ANNEXUE- 12

SMART MANUFACTURING SECTIONAL COMMITTEE- LITD 34

In an era marked by rapid technological evolution and an ever-increasing demand for efficiency, innovation, and sustainability, the field of smart manufacturing has emerged as a transformative force. As an essential driver of economic growth and industrial competitiveness, smart manufacturing has the potential to revolutionize how products are designed, produced, and delivered. Recognizing the paramount significance of this dynamic landscape, Smart manufacturing sectional committee (LITD 34), has embarked on the journey to chart a comprehensive roadmap that envisions the future of smart manufacturing. This is a living document, which would evolve with changing landscape of industry and the manner in which products would be consumed.

This roadmap serves as a guiding document, paving the way forward in the ever-evolving world of smart manufacturing.

Item I- SCOPE: Standardization in the field of Smart Manufacturing including systems level standardization.

Item II- LIAISON INTERNATIONAL COMMITTEES: The following international committees have been identified as liaison committees of LITD 34

i. IEC SyC SM- Smart Manufacturing (P member)
ii. IEC SC 65C- Industrial networks (O Member)
iii. SC 65E- Devices and integration in enterprise systems (P member)
iv. ISO/IEC JTC 1/WG 12- 3D Printing and Scanning (O Member)

Item III- LIAISON BIS COMMITTEES: The following BIS committees have been identified as liaison committees of LITD 34

S.No.	BIS Technical Committees	Liaison International committees
1.	LITD 13-Interconnection and Information exchange among IT equipment and systems Sectional committee	ISO/IEC JTC 1/SC 6 - Telecommunications and information exchange between systems - Participating (P) ISO/IEC JTC 1/SC 25 - Interconnection of information technology equipment - Observer (O)
2.	LITD 17-Information Systems Security and Privacy Sectional Committee	ISO/IEC JTC 1/SC 27 - Information security, cybersecurity and privacy protection - Participating (P)
3.	LITD 27-Internet of Things and & Digital Twin Sectional Committee	ISO/IEC JTC 1/SC 41 - Internet of Things and Digital Twin - Participating (P) ISO/IEC/JTC1 SC 41/ JWG 32 - Maritime and Underwater IoT Effects on Environment and Ecology linked to ISO/TC 43/SC 3 - Participating (P)
4.	LITD28 - Smart Infrastructure	SyC Smart Cities - SyC Smart Cities - Participating (P)

		ISO/IEC JTC 1/WG 11
5.	LITD 30-Artificial Intelligence Sectional Committee	ISO/IEC JTC 1/SC 42 - Artificial intelligence - Participating (P) ISO/IEC/JTC1 SC 42/WG JWG 4 - Joint Working Group ISO/IEC JTC1/SC 42 -IEC TC 65/SC 65 A :Functional Safety And AI systems ISO/IEC/JTC1 SC 42/WG JWG 5 - Joint Working Group ISO/IEC JTC1/SC 42 -ISO TC 37 WG : Natural Language processing
6.	ETD 18-Industrial Process Measurement and Control Sectional Committee	IEC TC 27 - Industrial electroheating and electromagnetic processing - Participating (P) IEC TC 65 - Industrial-process measurement, control and automation - Participating (P) IEC TC 65 / SC 65A - System aspects - Participating (P) IEC TC 65 / SC 65B - Measurement and control devices - Participating (P)
7.	PGD 18-Industrial and Production Automation Systems And Robotics	ISO/TC 184 - Automation systems and integration - Participating (P) ISO/TC 184/SC 1 - Industrial cyber and physical device control - Participating (P) ISO/TC 184/SC 4 - Industrial data - Participating (P) ISO/TC 184/SC 5 - Interoperability, integration, and architectures for enterprise systems and automation applications - Participating (P) ISO/TC 299 - Robotics - Participating (P) ISO/TC 299/JWG 5 - Joint ISO/TC 299 - IEC/SC 62A - IEC/SC 62D WG: Medical robot safety

Item IV- BACKGROUND OF THE COMMIITTEE: A brief history of LITD 34 is as below:

1. A Woking group on Smart Manufacturing (LITD 28/WG 3) was earlier constituted under LITD 28 Smart Cities Sectional committee. The working group prepared a study report on Smart manufacturing.

