Digital Transformation and Innovation Ecosystem to Comply with Innovation Management System Standards – Opportunities and Priorities

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Abstract

The digital economy impacts all 17 Sustainable Development Goals (SDGs) of The United Nations (UN) and Its Agenda 2030 very decisively. Digital Platform Economy is emerging and digital ecosystems are essential for digital transformation in the emerging digital world. While the Open Digital Ecosystem (ODE) empowers and enables collaboration in unprecedented ways, there are many underlying challenges, emanating from such interconnected digital networks, that need to be addressed in all seriousness.

As digital technologies continue gaining adoption and thereby intensfication, they start enabling new ways of organising how value is created. This transition means moving from value chains to digital ecosystems. Innovating organizations are adopting and quickly implementing open innovation (OI) approach for developing new products and services. Dark data, acquired through various computer network operations, are not used in any manner to derive insights or for decision making. Businesses within an industry share open standards because this allows them to bring huge value to both themselves and to customers.

In 1975, the Government of India strategically decided to take effective steps for the development of information systems and utilization of information resources through nucleating a high priority UNDP Project titled "**National Informatics Centre (NIC) Programme**" in 1976. The Government identified about 30 digital themes in 2019, if scaled up nationally, could accelerate India's progress in 9 key areas, and India's digital economy has the potential to become a 3-Trillion USD ecosystem by 2025. The Digital India Programme 2015 envisioned a transition from its earlier National e-Governance Programme (NeGP) to National Open Digital Ecosystems (NODEs). Its Doubling Farmers Income by 2022 (DFI-2022) Report 2018 suggested reforms measures for income rise through strategic use of Digital Technology in Farming System Life Cycle i.e. Digital Transformation, and advocated Seven Mission Mode Programmes.

Transformation and Innovation are two terms often used synonymously, not the same thing but linked. The United Nations Industrial Development Organisation (UNIDO) has been the strong advocate of Standards to promote "digital transform and Innovation ecosystem". The idea is to use digital transformation to improve innovation management systems in organizations and companies within the framework of ISO 56002. ISO Standards provide a common international

language. Electronics have revolutionized agriculture in recent years by enabling different technologies and types of machinery to work effectively together and even allowing for the accurate identification and tracking of livestock.

One powerful strategy that can accelerate change across the value chain—globally and in India—is the use of Sustainability Standards, Frameworks and Certifications. More than 270 Voluntary Sustainability Standards (VSS) are widely used today to govern environmental, social and ethical issues in global supply chains. Agriculture is the sector, most covered by VSS and today, many food industries are putting certification schemes at the centre of their sustainability approaches. The ISO 56002:2019 is the guiding framework for innovation management systems and provides a systematic approach to integrating innovation into an organization.

Standards can serve as accelerators of change as they promote open innovation. This Chapter reviews the need for digital transforms and innovation ecosystem for process innovation, market invention and organisation promotion and also to comply with Innovation Management Systems Standards. It also looks into underlying aspects for "Legal enablement of ICT Systems" or "Legal e-Governance" and also strategic intervention advocated for ongoing digital transformation in Indian Agriculture, as a "Use Case". The digitalisation of agricultural system facilitates achieving many Sustainable Development Goals (SDGs) of the UN and its Agenda 2030. It also quotes the suggestion of the Doubling Farmers Income by 2022 Committee Report 2018 (Volume XII (B)) of the Government of India, on the strategic use of Digital Technology in Farming System Life Cycle, through 7 Mission Mode Programs.

The Digital India program facilitates innovations for the bottom of pyramid segment for effective and sustainable growth. More and more innovations are expected in the sectors like education, agriculture, healthcare and environment in the coming years to solve the challenges faced by the rural masses. This Chapter hence recommends early adoption of Innovation Management System Standards to facilitate Digital Transformation resulting in an Innovation Ecosystem, and the need for a Competency Development Programme for practioners.

Keywords: Digital Transformation, Innovation ecosystem, Management Information System, ISO Standards, Legal enablement, e-Governance, Open Digital Ecosystem, Competency Development, SDGs, Digitalization,

Introduction

Information Theory of Claude Elwood Shannon (1948) to Internet of Things (IOT) of Kevin Ashton (1999) have impacted digital technological applications very decisively, in various development fields. The words, Transformation and Innovation, are used synonymously, and evoke thoughts of change and modernization. Both innovation and transformation are important outcomes of the Change Management Life Cycle (Deb Smallwood, 2016) [1]. Innovation is what results from the sustained Transformation. The World Humanitarian Summit (WHS), held in Istanbul on 9th May 2016, outlined three key requirements of turning "**transformation through innovation**" from a Vision into a Reality: (1) **good data** (open data. big data) (2) **collaboration across sectors** and (3) **sustained funding** [2] and it requires a lot of analytics. In general, Digital transformation (DT) include the function and correlation of data, innovation, design, and technology, and **adopts technology** to support business or otherwise goals of an organisation, after realising the value of digitalisation. Uber, a ride-sharing services, is said to be a true act of innovation in the transportation space, and has become a prime example of the gig economy at work [3]. review, as available in the www.amazon.com, of the Book titled "**Leading Digital**" [4] **highlights** how large companies in traditional industries—from finance to manufacturing to pharmaceuticals—are using digital to gain strategic advantage, **illuminates** the principles and practices that lead to successful digital transformation, and **explains** successful transformation in a clear, **two-part framework**: where to invest in digital capabilities, and how to lead the transformation.

Technology is the sum of engineering, techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives (Source: www.wikipedia.org). Jack Ma, CEO of Alibaba, once said, "Our philosophy is that we want to be in an ecosystem. Our philosophy is to empower others to sell, empower others to service, making sure the other people are more powerful than us. With our technology, our innovation, our partners - 10 million small business sellers - they can compete with Microsoft and IBM. Our philosophy is, using internet technology we can make every company become Amazon" (www.cnbc.com). He obviously referred to his "**Rural Taobao**" e-commerce store in China. The world of manufacturing is changing. Industry 4.0, which encompasses IIoT and smart manufacturing, marries physical production and operations with smart digital technology, machine learning, and big data to create a more holistic and better connected ecosystem for companies that focus on manufacturing and supply chain management [5].

