**Bureau of Indian Standards**

**Electronics and Information Technology Department**

**6th MEETING OF SAMRT MANUFACTURING SECTIONAL COMMITTEE**

**LITD 34**

|  |  |
| --- | --- |
| **Venue:**  **Meeting link:**  **Meeting number:** | Hybrid Meeting  https://bismanak.webex.com/bismanak/j.php?MTID=me8fbaeddec6711b5199f363ef5689780  2517 088 3638 |
| **Date:** | 22nd March 2024 |
| **Time:** | 11:00 AM |
| **Chairperson:** | Mr. Dr. Nagahanumaiah (Central Manufacturing Technology Institute, Bengaluru) |
| **Member**  **Secretary:** | Ms Ankita Srivastava (Scientist-D, LITD) |

**AGENDA**

**ITEM 0: WELCOME ADDRESS**

* 1. Welcome by Member Secretary
  2. Opening Remarks by the Chairperson

**ITEM 1: FORMAL CONFIRMATION OF THE MINUTES OF LAST MEETING**

* 1. The minutes of the last meeting of committee held on 15-11-2023 were circulated on 18-03-2024.No comments have been received on the minutes. The committee may formally confirm the minutes.

*The committee may confirm the minutes*

**ITEM 2: SCOPE & COMPOSITION OF LITD 34**

**2.1** Scope of LITD 34 is “Standardization in the field of Smart Manufacturing including systems level standardization.”

**2.2** LITD 34 liaisons with the following international committees:

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 (P member)

*The committee may note.*

**2.3** The composition of “Smart Manufacturing Sectional Committee LITD 34” is given in **Annexure -1.**

*The committee may note.*

**2.4** Prof. Amaresh Chakrabarti, the chair of the committee had to relinquish his position as the Chair of LITD 34 due to his increasingly busy schedule. The committee is grateful for Prof. Chakrabarti's leadership and contributions to the committee and understands his need to step down. Dr. Nagahanumaiah, Director- Central Manufacturing Technology Institute, Bengaluru has kindly agreed to the offer to chair LITD 34 and guide the committee. His acceptance is subject to approval and ratification by the LITDC.

*The committee may note.*

**2.5** Following co-option requests were received for membership in LITD 31:

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| **S.No.** | **Name** | **Organization** |
| 1. | Shri. RajendraTodalbagi | In Personal capacity |

*The committee may consider and decide.*

**2.6** The committee currently lacks experts form Additive manufacturing/ 3-D printing domain, thereby resulting in poor participation in the WG 12 meetings. Further, a request was received from BITS, Pilani for a lecture on Additive manufacturing by experts of LITD 34.

*The committee may deliberate.*

**ITEM 3: INTERNATIONAL STANDARDIZATION ACTIVITIES**

**3.1** IEC SyC SM- “Smart Manufacturing” aims “*To provide coordination and advice in the domain of Smart Manufacturing to harmonize and advance Smart Manufacturing activities in the IEC, other SDOs and Consortia according to clause 2 in AC/22/2017 superseded by the AC/17/2018*”. India is a participating member (P Member) of IEC SyC SM and has the obligation to vote and send response on all the documents emanating from this systems committee. Details of the members nominated in the committee placed in **Annexure 2.**

*The committee may please note.*

**3.2**  Next plenary meeting of IEC SyC SM is scheduled to be held in Edinburgh, United Kingdon in Hybrid from 23.10.2024 to 25.10.2024. Nominations of members to participate and contribute in the meeting will be sought in the 2nd quarter of FY 2024-25.

*The committee may please review.*

**3.3** IEC SC 65C- “Industrial networks” is a sub-committee of IEC TC 65 – “ Industrial-process measurement, control and automation” and it aims “*To prepare international standards on wired, optical and wireless industrial networks for industrial-process measurement, control and manufacturing automation, as well as for instrumentation systems used for research, development and testing purposes. The scope includes cabling, interoperability, co-existence and performance evaluation*”. India is an observer member (O Member) in the sub-committee. Details of the members nominated in the committee placed in **Annexure 2.**

*The committee may please note.*

**3.4** IEC SC 65E- “Devices and integration in enterprise systems” is a sub-committee of IEC TC 65 – “ Industrial-process measurement, control and automation” and it aims “*To prepare international standards specifying: (1) Device integration with industrial automation systems. The models developed in these standards address device properties, classification, selection, configuration, commissioning, monitoring and basic diagnostics. (2) Industrial automation systems integration with enterprise systems. This includes transactions between business and manufacturing activities which may be jointly developed with ISO TC184*”. India has become P member in the committee, based on the decision taken in 5th meeting of the committee. Being P members now, we are required to vote on the ballot documents received and actively participate in the working group meetings of the committee.