2. The committee on Smart Manufacturing was constituted in the 18th meeting of Electronics and Information Technology Division Council (LITDC) held on 06.09.2019 to give proper focus to Smart Manufacturing Standardization.

3. First meeting of LITD 34 was held on 03.01.2020. In the meeting the committee reviewed the following the following ISO definition of "Smart Manufacturing" which was approved by ISO TMB and the committee agreed on the same definition to initiate the work of LITD 34.

    a. *Smart Manufacturing is:*
        i. *Characterized by convergence of advanced manufacturing capabilities, digital technologies and Internet of Things (IoT);*
        ii. *Integration of customers and business partners in business and value-added processes;*
        iii. *The collaboration of human beings, embedded systems, fully or partly autonomous machines, and systems of systems.*
    b. *It leads to:*
        i. *The individualization (up to lot size 1 in mass production) of products, services and processes;*
        ii. *The networking of systems, which results in highly complex structures and cyber physical systems (CPS);*
        iii. *New forms of value creation, business models and subsequent services;*
        iv. *Evolution of safety, security, organization, processes and work design;*
        v. *An impact on human productivity and innovation cycles.*

4. In the first meeting of LITD 34, the committee also agreed to create two panels in the committee with the following scope:

    a. *Panel 1, LITD 34/P 1 Smart Manufacturing Use case group*- Analyse the user needs
    b. *Panel 2, LITD 34/P 2 Smart manufacturing Ecosystem Status*- Analyse existing Standards, conformity assessments, platforms (like Platform industry 4.0, smart factory, OPC UA foundation, arena 2036) for industry 4.0/Smart Manufacturing, various activities going on Smart manufacturing in India (CII, FICCI and DHI, DST etc.)

Item V – Creation of new Indian Standards:

Smart Manufacturing technology can act like a torch bearer for all the large-scale manufacturing industries and firms. Indian Standards need to be developed in a large way in order to meet the requirements of the stakeholders in Smart Manufacturing.

Item VI- STRATEGIC ROADMAP: It is important to recognize that Industrie 4.0 is a collaborative effort that necessitates the close coordination of diverse domain experts, manufacturers, and users. This collaboration encompasses the development of fundamental concepts and the advancement of

technology towards market readiness. In terms of standardization, this requires the establishment and execution of cooperation with these organizations.

This differs from the conventional competitive technology development, where individual companies or market players independently bring technology to market maturity and subsequently standardize requirements through standards and specifications. In view of the same, the document outlines an immediate, progressive and visionary goals for the committee. The same is elaborated below:

1. ***IMMEDIATE GOALS*:** Immediate goals of the committee enlists the domain areas/standards which the committee would aim to publish within a maximum time-period of 2 years from the approval of the roadmap document:
    1. ***Terminologies and definitions*:** Defining basic and domain specific terms is essential and pivotal to ensure clarity, consistency, compatibility and interoperability in the domain. Standardized terminology would be the foundation upon which effective standards for smart manufacturing are built.
    2. ***Reference architecture*:** A reference architecture would provide a common framework and set of standards ensuring that diverse elements can work together seamlessly. Scalability, vendor neutrality, quality and reliability are some aspects which would be catered to by a standardized reference architecture.
    3. ***Maturity model*:** Maturity models would provide a structured framework for assessing an organization's current capabilities in smart manufacturing. By benchmarking against well-defined maturity levels, companies would be able to understand where they stand in terms of smart manufacturing readiness. It would not only help in goal setting, prioritization, resource allocation but also in risk management.
    4. ***Use cases*:** Use case repository creation would not only help in eliciting and gathering functional requirements for smart manufacturing systems but would also ensure that data collated would be easily consumable and would essentially contain the crucial factors required for analysis.
    5. ***Active liaison:*** Active liaising with international organizations and committees would not only ensure that the global progress is dove-tailed closely but also enable Indian experts to raise and address country specific concerns at the global forum thereby ensuring parity.

    Apart from the goals identified above, certain areas where standards have been developed by various liaison committees can be assessed for suitability and adoption. Some of the identified areas are listed below:

2. ***PROGRESSIVE GOALS*:** Progressive goals of the committee enlists the domain areas/standards which the committee would aim to publish within a maximum time-period of 5 years from the approval of the roadmap document:
    1. ***Interoperability Standards*:** Develop standards that enable seamless communication and interoperability between various devices, systems, and technologies used in smart manufacturing. This includes protocols for data exchange, IoT device connectivity, and machine-to-machine communication.
        i. ***Cloud and Edge Computing Standards***: Create standards that support the integration of cloud and edge computing technologies in smart manufacturing.