Digital Transformation – Progressive Steps undertaken in India since 1970s

In 1975, the Government of India strategically decided to take effective steps for the development of information systems and utilization of information resources and also for introducing computer based decision support system (informatics-led development) in government ministries and departments to facilitate planning and programme implementation to further the growth of economic and social development. Following this, the Central Government nucleated a high priority plan project – **an UNDP Project - "National Informatics Centre (NIC)"** in 1976. . Since then, India has been achieving its milestones on digitalisation, through its national level programmes viz., **e-Government** – NICNET and DISNIC (1986) (District Information System - 28 Sectoral Database Development Programme), NICNET Infrastructural facilities in in 512+ Districts, State Informatics Programme in State / UTs (1987), GISTNIC Information Dissemination Kiosks (1987), IntraNIC Portal (2002), IntraGov Portal (2008), e-Office (2010), National Knowledge Network –NKN (2010), National Portal of India (india.gov.in), Open Data, OpenGov, Digital Networks for Farmers (ISDA-1995), SMART Village Scheme (2002-07), e-Governance Programme (2005) – 27 Mission Mode Projects and SWAN, e-Kranti Renewed Strategy (2014), Digital India Programme (2015) and National Open Digital Ecosystem - NODE (2020). The RTI Act 2005 mandates digitalisation of the Government Departments. However, many Government Departments Websites still do not carry "RTI Act Ready" sticker.

The Digital India as launched on 1st July 2015, was centered on three key areas viz., (a) **digital infrastructure** as a utility to every citizen, (b) **governance and services** on demand, and (c) **digital empowerment** of citizens. Digital India has emerged as a way of life. During the Covid19 Pandemic, on 15th May 2020, the Government of India has launched its very ambitious "Atmanirbhar Bharat Abhiyan" of making India a self-reliant nation, which is **rested on 5 I's** - Intent, Inclusion, Investment, Infrastructure and Innovation, and **based on five pillars** viz., (a) Economy – Quantum Jump and not incremental, (b) Infrastructure – one that represents modern India, (c) System – 21st century technology driven, (d) Vibrant Demography – source of energy for self-reliant India and (e) Demand – whereby the strength of our demand and supply chain should be utilized to full capacity. India stands to create more value if it can nurture new and emerging digital ecosystems in sectors such as agriculture, education, energy, financial services, healthcare, and logistics (Noshit Kaka et al, 2019) [6].

In India, the **Open Network for Digital Commerce** (ONDC) Project (2022) is an initiative aiming at promoting open networks for all aspects of exchange of goods and services over digital or electronic networks. The ONDC is to be based on open-sourced methodology, using open specifications and open network protocols independent of any specific platform (https://pib.gov.in). The **Secured Logistics Document Exchange (SLDE) platform** is a solution to replace the present manual process of generation, exchange and compliance of logistics documents with a digitized, secure and seamless document exchange system. The **Aspirational Districts Programme** 2018 – a Data Driven e-Governance Model - is aimed at localizing Sustainable Development Goals, to improve the socio-economic status of 112 aspirational districts across 28 States, accounted for more than 20% of the country's population and covered over 8,600 gram panchayats (Gajanan Rauta, 2022) [7].

Ecosystem Architecture for Digital Transformation to overcome Perceived Challenges

As digital technologies continue gaining adoption, they start enabling new ways of organising how value is created. This transition means moving from value chains to digital ecosystems. However, there is still limited

knowledge of digital ecosystems in many domains wherein the onset and progress of digitization itself is not on par with others: how they are created, how they work and, importantly, how organisations beyond digital giants can approach digital ecosystems. Ecosystems allow the integration of data cross a series of services, and main elements for building a successful ecosystem are: a platform, network effects and market expectation (Omar Valdez-de-Leon, 2019) [8]. While the Open Digital Ecosystem (ODE) empowers and enable collaboration in unprecedented ways, there are many underlying challenges, emanating from such interconnected digital networks that need to be addressed.

In India, the Digital India Programme is seeking a transition its earlier National e-Governance Programme (NeGP) to National Open Digital Ecosystems (NODEs), **GovTech 3.0**, which are "open and secure digital delivery platforms, anchored by transparent governance mechanisms, which enable a community of partners to unlock innovative solutions, to transform societal outcomes". The GovTech 3.0 Approach is to build NODEs, e.g. Health NODE, Agriculture NODE, and State Service Delivery NODE (e.g. UPI). This list is growing. The Guiding Principles are: Openness and Interoperability, Reusability and Shareability, Scalability and Privacy-enabling and data-driven (Fig-1).

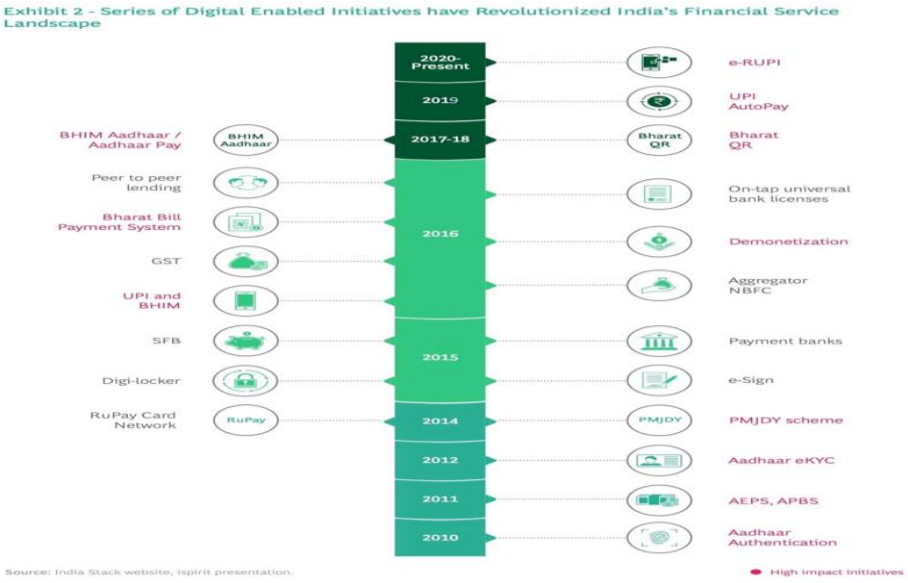

Fig-1: Digital Enabled Initiatives

Fig-2: Frontier Technologies in a Digital Ecosystem

An International Telecommunication Union (ITU) Thematic Report (2019) titled "Digital Transformation and the Role of Enterprise Architecture" identified eight first level building blocks viz., **digital strategy, digital platform, value delivery ecosystem, digital service attributes, digital enterprise architecture, institutions and governance, citizen insights and delivery capabilities** that are required as foundation to ideate, plan, design, deploy and operate citizen-centric transformational digital services. This Report also emphasized that "missing investment to develop such architecture and consequently the digital platform, will lead to fragmented, siloed and duplicative digital services, which is one of the main impediments against leveraging digital services that can induce desired transformation". In the United States of America (USA), the Republic of Korea (South Korea), and Estonia, such Government Enterprise Architecture (ESA) is mandated by law.