*The committee may please consider.*

**3.5** Next plenary meeting of IEC SyC SM is scheduled to be held in Calgary, Canada in Hybrid from 09.09.2024 to 13.09.2024. Nominations of members to participate and contribute in the meeting will be sought in the 1st quarter of FY 2024-25.

*The committee may please review.*

**3.5** ISO/IEC JTC 1/WG 12- “3D Printing and Scanning” is a working group with following terms of reference:

*a) Serve as a focus of and proponent for JTC 1’s standardization program on 3D Printing and Scanning.*

*b) Develop ICT related foundational standards for 3D Printing and Scanning upon which other standards can be developed.*

*c) Develop other 3D Printing and Scanning standards that are built upon the foundational standards when relevant ISO and IEC committees that could address these standards do not exist or are unable to develop them.*

*d) Identify gaps and opportunities in 3D Printing and Scanning standardization.*

*e) Develop and maintain liaisons with all relevant ISO and IEC committees as well as with external organizations that have interests in 3D Printing and Scanning.*

*f) Engage with 3D Printing and Scanning communities to raise awareness of JTC 1 standardization efforts and provide an open platform for discussion and further cooperation.*

*g) Develop and maintain a list of existing 3D Printing and Scanning standards produced and standards development projects underway in ISO TCs, IEC TCs and JTC 1.*

Active contribution in the working group from India may be promoted.

*The committee may please note.*

**ITEM 4: ROADMAP OF LITD 34**

**4.1** A roadmap document for the committee was deemed essential for the following reasons:

a) To offer guidance to the committee.

b) For the establishment of priorities and time-bound goals for the committee.

c) As a valuable resource to present to potential and interested members, offering them an overview of the committee.

In view of the same, a draft roadmap document was prepared for the committee and is placed as **Annexure-3**.

**4.2** As per the decision taken in the 5th meeting of LITD 34, held on 15.11.2023, the draft roadmap document was circulated to the members of LITD 34 for comments. No further comments were received on the document. In view of the same, the committee may finalise the roadmap of the LITD 34.

*Committee may deliberate and decide.*

**ITEM 5: R&D PROJECTS OF LITD 34**

**5.1** Two R&D proposals were discussed during the 4th and 5th meeting of LITD 34. As per the decision taken in the 5th meeting the ToRs were finalised and after modification based on the suggestion of screening committee of BIS, the projects were hosted in the public domain or comments. The proposals hosted are as listed below. Copy of proposals is placed as **Annexure- 4**:

1. Study of Reference architecture for Smart Manufacturing in India- 3 bids received
2. Use case compilation for Smart manufacturing in India. - 2 bids received

*Committee may note.*

**5.2**  The following experts were nominated from LITD 34 in the Screening committee for technical evaluation of the bids received, based on approval of the committee by circulation vide email dated 28.02.2024.

1. Shri Sanjiv Singh
2. Ms Lavanya Nupur

*Nominated experts may update the committee.*

**ITEM 6: WAY FORWARD FOR LITD 34 PANELS**

**6.1** LITD 34 has constituted two panels namely:

1. LITD 34 : P1 - Smart Manufacturing Use case Panel (Convenor- Shri Saroop Chand)
2. LITD 34 : P2 - Smart manufacturing Ecosystem Status Panel (Convenor- Ms Lavanya Nupur)

*The committee may note.*

**6.2** It is important to note that the panels have not met very frequently and the tasks assigned to the panels are yet to be complete. In view of the same, it is proposed that a ToR/Scope of the panels may be defined and a meeting plan for first quarter of FY 2024-25 may be put up to the committee by the convenors of the panel. Update from the panel convenors may be sought in the next meeting of the committee.