This involves guidelines for data storage, processing, and real-time analytics at the edge and in the cloud.

ii. ***Sensor and Actuator Standards***: Define standards for sensors and actuators used in smart manufacturing, ensuring compatibility, accuracy, and reliability. These standards address sensor data formats, communication protocols, and calibration.

2. ***Cybersecurity Standards*****:** Establish cybersecurity standards to protect smart manufacturing systems from cyber threats and vulnerabilities. This includes guidelines for secure data transmission, access control, and incident response.
3. ***Data Standards*****:** Define standards for data modeling, data formats, and data exchange in smart manufacturing. This ensures that data can be consistently and meaningfully shared and utilized across the manufacturing ecosystem.
4. ***Semantic Interoperability*****:** Develop standards for semantic interoperability, allowing different systems to understand and interpret data and information consistently. This is essential for contextualizing and making sense of data generated by various devices and systems.
5. ***Digital Twin Standards*****:** Develop standards for digital twins, which are virtual representations of physical assets and processes. Standardization in this area helps facilitate the creation, utilization, and synchronization of digital twins in smart manufacturing.
6. ***AI and Machine Learning Standards*****:** Establish standards for machine learning models, algorithms, and data handling in smart manufacturing applications. This ensures transparency, fairness, and consistency in AI-driven decision-making processes.
7. ***Quality and Process Standards*****:** Define standards for quality management and process optimization in smart manufacturing. These standards help maintain product quality, minimize waste, and improve production efficiency.
8. ***Supply Chain Standards*****:** Develop standards for supply chain visibility and traceability, allowing for better coordination and real-time monitoring of the supply chain in smart manufacturing.
9. ***Human-Machine Interaction Standards*****:** Address the standardization of interfaces and interaction methods between humans and smart manufacturing systems, including augmented reality (AR), virtual reality (VR), and user interfaces for manufacturing workers.
10. ***Energy Efficiency Standards*****:** Establish standards to promote energy-efficient practices in smart manufacturing, including guidelines for energy monitoring, management, and sustainability.
11. ***Regulatory Compliance Standards*****:** Develop standards that ensure smart manufacturing systems comply with industry-specific and regional regulations, including those related to safety, environmental impact, and product quality.
12. ***Emerging Communication Technologies:*** Define standards for integrating and utilizing emerging communication technologies in smart manufacturing systems, ensuring compatibility and efficiency in communication networks.

These progressive standardization areas play a vital role in fostering the growth and adoption of smart manufacturing technologies by providing a structured framework and guidelines for implementing and maintaining advanced manufacturing practices.

3. ***VISIONARY GOALS*****:** Visionary goals of the committee enlists the domain areas/standards which the committee would aim to publish in long-term. It would aim to address complex and

evolving challenges in the manufacturing landscape, with a focus on driving innovation, sustainability, and competitiveness. Some key visionary standardization areas for smart manufacturing identified are:

1. ***Sustainable Manufacturing Standards***: Develop standards that promote sustainability by addressing resource efficiency, waste reduction, and the environmental impact of manufacturing processes. This includes guidelines for eco-design, recycling, and circular economy practices.
2. ***Digital Thread Standards***: Define standards for end-to-end digital threads that encompass the entire product lifecycle, from design and manufacturing to operation and maintenance. These standards promote seamless data flow and traceability.
3. ***Advanced Robotics Standards***: Develop standards for highly advanced robotics, including collaborative robots (cobots), autonomous mobile robots, and human-robot interaction standards. These standards ensure safety and interoperability.
4. ***Societal and Ethical Standards***: Develop standards related to societal and ethical considerations in smart manufacturing, including guidelines for data privacy, responsible AI, and the ethical use of technologies.

These visionary standardization areas are forward-looking and consider the transformative impact of emerging technologies and practices on smart manufacturing. They enable the industry to embrace innovation, adapt to evolving market demands, and lead the way in sustainable, efficient, and ethical manufacturing practices.