The worldwide initiatives on "Open Government Data" (OGD) focus on open APIs (Application Programme Interfaces) to easily access the information collected by various Government organizations of a country. The Policy on Open Standards for e-Governance and Technical Standards on Interoperability Framework for e-Governance, as adopted in India in 2015, facilitate "software interoperability" across various Government departments and agencies. Digital Transformation is, however, a fundamental change in how an organization delivers value to its customers. Satyanarayana (2020) [9] **categorized** challenges of Digital Transformation into : (a) 'Immediate' supersedes 'Important', (b) lack of Architectural capabilities, (c) We can't 'procure' Transformation, (d) resistance to Organizational and Domain Transformation, and (e) hesitation in adopting bold business models, and **gave a roadmap of evolution** from Indian perspective**: e-Government** – efficiency (1989), **e-Governance** - Citizen centric (1999), **m-Governance** - Convenience (2009), **Digital Transformation** – Innovation and Enterprise IT (2017), **Agile Governance** – Emerging Technologies (2020), **Integrated Services** – Ecosystem Technologies (2025) and "**Invisible Government**" - Future Technologies (2050).

During 2006-07, the Department of Information Technology (DIT) of Government of India, constituted the e-Governance Standards Working Group in the following areas, to strengthen National e-Governance Programme (NeGP):

- Network & Information Security Standards
- Metadata & Data Standards for Application Domains
- Localization & Language Technology Standards
- Quality & Documentation Standards

- Technical Standards & e-Governance Architecture

In view of a large scale funding from the Government of India, it was considered necessary to establish a Committee on "**Legal enablement of ICT Systems**" and was established under the Chairmanship Justice B. K. Somasekhara, Former Judge of High Courts of Andhra Pradesh & Karnataka, with Terms of Reference (TOR) including "to suggest adopting and applying international standards, best practices in legal e-Governance to suit international methods and standards to achieve uniformity". The e-Governance Standards, Guidelines, Frameworks make government services accessible to the common man through common service delivery outlets, ensuring efficiency, transparency, and reliability at affordable costs (www.egovstandards.gov.in).

The Vision of MeitY (www.meity.gov.in) envisages **e-Development of India** as the engine for transition into a developed nation and an empowered society, through components viz.,

- **e-Government**: Providing e-infrastructure for delivery of e-services
- **e-Industry**: Promotion of electronics hardware manufacturing and IT-ITeS industry
- **e-Innovation / R&D**: Implementation of R&D Framework - Enabling creation of Innovation/ R&D Infrastructure in emerging areas of ICT&E/Establishment of mechanism for R&D translation
- **e-Learning**: Providing support for development of e-Skills and Knowledge network
- **e-Security**: Securing India's cyber space
- **e-Inclusion**: Promoting the use of ICT for more inclusive growth
- **Internet Governance**: Enhancing India's role in Global Platforms of Internet Governance.

The MeitY Report (2019) [10] identified about 30 digital themes, if scaled up nationally, can accelerate India's progress in 9 key areas, and India's digital economy has the potential **to become a 3-Trillion USD ecosystem by 2025**. The Covid19 lockdown situation has forced everybody to adopt "digital technology" in all walks of life and Work from Home (WFH) has become the new Normal. But Cyber Security issue has become both a Challenge and an Opportunity. According to the World Bank Report, 10% growth in mobile and broadband penetration upsurges the per capita GDP by 0.81% to 1.38% in developing countries (www.deshpee.com).

A common set of Digital transformation (DX) Technologies fundamental to achieve digital transformation includes: Mobile, IOT, Digital Twin, Robotics, Cloud & Bigdata Analytics, Artificial Intelligence and Machine Learning, Augmented Reality and Additive Manufacturing. Blockchain Technology, Mobile computing, GIS and Industry 4.0, **are leading** to Digital Transformation in Governance and Society into e-Governance and Society 5.0. Figure-1 depicts frontier technologies in digital ecosystem of the Planet. The Government of India has envisioned "**Amrit Kaal leadup to @100**", in its Budget 2022, viz., (a) complementing the macro-economic level growth focus with a micro-economic level all-inclusive welfare focus, (b) promoting Digital economy & FinTech, Technology enabled development, Energy transition, and Climate action, and (c) relying on virtuous cycle starting from private investment with public capital investment helping to crowd-in private investment. This requires a tremendous amount of Capacity building and Competency development in people, to undertake process transformation, through technologies.

Digital Transformation (DX) Strategy - Way Forward for growth of Platform Economy

Platform Economy is the tendency for commerce to increasingly move towards and favour digital platform business models, providing as an Opportunity for SMEs and StartUps. It is visible that the Digital Platform Economy is advancing and therefore, digital ecosystems are essential for digital transformation in the digital world. The evolving digital economy is closely associated with several frontier technologies (Fig-2), fueled by DATA. The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, **provides a shared blueprint for peace and prosperity for people and the planet, now and in the future.** At its heart, there are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership (Fig-3). **The digital economy impacts 17 Sustainable**

development Goals (SDGs). The digitalisation of agricultural system facilitates achieving many Sustainable Development Goals (SDGs) of the UN and its Agenda 2030. The UN Decade of Action (2019) on the SDGs signals a renewed commitment by the international community to accelerate action towards reaching the global goals by 2030.

Fig-3

According to Behnam Tabrizi et al (2019) [11], Companies are pouring millions into "**digital** transformation" initiatives — but a high percentage of those fail to pay off. That is because companies **put the cart before the horse**, focusing on a specific technology ("we need a machine-learning strategy!") rather than doing the hard work of fitting the change into the overall business strategy first. The Authors further suggest that not only should these companies align tech investments with business goals — **they should also lean more on insider knowledge than outside consultants**, acknowledge fears about job loss that those insiders may have, develop deep knowledge of how changes will affect customer experience, and use process techniques borrowed from the tech world (experimentation, prototyping, etc.) to facilitate change.

Bumann and Peter (2019) [12] discusses, in their review article, that Action Fields of Digital Transformation consist of **Digitization** - conversion of analogue to digital (Data), **Digitalisation** - Adaption (Process) and **Digital Transformation** - Creation (Business) as depicted in Fig.1. An article titled "Digital Transformation Strategy" in (www.ptc.com) [13] suggests **7 essential steps** to drive Digital Transformation (DX) in the enterprise viz. (a) Align the Why, (b) Prepare for Culture Change, (c) Start Small but Strategic, (d) Map Out Technology, (e) Seek Out Partners and Expertise, (f) Gather Feedback and Refine and (g) Scale and Transform. As Digital Transformation progresses, new ways for digital to transform physical emerge, and transformation looks different at every organisation, and this article cautions that adoption of New Technologies on Old Operations will lead to Expensive Operations. Digital Transformation is more than just using a piece of technology (Maltaverne, 2017) [14].