The committee may deliberate and decide

**ITEM 7: UPDATE FROM INDO-GERMAN COLLABORATION**

**7.1** Under the aegis of the on-going Indo-German collaboration, a session was organised by Siemens India for the Indian experts, to deliberate on OPC-UA and its application in the industry. An update regarding the same may be provided to the committee by Siemens India

The committee may deliberate

**ITEM 8: DATE AND PLACE FOR THE NEXT MEETING**

**ITEM 9: ANY OTHER BUSINESS**

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# ANNEXURE-1

**LITD 34-SMART MANUFACTURING SECTIONAL COMMITTEE**

**Member Secretary: Ms. Ankita Srivastava**

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| **COMPOSITION** | | |
| **S.No.** | **Organization** | **Member Name** |
| 1 | Central Manufacturing Technology Institute, Bengaluru | Dr. Nagahanumaiah (Principal Member) |
| 2 | Automation India Association, New Delhi | Shri Pankaj Aswal (Alternate Member) |
| 3 | B&R Industrial Automation Private Limited, Pune | Himanshu Sharma (Principal Member) |
| Jhankar Dutta (Alternate Member) |
| 4 | Confederation of Indian Industry, New Delhi | Mr. Anupam Kaul (Principal Member) |
| Shri Somnath Mitra (Alternate Member) |
| Shri Vipin Sahni (Alternate Member) |
| 5 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Shri Chetan Bijesure (Principal Member) |
| Ms Ankita Sharma (Alternate Member) |
| 6 | Gilard Electronics Private Limited, Sahibabad | Shri Sanjiv Singh (Principal Member) |
| 7 | Narnix Technolabs Private Limited, New Delhi | Shri Kishor N. Narang (Principal Member) |
| 8 | National Productivity Council, New Delhi | Sh. Umashankar Prasad (Principal Member) |
| Sh. Nikhil Panchabhai, GH (IT) (Alternate Member) |
| 9 | PricewaterhouseCoopers Private Limited, Gurugram | Ankur Basu (Principal Member) |
| 10 | Seconded European Standardization Expert for India (SESEI), New Delhi | Shri Dinesh Chand Sharma (Principal Member) |
| Shri Nitin Sharma (Alternate Member) |
| 11 | Secure Meters Limited, Gurugram | Shri Anil Mehta (Principal Member) |
| Shri Deepak Pandya (Alternate Member) |
| Shri Ankit Agarwal (Alternate Member) |
| 12 | Siemens Limited, Mumbai | Shri Manoj Belgaonkar (Alternate Member) |
| Shri Gautam Dutta (Alternate Member) |
| 13 | Telecommunication Engineering Center, New Delhi | Shri R.S Singh (Principal Member) |
| Ms. Ashima (Alternate Member) |
| Ms. Namrata Singh (Alternate Member) |
| 14 | In Personal Capcity | Ms. Lavanya Nupur |

***LITD 34 : P1 - Smart Manufacturing Use case group Panel***

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| **S.No.** | **Organization** | **Member Name** |
| 1 | Adroitec Information Systems Pvt. Ltd | Shri Saroop Chand |
| 2 | Automation India Association, New Delhi | Shri Anup Wadhwa |
| 3 | B&R Industrial Automation Private Limited, Pune | Himanshu Sharma |
| 4 | Central Manufacturing Technology Institute, Bengaluru | Prakash Vinod |
| 5 | Confederation of Indian Industry, New Delhi | Shri Anupam Kaul |
| 6 | Confederation of Indian Industry, New Delhi | Shri Somnath Mitra |
| 7 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Ms Ankita Sharma |
| 8 | Gilard Electronics Private Limited, Sahibzada Ajit Singh Nagar | Shri Sanjiv singh |
| 9 | Indian Railway Catering And Tourism Corporation Limited, New Delhi | Mr Ankur Verma |
| 10 | Ministry of Heavy Industries and Public Enterprises, Department of Heavy Industry, New Delhi | Shri Sanjay Chavre |
| 11 | PricewaterhouseCoopers Private Limited, Gurugram | Shri Ulhas Deshpande |
| 12 | Siemens Limited, Mumbai | Shri Manoj Belgaonkar |
| 13 | Siemens Limited, Mumbai | Shri Nitin Nair |
| 14 | Wipro Limited, Bengaluru | Mr. Khushal Kalra |

