intersection of cyber and physical infrastructure. Variety of secure and sophisticated tools supported by AI/machine learning enables real-time responses for dealing with cybersecurity threats. This is very helpful to empower a secure, resilient, and vigilant approach to Industry 4.0-enabled devices and digital networks, supporting manufacturing environments.

Transformation enabled by exponential technologies is unlocking new forms of value for manufacturers and is helping them to grow faster and be more agile. Though exponential technologies are becoming more crucial than ever, the pace of their adoption in manufacturers is relatively slow. Another barrier which manufacturers face for digital adoption are structural and cultural challenges, regulatory burdens, talent constraints, and leadership drive for transformation. Organizations also need to consider the fact that innovation's value also lies outside the product—be it in the profit or business model or at customer engagement. Hence, organizations shouldn't be restricting exponential technologies only to products and processes, but they must consider their application across all the functions and processes inside the outside the firm.