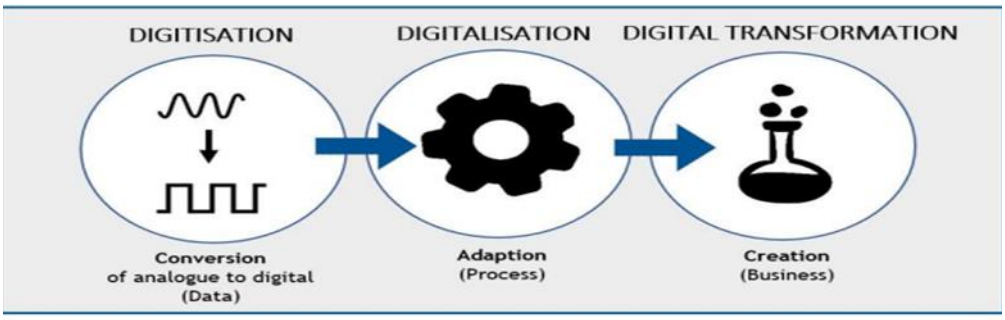

Fig-4: Phases of Digital Transformation (based on Maltaverne, 2017)

Despite the fact that digital transformation is referred to as the fourth industrial revolution, this revolution goes through roughly three digital evolutionary phases (as in Fig-4) (Govers and Amelsvoort, 2019) [15] viz.

- **Digitisation** concerns the conversion of analogue carriers of data (paper) to digital carriers (databases). This phase began in the 1960s and is still in full swing.
- **Digitalisation** concerns the adaptation of digital technology in business processes. The massive introduction of transaction and management information systems, such as enterprise systems (ERP), at the end of the 1980s marks this phase. This phase is still in full swing.
- **Transformation** concerns the creation of new business models based on the possibilities of digital technology and platforms to integrate business processes. This third phase fundamentally changes the way in which organisations operate and how organisations realise value for customers.

The McKinsey & Company identifies **six elements** of a successful Digital transformation – digital strategy and targets, Organisation structure, Test-and-Learn Approach, Talent and Capabilities, Ecosystem Leverage, and Culture Change. **Digital data and Digital Platform** are increasingly driving Value Creation in the Digital Economy and have its implications for National and International policies. It is also time for **India to forge digital policies** that are tailored made for the Indian scenario and tap into the vast treasure trove of technical competence at India's disposal (Dataquest, 2020) [16].

Data is growing at a pace faster than ever before. Dark data is data which is acquired through various computer network operations but not used in any manner to derive insights or for decision making. Big data analytics is the process of examining large and varied data sets -- **i.e., big data** -- to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful information that can help organizations make more-informed business decisions. Data mining can help solve business problems through data analysis. It combines statistics, artificial intelligence and machine learning to find patterns, relationships and anomalies in large data sets. Data mining has grown in popularity, mainly because of its demonstrated value to companies.

The National Data and Analytics Platform (or NDAP) is NITI Aayog's flagship initiative to improve access and use of government data, and a user-friendly web platform that aggregates and hosts datasets from across India's vast statistical infrastructure: (a) Media as a big data source, (b) Cloud as a big data source, (c) Web as a big data source, (d) IOT as a big data source and (e) Database as a big data source. The NDAP seeks to democratize data delivery by making government datasets readily accessible, implementing rigorous data sharing standards, enabling interoperability across the Indian data landscape, and providing a seamless user interface and user-friendly tools (http://ndap.niti.gov.in). In the Indian context, far-sighted planning by the Government of India, in the last five years, has made its Digital India program all pervasive touching virtually every facet of day to day life of a citizen in India. This has begun to have transformative impact on the quality of governance in India, through '**Minimum Government, Maximum Governance**' - a concept which is deeply intertwined with optimal and thoughtful use of digital technologies (Sharma, 2020) [17]. To achieve Self-Reliant India, Indian Citizens needs to have their emails created, stored and protected in India and seamlessly integrated with all e-governance applications. **This is required to create Society 5.0 [**18]. **The "metaverse" is a parallel universe where human, augmented and virtual realities are supposed to merge.**

The **industrial metaverse** is a network of digital twins that links physical assets and the digital world. It enables manufacturers to connect their digital twins with their customers and suppliers so they can work together and get insights based on real time data. The industrial metaverse offers companies a way to design and test products, run simulations, and collaborate on research and development in a 3D immersive environment with the benefit of AR and VR technologies (www.pli.edu). **Boeing is reportedly planning to create its next aircraft in the metaverse.** Following the idea of democratization, the Metaverse AI (and its decentralization layer) promises to allow creators and users to exchange digital assets and entitlements easily, protecting ownership and ensuring disintermediation from big technology corporations. In the era of Industry 4.0, innovation of complex technology systems and the development of intelligent technologies rely on technology standards. There-fore, the competition of technology standards becomes vital for enterprises to gain competitive advantage (Jiang Hong, et all, 2020)[19].

Knowledge for Innovation (K4I)

Knowledge Management (KM) facilitates (a) utilizing current expertise, (b) leveraging learning from previous experiences, (c) enabling rapid scaling up, (d) mitigating risk of attrition, and (e) sharing best practices, in organizations who aim at productivity. **Knowledge Representation (KR) is a key pillar of Knowledge Management, Artificial Intelligence, Cognitive Science and Software Engineering.** KM comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences (http://www.wikipedia.com). With increased use of computers, specific adaptations of technologies such as **knowledge bases**, **expert systems**, **knowledge repositories**, **group decision support systems**, **intranets**, and **computer supported cooperative work** have been introduced to further enhance KM efforts. The focus of KM is connecting people, processes and technology for the purpose of leveraging organizational knowledge. Various components of KM Technologies are detailed in Fig-5.