***LITD 34 : P2 - Smart manufacturing Ecosystem Status Panel***

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| **S.No.** | **Organization** | **Member Name** |
| 1 | In Personal Capacity, New Delhi | Ms. Lavanya Nupur |
| 2 | Adroitec Information Systems Pvt. Ltd | Shri Saroop Chand |
| 3 | Automation India Association, New Delhi | Shri Pankaj Aswal |
| 4 | Central Manufacturing Technology Institute, Bengaluru | Dr. Nagahanumaiah |
| 5 | Confederation of Indian Industry, New Delhi | Shri Anupam Kaul |
| 6 | Confederation of Indian Industry, New Delhi | Shri Somnath Mitra |
| 7 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Ms Ankita Sharma |
| 8 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Shri Chetan Bijesure |
| 9 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Guruprasad Kuppu Rao |
| 10 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Shri Dhanraj Kalbhor |
| 11 | Federation of Indian Chambers of Commerce and Industry, New Delhi | Shri Ramkrishna Patra |
| 12 | Gilard Electronics Private Limited, Sahibzada Ajit Singh Nagar | Shri Sanjiv singh |
| 13 | Indian Railway Catering And Tourism Corporation Limited, New Delhi | Mr Ankur Verma |
| 14 | Narnix Technolabs Private Limited, New Delhi | Sh. Narang N Kishor |
| 15 | PricewaterhouseCoopers Private Limited, Gurugram | Ankur Basu |
| 16 | ST Microelectronics Private Limited, Greater Noida | Shri Alok Mittal |
| 17 | Vann Consulting Private Limited, Bengaluru | Shri P. V. G. Menon |
| 18 | Wipro Limited, Bengaluru | Mr. Khushal Kalra |
| 19 | National Institute of Urban Affairs, New Delhi | |
| 20 | PricewaterhouseCoopers Private Limited, Gurugram | |
| 21 | Siemens Limited, Mumbai | |

**ANNEXURE- 2**

IEC SyC SM- Smart Manufacturing (P Membership)

1. Working Group 1- Use Cases & Supporting IT Tools
2. Working Group 2- Terminology
3. Working Group 3- Navigation Tools for SyC SM

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| **S.No.** | **Member Nominated** | **Organization** |
|  | Shri Amaresh Chakrabarti | IISc, Bengaluru |
|  | Shri Manoj Ramesh Belgaonkar | Siemens Limited, Mumbai |
|  | Shri Vidyabhushan Hande | - |
|  | Shri Nand Kishor Narang | Narnix Technolabs Pvt. Ltd. |
|  | Ms. Lavanya Nupur (WG 1, WG 2, WG 3) | PGP Glass. |
|  | Ms Ankita Srivastava | Bureau of Indian Standards |

IEC SC 65C- Smart Manufacturing (O Membership)

1. Working Group 9- Industrial wired communication systems
2. Working Group 12- Functional Safety for industrial communication systems
3. Working Group 15- High Availability Networks
4. Working Group 16- Industrial wireless communication systems
5. Working Group 17- Wireless Coexistence
6. Working Group 18- Time-sensitive networking for industrial automation

\*\*No experts are nominated in any of the working groups listed above.

IEC SC 65E- Smart Manufacturing (No Membership)

1. Working Group 2- Product properties & classification
2. Working Group 3- Commissioning
3. Working Group 4- Field device tool interface specification
4. Working Group 7- FB for process control, EDDL and FDI
5. Working Group 8- OPC
6. Working Group 9- AutomationML - Engineering Data Exchange Format
7. Working Group 10- Intelligent Device Management
8. Working Group 12- Predictive Maintenance
9. Working Group 13- Representation of electrical & instrument objects in digital 3D plant models during engineering
10. Working Group 14- Modular Type Package (MTP) .

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| S.No. | Name | Working Group |
| 1. | Shri. Sanjeev Sethi | IEC SC 65E (WG2, WG8, WG9, WG10) |
| 2. | Ms. Ankita Srivastava | IEC SC 65E/WG8 |

ISO/IEC JTC 1/WG 12 (P Membership)

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| **S.No.** | **Member Nominated** | **Organization** |
|  | Shri Saroop Chand | - |

# ANNEXUE- 3

# 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 (Not a member)

iv. ISO/IEC JTC 1/WG 12- 3D Printing and Scanning

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

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| --- | --- | --- |
| **S.No.** | **BIS Technical Committees** | Liaison International committees |
|  | LITD 13-Interconnection and Information exchange among IT equipment and systems Sectional committee |  |
|  | LITD 17-Information Systems Security and Privacy Sectional Committee |  |
|  | LITD 27-Internet of Things and & Digital Twin Sectional Committee |  |
|  | LITD 30-Artificial Intelligence Sectional Committee |  |
|  | ETD 18-Industrial Process Measurement and Control Sectional Committee |  |
|  | PGD 18-Industrial and Production Automation Systems And Robotics |  |

**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.
   1. *Smart Manufacturing is:*
      1. *Characterized by convergence of advanced manufacturing capabilities, digital technologies and Internet of Things (IoT);*
      2. *Integration of customers and business partners in business and value-added processes;*
      3. *The collaboration of human beings, embedded systems, fully or partly autonomous machines, and systems of systems.*
   2. *It leads to:*
      1. *The individualization (up to lot size 1 in mass production) of products, services and processes;*
      2. *The networking of systems, which results in highly complex structures and cyber physical systems (CPS);*
      3. *New forms of value creation, business models and subsequent services;*
      4. *Evolution of safety, security, organization, processes and work design;*
      5. *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:
   1. *Panel 1, LITD 34/P 1 Smart Manufacturing Use case group-* Analyse the user needs
   2. *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- 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:

1. ***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.
      1. ***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.
      2. ***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.

1. ***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.

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ANNEXURE- 4

**TERMS OF REFERENCE FOR THE R&D (PROJECT 1 - LITD 34)**

(*Refer to the Guidelines on R&D Projects issued vide note SCMD/R&D dated 09-09-2023*)

**1. Title of the Project**: Study of Reference architecture for Smart Manufacturing in India

**2. Background:**

a) A reference architecture is a standardized framework or blueprint that provides a structured and comprehensive design for the implementation of any system. It serves as a guide, offering a set of best practices, principles, and specifications to design and deploy integrated solutions in the context of any modern manufacturing processes.

b) Smart manufacturing refers to the use of advanced technologies and data-driven intelligence to enhance and optimize the entire manufacturing process. It involves the integration of cutting-edge technologies, such as the Internet of Things (IoT), artificial intelligence (AI), machine learning, data analytics, and automation, into traditional manufacturing systems. The goal of smart manufacturing is to create more efficient, agile, and adaptable production processes that can respond quickly to changes in demand and market conditions.

c) A reference architecture for smart manufacturing would be essential as it would provide a standardized framework and set of guidelines for the design and implementation of interconnected and intelligent manufacturing systems. This would not only facilitate seamless integration of technologies but also streamline the development process, reduce implementation risks, and accelerate innovation. Additionally, a reference architecture would serve as a common language for industry stakeholders, enabling effective communication and collaboration.

d) This research project intends to review the existing reference architectures for smart manufacturing developed by various consortiums and countries. It further aims to assess the current status of implementation of smart manufacturing across various sectors of industry of varied scales and assess the suitability of implementation of the existing reference architectures on Indian industry. This would result in development of a standard for reference architecture for smart manufacturing in India.

**3. Objective:** To collect technical data, assess the landscape, and create a structure of a reference architecture for smart manufacturing in the context of Indian industries.

**4. Scope:**

a) Study and comparative analysis of existing literature which includes international standards such as standards published by IEC, DIN/DKE etc., research papers, SOPs/instruction/guidelines/laws applicable to smart manufacturing, any other study report available. Study of international standards may be done specifically keeping in view their suitability for implementation in Indian context.

b) Collection of the following data regarding industries where Smart manufacturing practices have been implemented in India. Similar discussion and assessment should be done with smart manufacturing solution providers in India:

i. Current state of smart manufacturing: Overview of the existing smart manufacturing landscape in India and adoption rates and maturity of smart manufacturing technologies.

ii. Industry-Specific Requirements: Analysis of specific needs and requirements across different industries and customization of reference architecture required to accommodate industry-specific challenges and opportunities.

iii. Technology Stack: Examination of the technologies involved, including IoT, AI, machine learning, data analytics, and automation. Also assess compatibility and integration of various technologies within the reference architecture.