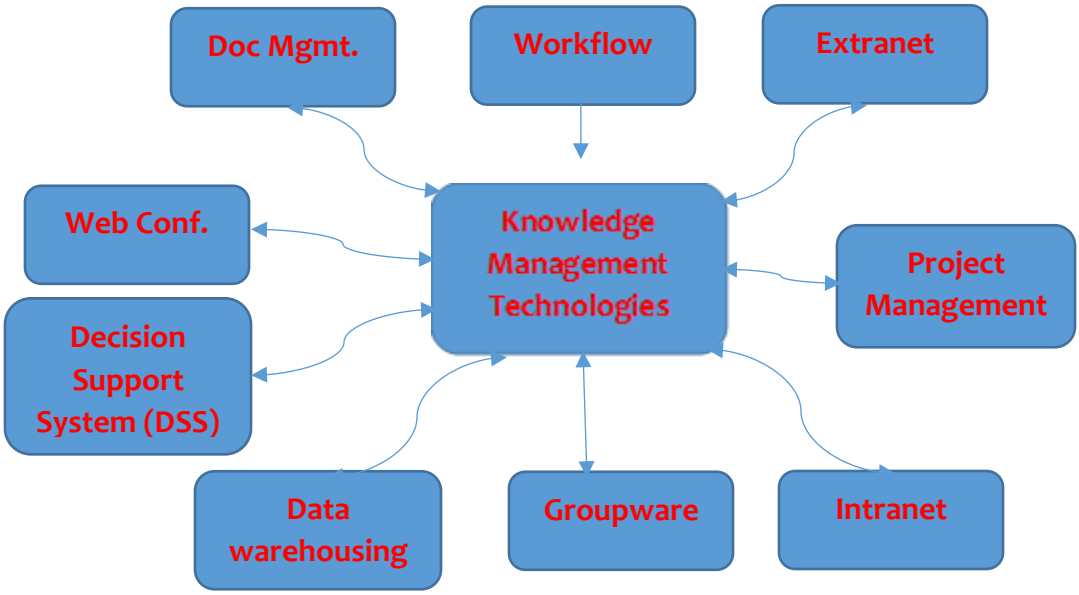

Fig-5: Knowledge Management Technologies

A next generation of data-driven modelling and decision-making applications can help organisations, governments and stakeholders to make informed decisions, **based on the concept of Knowledge Chain.** Knowledge Pyramid linking data to information to knowledge and wisdom, in which data is the raw material for the development of applications addressing decision making through wisdom in research, government, business and Ngo/Foundations is depicted in Fig-6 (Lokers et al, 2016) [20]. The Paradigm shift is towards "**Knowledge for Innovation**" (K4I) and "**Information Representation**" is towards **Data standards and Metadata Standards** for application in Information System Management. Resource Description Framework (RDF), a W3C recommendation in February 1999, is an infrastructure for encoding, modelling and exchanging metadata (Heting Chu, 2010) [21]. Computer Vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding (Cognitive Computing) from videos or digital images (data sets). Global Companies to provide such required "data sets" including audio and text data for Artificial Intelligence (AI) development and Machine Learning (ML), are emerging (www.gts.ai).

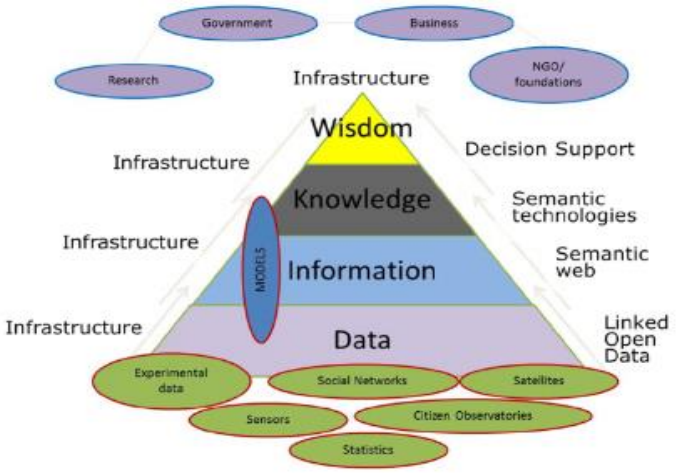

Figure 6: Knowledge Pyramid

Open Innovation and Digital Technologies

Innovating organizations are adopting and quickly implementing the open innovation (OI) approach for developing new products and services. The integration of disruptive digital technologies (DTs) into the innovation processes bolsters the development of new business models, innovation processes, and ecosystems. However, there is limited information regarding the management of a digitalized OI process, and the role of different DTs across the stages of the innovation process. Pierre-jean et al (2020) [22] established a conceptualized framework, which integrates different DTs such as Bigdata, the IoT, Cloud computing, Artificial Intelligence, Blockchain and Social media, and maps them across the stages of the OI process. Open innovation is basically an alternative to the Conventional method of doing innovation where information has to stay within preset confines. The word "Open innovation" was

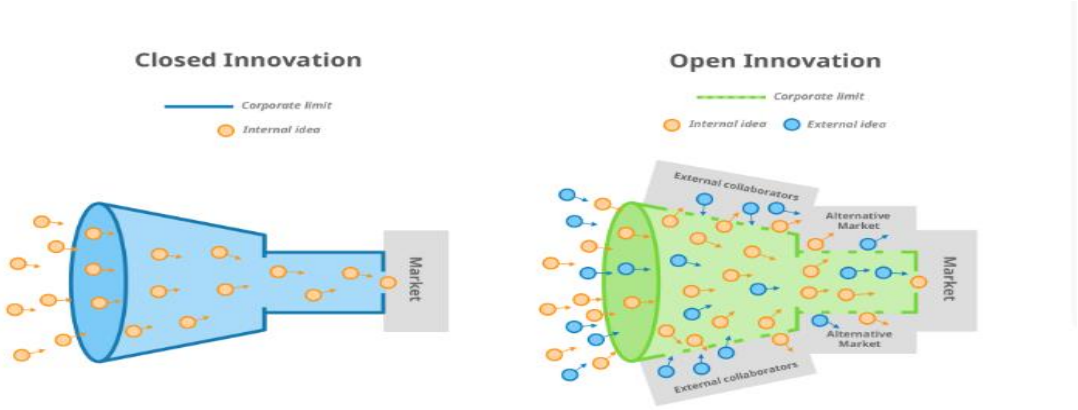

Fig-7: Open Innovation Vs. Closed Innovation

coined for the first time in (Henry W. Chesbrough, 2006) [23] and Atte Isomaki (2018) [24] discusses what Open Innovation is and how to achieve that (Fig-7). The main difference between Open and Closed Innovation lies in the way the innovation comes about: Companies/Organisations engaging in closed innovation carry out work in a self-contained innovative environment, whilst those using Open Innovation methods rely on external knowledge sources also for their innovation management strategies. Jebamalai Vinanchiarachi (2020) [25] advocates that it is necessary to seize opportunities in open innovation and value creation networks in the digital world for self-reliant economy. Ricciotti (2020) [26] quotes **six key concepts emerged** that guided the Evolution from Value Chain to Value Network: **sustainability, globalization, collaboration, intangible assets, flexibility, and agility**. Digital platforms and value creation in developing countries have its implications for National and International policies.

A number of open source products that have been crowned with a remarkable technical and economic success viz. **Apache** (a web server), **Linux** (an operating system), and **Sendmail** (an Internet transfer mail agent), are the most notable examples. In India, the Ministry of Electronics & Information Technology (MeitY) has taken many initiatives for promoting and fostering the adoption of Free and Open Source Software (FOSS), in view of various inherent advantages like: increasing interoperability, developing local capacity/ industry, reducing costs, conserving foreign exchange, achieving vendor independence, enabling localization and reducing piracy/copyright infringements. India's strength in Information Technology (IT) could be further utilized to develop products using FOSS which would help in bridging the digital divide with significant cost savings and facilitate the creation of a Knowledge Society viz., Society 5.0.

The Open Platform Communications (OPC) [27] is an **Industrial Interoperability Standard** for the secure and reliable exchange of data in the industrial automation space and in other industries. It is platform independent and ensures the seamless flow of information among devices from multiple vendors. Balasubramanian (2021) [28] suggests **affordable IT-Infrastructure** to all stakeholders in the Supply-Chains and Value Chains by using "Reuse & Sharing" concepts", based on Open Source Software, Open Standard and Recommended-Software-Stack, and Adaptive-Methodologies to minimise the risks/issues during digital-transformation. The proposed set of key-recommendations towards the adoption of Industry 4.0 (IR4) & Industry 5.0 (IR5) are: -

a) Reuse and Share the Digital-Infrastructure
b) Use solutions based on open innovative concepts
c) Collaborate with others in the Ecosystem
d) Carry out capacity building on new technical-skills and new business-skills
e) Prefer Manufacturing as a Solution (MaaS)
f) Provision the Funding / Incentives
g) Drive the initiatives through a dedicated establishment
h) Establish & Use Innovation-Labs /Competence-Centres
i) Use Agile Methodology in Manufacturing
j) Monitor the progress of each individual-Industry
k) Include the purpose of Digital-Transformation
l) Create and sustain a living-condition with decency for the workforces, and
m) Spread the industries to many other new locations for the balanced-growth.

Innovation Ecosystem

An innovation ecosystem includes universities, government, corporations, startup accelerators, venture capitalists, private investors, foundations, entrepreneurs, mentors, and the media. Innovation ecosystems create an active flow of information and resources for ideas to transform into reality. The focus of innovation ecosystems is the value creators - the innovators and startups creating jobs and solving problems (Mike Millard, 2018) [29]. Innovation ecosystems connect the dots and provide the spark. Islands of Innovation need to become part of "Value-Creation" networks in the era of Platform Economy.

India has a well evolved system for supporting and funding science, technology and innovation (STI). The Digital India program facilitates innovations for the bottom of pyramid segment for effective and sustainable growth, and more and more innovations are expected in the sectors like education, agriculture, healthcare and environment in the coming years to solve the challenges faced by the rural masses. **Innovation in India is required at all levels.** New approaches to developing an enabling environment conducive to digital innovation and entrepreneurship are needed across sectors.

Innovation Management Standards for achieving Return on Investment (ROI)

Digital strategies are all about speed, flexibility, and efficiency**.** One of the big casualties of working without industry-wide standards is innovation, as different areas of manufacturing have a lot of equipment and processes in common, but the way that those pieces of equipment communicate with one another are generally proprietary to each supplier. **Generally,** Businesses within an industry share open standards because this allows them to bring

huge value to both themselves and to customers. Standards facilitates the ongoing digitalization of industry by enhancing productivity and efficiency, promoting compatibility and interoperability between products and processes through common language, while guaranteeing minimum levels of quality and safety.

An open standard is a standard that is freely available for adoption, implementation and updates. A few famous examples of open standards are XML, SQL and HTML. **Open ecosystem comprises of Open Source Software, Open Standard and Open Data.** Open Standards enable digital-first strategies to usher in "Smart Factory" (Smartindustry, 2021) [30]. An open approach to digital development can help to increase collaboration in the digital development community and avoid duplicating work that has already been done. Programs can maximize their resources — and ultimately their impact — through open standards, open data, open source technologies and open innovation. Among the Standards Organisations viz., Internet Engineering Task Force (IETF), International Organization for Standardization (ISO), International Electrotechnical Commission (IEC) and ITU-T, **only the IETF and ITU-T explicitly refer to their standards as "open standards"** (www.en.wikipedia.org).

The United Nations Industrial Development Organisation (UNIDO) has been the strong advocate of Standards to promote "**digital transform and Innovation ecosystem**" for enhancing prosperity and wellbeing of People, through sustainable industrial development (Fig-8). Timely and harmonized standards can play a pivotal role in shaping the digital transformation process, complementing regulations and contributing to digital transformation governance in areas viz., Food and Agriculture; Affordable and Clean Energy; Decent work and Economic Growth; Industry, Innovation & Infrastructure; Sustainable Cities and Communities; Climate Action; Life on Land and below Water; Responsible consumption and production; and Good health and well-being. Furthermore, **standards can serve as accelerators of change** as they promote innovation and the uptake of new digital technologies and spread knowledge through codification (UNIOD, 2021) [31]

Fig-8: Standards & Digital Transformation

Transformation and Innovation are two terms often used synonymously, not the same thing but linked. Digital transformation is adopting technology to support your business goals (after realising the value of digitalisation), whereas Innovation is what results from that. Innovation systems have been categorized into national innovation systems, regional innovation systems, local innovation systems, technological innovation systems and sectoral innovation systems. Hary Vincent (2021) [32] suggests "**Use of Standardized Processes"**, in order to leave innovation approaches neither to chance nor to chaos. Companies manage and upscale innovation on a company-wide basis in a variety of ways, and in general, however, the most popular innovation management approaches fall

into two broad categories – incremental and disruptive (www.qmarkets.net). However, deciding which approach will deliver the best Return on Investment (ROI), is not always easy.

The ISO 56000 Series is on Innovation Management Standards **(https://www.nsai.ie/)** and the ISO 56002 is the **first Global Standard for Innovation Management system**. The idea is to use digital transformation to improve innovation management systems in organizations and companies within the framework of ISO 56002. Developed by innovation experts from across the world, ISO 56000 Series provides **international best practice on the systematic management of innovation activities** in organisations of all types, including SMEs. Organisations that pro-actively manage innovation activities as outlined in the ISO 56000 series will ultimately and be more likely **to take effective action and achieve sustained success** by systematically addressing customer needs (Fig-9). **ISO 56002 addresses** viz., (a) all established organizations regardless of industry and size, (b) all types of innovation (products, services, processes, models and methods), and additionally (c) all types of innovation approaches (internal and open innovation, user, market, technology and design-driven innovation activities).