iv. Identification and evaluation of interoperability standards for seamless communication between different components of smart manufacturing systems currently being implemented.

v. Assessment of security measures within the reference architecture to protect sensitive data.

vi. Evaluation of the existing reference architectures reviewed under literature survey for scalability to accommodate growth and changing demands and flexibility to adapt to evolving technologies and industry requirements.

vii. Identification of potential challenges and obstacles in implementing smart manufacturing reference architecture in the Indian context. Also suggest, strategies to overcome these challenges.

viii. Assessment of the economic impact of adopting smart manufacturing reference architecture, including potential cost savings, increased productivity, and job creation.

ix. Analysis of the availability of skilled professionals to implement and manage smart manufacturing systems.

x. Strategies and plans for disaster recovery, Business continuity measures in place.

xi. Development of a roadmap for the future evolution of smart manufacturing reference architecture in India.

xii. Collection of feedback from industries that have adopted smart manufacturing reference architecture.

c) Feedback from users of smart manufacturing solutions in India.

**5. Research Methodology**:

a) Review and analyze the literature as per the details mentioned scope.

b) Collect feedback/information through circulation of structured questionnaire.

c) During the visit to smart manufacturing industries and solution providers:

a. Observe the facilities/solutions for collection of data.

b. Conduct focused group discussion in a structured format.

**6. Sampling Plan:**

a) Two large, medium and small scale each industry shall be visited where smart manufacturing practices have been implemented.

b) Atleast two smart manufacturing solution providers should be visited for in depth-review.

c) Feedback from atleast five users shall be sought.

**7. Deliverables**: The following should be submitted in hard copy and digital format to BIS:

a) Study report covering all the aspects mentioned in the scope.

b) Questionnaire and response received to them.

**8. Requirement for the CVs:** CVs of the following members to be shared by the organization conducting the research:

a) Project leader for the R&D project.

b) Team members to be engaged for the project.

**9. Timeline and Method of Progress Review:**

a) The timeframe for completing the study and submission of the final report is 3 months from the date of award of the project.

a) Mid-term review of the project: Mid-term report covering the review of the literature and survey conducted to be submitted within 45 days from the date of award of the project.

b) Draft report: To be submitted with 75 days from the date of award of the project.

c) In case of delay in submission of final draft report, the justification shall be given by the project proposer for consideration by the Sectional Committee.

d) d) The proposer shall comply to the provisions given in the BIS guidelines for Research & Development Projects for Formulation and Review of Standards, i.e., **doc no. SCMD/R&D Guidelines/20230909.**

e) e) The proposer taking up the project shall clear all doubts on provisions of research including ToR and BIS guidelines before acceptance of the project and signing agreement.

**10. Support BIS will Provide:** Following will be provided by BIS on request

a) Any national/international standard relevant to the project.

b) Assistance by introducing researchers to third parties wherever suitable.

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**TERMS OF REFERENCE FOR THE R&D (PROJECT 2 - LITD 34)**

(Refer to the Guidelines on R&D Projects issued vide note SCMD/R&D dated 09-09-2023)

**1. Title of the Project**: Use case compilation for Smart manufacturing in India.

**2. Background:**

**a)** Smart manufacturing refers to the use of advanced technologies and data-driven intelligence to enhance and optimize the entire manufacturing process. It involves the integration of cutting-edge technologies, such as the Internet of Things (IoT), artificial intelligence (AI), machine learning, data analytics, and automation, into traditional manufacturing systems. The goal of smart manufacturing is to create more efficient, agile, and adaptable production processes that can respond quickly to changes in demand and market conditions.

b) India, with its diverse industrial landscape, is poised to leverage Smart Manufacturing technologies to enhance efficiency, productivity, and global competitiveness. Recognizing the potential benefits and challenges of this technological transition, there is a growing need to systematically document and analyze real-world use cases within the Indian manufacturing context. The absence of a centralized repository hampers the dissemination of best practices, lessons learned, and insights gained from implementing Smart Manufacturing solutions across different sectors.

c) This project endeavors to capture a spectrum of use cases, ranging from small and medium enterprises to large-scale manufacturing units, across various domains such as automotive, electronics, pharmaceuticals, and more. By compiling and categorizing these use cases, the repository will serve as a valuable resource for industry stakeholders, policymakers, researchers, and technology providers seeking to understand, replicate, and advance Smart Manufacturing practices in the Indian context.

d) The repository will also help in identification of aspects of smart manufacturing which require standardization on priority.