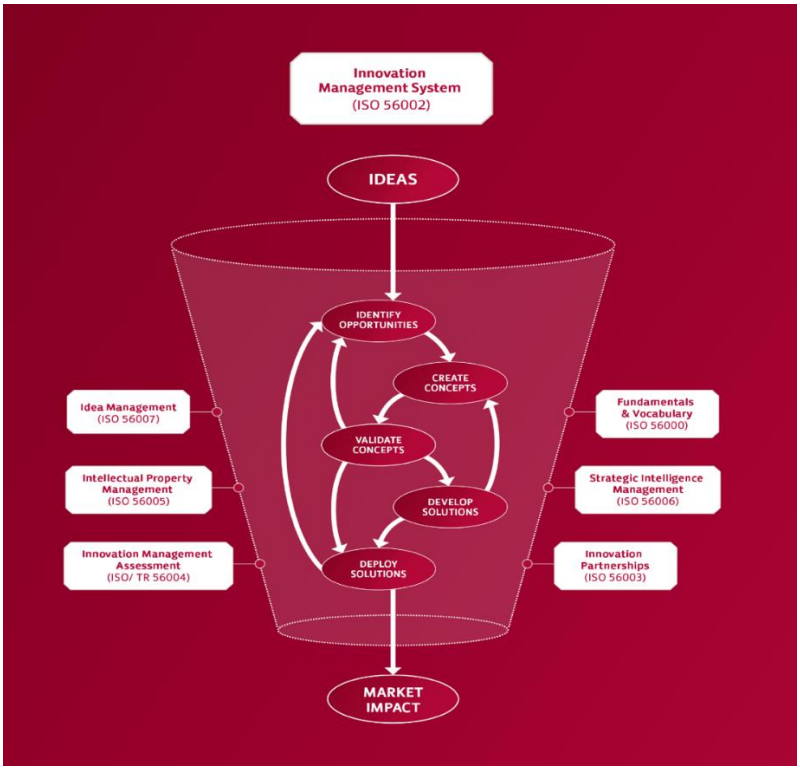

Fig-9: Innovation Management System (ISO 56002)

The MSSs are designed to be applicable across all economic sectors, various types and sizes of organizations and diverse geographical, cultural and social conditions. ISO 56002 and ISO's innovation management series are a very good framework to start with, to apply, adopt and integrate with other Management System Standards:

- *ISO 9001 - Quality management systems*
- *ISO/IEC 27001 - Information technology — Security techniques — Information security management systems*
- *ISO 14001 - Environmental management systems*
- *ISO 26000 – Social Responsibility Framework to maximize the contribution of organizations to Sustainable Development (SDGs)*
- *ISO 55001 - Asset management*

The ISO 56000 suite of Standards and Guidance documents on innovation management offers a systematic approach to **integrating innovation** into **all layers** of an organization.

- *ISO 56000: Innovation Management - Basics and Vocabulary*
- *ISO/AWI 56001: Innovation management — Innovation Management System — Requirements*
- *ISO 56002:2019 - Innovation management — Innovation Management System — Guidance*
- *ISO 56003:2019 - Innovation management — Tools and methods for innovation partnership — Guidance*
- *ISO 56005: Innovation Management - Tools and Methods for Managing the Intellectual Property*
- *ISO 56006: Innovation Management - Strategic Intelligence Management*
- *ISO 56007: Innovation Management - Idea Management*

ISO 56002's earlier Version **ISO 50501(2018)** aimed to promote Innovation viz., Marketplace Innovation, Value Chain Innovation, Process Improvement Innovation, Organizational Culture Innovation, Product/Service Innovation and Social Innovation. According to Johan Grundström Eriksson (2021) [33], **ISO 56002** is a blueprint for sustainable innovation and enables creative collaboration to flourish and released just in time for the disruption of Global Value Chains of 2020. He has further stressed that there is a need to train all of the available workforce to collaborate in parallel, with high degrees of automation and flexibility, and, where value chains are digitalized, using innovation enabled by 5G, Virtual Reality/Augmented Reality (VR/AR), artificial intelligence (AI) and machine learning (ML) technology. By adopting the concepts of ISO 56002, manufacturing companies and institutions can get **a running start** in their endeavours **to innovate and transform**. This adds **new value to the supply chains** that are being reshaped and allows more focus on technical uncertainty. The professionalization and standardization of Innovation Management will continue to gain momentum in days to come.

ISO 9001 quality management standard (QMS) has been adopted by over 1 million organisations across the world and is used by businesses to continually monitor, manage and improve the quality of their products and services. Lopes and Polónia et al (2022) [34] intend to investigate how organisations can leverage ISO 9001:2015 in implementing the ISO 56002:2019 innovation management standard (IMS), given that both standards have a high degree of compatibility with each other. This combination of QMS and IMS will lead to an Integrated Management System contributing to foster an innovation process within a company, enabling an environment for innovation development (Tidd, 2021) [35].

Integrated Management System (QMS + IMS) for Agricultural Innovation – A Case Study

Electronics have revolutionized agriculture in recent years by enabling different technologies and types of machinery to work effectively together and allowing for the accurate identification and tracking of livestock. Out of a total of more than 21500 International Standards, ISO has more than 1000 related to agriculture, with many more in development (ww.iso.org), of which a few standards are listed below for reference: -

- ISO 17989 Tractors and machinery for agriculture – Sustainability
- ISO/TC 23 Tractors and machinery for agriculture and forestry
- ISO 20966 Automatic milking installations – Requirements and testing
- ISO 4002 Equipment for sowing and planting
- ISO 15886 Agricultural irrigation equipment – Sprinklers
- ISO 8026 Agricultural irrigation equipment – Sprayers
- ISO 9635 Agricultural irrigation equipment – Irrigation valve
- ISO 22000 Food safety management systems –Requirements for any organization in the food chain
- ISO 22005 Traceability in the feed and food chain – General principles and basic requirements for system design and implementation
- ISO 14055 Environmental management – Guidelines for establishing good practices for combatting land degradation and desertification
- ISO 24631 Radiofrequency identification of animals

- ISO 21384-2:2021 Unmanned aircraft systems

ISO Standards for Agriculture cover all aspects of farming, from irrigation and global positioning systems (GPS) to agricultural machinery, animal welfare and sustainable farm management. Sustainable agriculture is achieved through efficient use of farmland. Farmers, manufacturers and food producers are the main beneficiaries of the ISO Standards which help increase efficiencies, sustainability and traceability in food production.

One powerful strategy that can accelerate change across the value chain—globally and in India—is the use of Sustainability Standards, Frameworks and Certifications. It is estimated that more than 8% of Agricultural Land in the World is certified under different Sustainability Standards. More than 270 Voluntary Sustainability Standards (VSS) are widely used today to govern environmental, social and ethical issues in global supply chains (UNCTAD, 2020) [36]. Agriculture is the sector most covered by VSS and today many food industries are putting certification schemes at the centre of their sustainability approaches. The stakeholders in the value Chains need to understand the difference between frameworks, disclosures, certifications, and assessments to facilitate strengthening sustainable Agri-food Value Chains.

The **Good Agricultural Practices (GAP**), as defined by FAO, are a "Collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability. The India GAP **(**INDGAP) Certification Scheme for GAP (www.qcin.org) is aimed to address viz., (a) quality and quantity of the produce obtained from a unit area, (b) various aspects of food safety, (c) pre-and post-harvest practices including workers health and safety, and (d) sustained supply of produce of the desirable quality, to suit the needs of the small and marginal farmers in India. At present in India, two types of certification system exists viz., Third Party Certification (NPOP – National Programme for Organic Production) System (India Organic) for global trade and PGS-INDIA Certification System (PGS-India Green, PGS-India Organic & Jaivik Bharat) for national trade (see Fig-10).

Fig-10: India Organic Certification Scheme

Over the last 30 years, more and more tea, coffee and cocoa farmers have embraced towards climate-smart and sustainable practices by adopting "certification standards" that help to maintain soil quality, increase productivity and reduce costs (UNEP, 2020) [37]. India is home to 30% of total organic producers in the World having 2.30 million ha. According to FiBL Survey 2021, India holds a unique position among 187 countries practicing organic agriculture. The **UN Decade of Family Farming 2019-2028** aims to shed new light on what it means to be a family farmer in a rapidly changing world and highlights, more than ever before, the important role they play in eradicating hunger and shaping our future of food. The Family Farming and Indigenous Peoples' Food Systems, together, are in for a more sustainable food system of the World.

The combination of QMS and IMS will provide an "enabling environment" for innovation process and development for Agricultural Innovation.

Agricultural Innovation - Pathway for Sustainable Agricultural and Rural development

From Web 2.0, we are now supposedly moving towards Metaverse, a virtual reality space where people interact with each other in a computer-generated environment, through Virtual and Augmented Reality (VR/AR) sets. Metaverse is possible through the evolution of digitalization of the power and use cases of "Data Units".

Agricultural Data has become a major source of competitive advantage. AgriTechs are plainly driving India's next Green Transformation, by developing innovative digital solutions to maximize productivity, improve market linkages, increase supply chain efficiency, and provide greater access to inputs for agri-businesses.

StartUps and ScaleUps work on technological solutions by automating farm operations and improving productivity through process improvement and automation using methods and technologies viz., Internet of Things, Agricultural Robotics, Artificial Intelligence, Drones, Precision Agriculture. Agricultural Biotechnology, Big Data & Analytics, Controlled Environment Agriculture, Regenerative Agriculture and Connectivity Technologies. Robotics Process Automation (RPA), through Virtual Software Agents (VSA), Cyber Physical System (CPS) and Physical Robots, provide enormous opportunities for products developments for farm management.

Digital technologies are critical for increasing productivity in agriculture, making agriculture fair for farmers, ensuring reduction in food loss both at pre/post-harvest stages, and ensuring food safety and security. Agriculture is an Unstructured and Semi-structured problem and hence Artificial Intelligence (AI) and ML Applications are having immense applications and use in agriculture. The Doubling Farmers Income by 2022 (DFI-2022) Report 2018 (www.agricoop.gov.in) of the Government of India, have suggested reforms measures for income rise through digitalisation of farm sector towards enhancing agricultural productivity, reducing post-harvest losses, enhancing efficiency gains in semi-processing and further processing into final products. Its Volume XII (B) has suggested **strategic use** of Digital Technology in Farming System Life Cycle, through seven DFI-2022 Mission Mode Programmes in its Chapter-10 as given below: -

1. *Digitalised Agriculture: Digital Technology and Innovation in Agriculture: Digital India, Make in India, Skill India and StartUps India Programmes for Transformational Reforms in Agricultural Sector (SMART Irrigated Farming, SMART Rainfed Farming and SMART Tribal Farming);*
2. *Digitalised Agro-Met Advisories & Agricultural Risk Management Solution;*
3. *Digitalized Agricultural Resources Information System (AgRIS) and Micro-Level Planning for achieving SMART VILLAGE & SMART FARMING;*
4. *Digitalized Value Chain for about 400 agricultural Commodities;*
5. *Digitalised Access to Inputs, Technology, Knowledge, Skill, Agricultural Finance, Credit, Marketing and Agribusiness Management, to Farmers;*
6. *Digitalized Integrated Land and Water Management System – Per Drop More Crop;*
7. *Digitalized Farm Health Management for reduction of Farmers' Losses.*

This needs **a robust digital framework** for data organisation, seamless integration of agricultural information systems by adopting open data standards, and structured approach for decision making process system, for effective service delivery to farmers, in 22 constitutionally recognized Indian languages. Digital Agriculture is required for their ability to analyse a vast amount of data to extract new knowledge and to help agriculture understand better the farming tasks and make better decisions. Big data, in turn, offers a support to farmers to extract new insights from their data and to make more accurate decision.

The digitalisation of agricultural system facilitates achieving many Sustainable Development Goals (SDGs) of the UN and its Agenda 2030. The 2030 Agenda explicitly refers to innovation as a critical means of implementation, acknowledging its role in accelerating the achievement of the SDGs. Accelerating and scaling up innovation in agriculture can trigger the transformation needed to respond to feeding a growing and increasingly urbanized population, climate change impacts and to achieve the Sustainable Development Goals (FAO, 2018) [38].

Conclusion

Digital Ecosystems are essential for Digital Transformation in the digital world. The Government's programme such as Digital India 2015, Aspirational Districts Programme, Open Network for Digital Commerce (ONDC), Secured Logistics Document Exchange (SLDE) etc., lead to Digital Transformation and Innovation Ecosystem in India. ISO Standards provide a common international language. The ISO 56002:2019 is the guiding framework for innovation management systems. A combination of QMS and IMS will provide an "enabling environment" for innovation process and development in all categories of Industries viz., primary, secondary and

tertiary. It provides a systematic approach to integrating innovation into an organization and provides us a Pathway and a desired Tunnel for undertaking digital transformation and innovation.

Knowledge for Innovation (K4I), Open Innovation and Digital Technologies, Industrial Interoperability Standard, affordable Open IT-Infrastructure, and Timely and harmonized standards can play a pivotal role in shaping the digital transformation process, complementing regulations and contributing to digital transformation governance. It is understood that adoption of new technologies on old operations in any organization will invariably lead to expensive operations. Transformation looks different and varies from organisation to organisation.

As the Digital Transformation progresses, Innovation Management Ecosystem will foresee the need for complying with an integrated management system of both Innovation Management Standards – ISO 56002 and Quality Management System 9001. This demands appropriate capacity building and competency development programs on Innovation Management System Standards and Quality Management Systems Standards, to be taught in Informatics and e-Governance Courses.

The Digital India program facilitates innovations for the bottom of pyramid segment for effective and sustainable growth. More and more innovations are expected in the sectors like education, agriculture, healthcare and environment in the coming years to solve the challenges faced by the rural masses. This Paper provides both opportunities and priorities for Rural India to contribute 8 Trillion Dollar Economy to India by 2030.

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