**3. Objective:** To collect technical data, assess the landscape, and create a use-case repository for smart manufacturing in the context of Indian industries.

**4. Scope:**

a) Study and comparative analysis of existing literature which would include use-case repositories created by countries, consortiums, industries etc., Study of these repositories may be done specifically to assess the suitability of use-case for utilization in Indian context.

b) Collection of following data regarding industries where Smart manufacturing practices have been implemented in India in addition to the parameters mentioned in the template provided by BIS:

a. Clear and detailed descriptions of the use case.

b. Categorization of use cases based on industry sectors, such as automotive, electronics, pharmaceuticals, etc.

c. Detailed information on the technologies and solutions employed in each use case, including IoT, AI, robotics, data analytics, and automation.

d. Identification and documentation of challenges encountered during the implementation of Smart Manufacturing solutions in each use case.

e. Strategies and innovative approaches adopted to overcome challenges and ensure successful implementation.

f. Quantifiable data on the operational impact of Smart Manufacturing, including improvements in efficiency, productivity, cost savings, and sustainability.

g. Measurement of performance indicators used to evaluate the success of Smart Manufacturing initiatives in each use case.

h. Insights and lessons learned from each use case, including what worked well and what could be improved for future implementations.

i. Assessment of the scalability and replicability of the Smart Manufacturing solutions, considering factors like company size, industry type, and geographic location.

j. Details on how Smart Manufacturing solutions were integrated with existing systems and processes within the organizations.

k. Information on how each use case adhered to regulatory standards and compliance requirements (if any applicable).

l. Documentation of collaborations and partnerships that played a role in the success of the Smart Manufacturing initiatives.

m. Evaluation of the costs associated with implementation versus the benefits achieved in terms of increased efficiency and ROI.

n. Inclusion of visuals, such as diagrams, photos, or videos, to enhance understanding and showcase the practical application of Smart Manufacturing technologies.

o. Insights into the future plans and roadmaps for Smart Manufacturing within each organization, highlighting potential expansions, upgrades, or additional use cases.

c) Feedback and testimonials from end-users, operators, and other stakeholders involved in the Smart Manufacturing processes.

**5. Research Methodology**:

a) Review and analyze the literature as per the details mentioned scope.

b) Collect feedback/information through circulation of structured questionnaire.

c) During the visit to smart manufacturing industries and solution providers:

a. Observe the facilities/solutions for collection of data.

b. Conduct focused group discussion in a structured format.

**6. Sampling Plan:**

a) At-least 50 use-cases should be compiled.

b) Three large, medium and small scale each industry shall be visited where smart manufacturing practices have been implemented.

c) Atleast two smart manufacturing solution providers should be visited.

d) Feedback from at-least five users shall be sought.

**7. Deliverables**: The following should be submitted in hard copy and digital format to BIS:

a) Study report covering all the aspects mentioned in the scope.

b) Questionnaire and response received to them.

**8. Requirement for the CVs:** CVs of the following members to be shared by the organization conducting the research:

a) Project leader for the R&D project.

b) Team members to be engaged for the project.

**9. Timeline and Method of Progress Review:**

a) The timeframe for completing the study and submission of the final report is 4 months from the date of award of the project.

a) Mid-term review of the project: Mid-term report covering the review of the literature, industries, solution providers identified to be visited and survey conducted to be submitted within 45 days from the date of award of the project.

b) Draft report: To be submitted with 90 days from the date of award of the project.

c) In case of delay in submission of final draft report, the justification shall be given by the project proposer for consideration by the Sectional Committee.

d) d) The proposer shall comply to the provisions given in the BIS guidelines for Research & Development Projects for Formulation and Review of Standards, i.e., **doc no. SCMD/R&D Guidelines/20230909.**

e) e) The proposer taking up the project shall clear all doubts on provisions of research including ToR and BIS guidelines before acceptance of the project and signing agreement.

**10. Support BIS will Provide:** Following will be provided by BIS on request

a) Any national/international standard relevant to the project.

b) Assistance by introducing researchers to third parties wherever suitable.

c) Template for use-case compilation (to assist in data compilation in addition to the details mentioned in the scope)

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