Cooperative Perspective

ISSN: 0302-7767

WPS (VAMNICOM) - 09/2021

9

VAMNICOM Working Paper Series

Volume 3 ✠ Issue 2

Industry 4.0 in Cooperatives: Challenges and Opportunities

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Vaikunth Mehta National Institute of Cooperative Management

April 2021

Working Paper - 9

Industry 4.0 in Cooperatives: Challenges and Opportunities

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Citation : Tripathy K. K., Paliwal Manisha and Sayed Saba (2021). Industry 4.0 in Cooperatives: Challenges and Opportunities. VAMNICOM Working Paper No. 9, Volume 3, Issue 2, pp 1-19.

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Abbreviations

AI	:	Artificial Intelligence
AMCS	:	Amul Automatic Milk Collection System
CPS	:	Cyber-Physical Networks
ICT	:	Information and Communication Technology
IFFCO	:	Indian Farmers Fertiliser Cooperative Limited
IoT	:	Internet of Things
IT	:	Information Technology
FDI	:	Foreign Direct Investment
GDP	:	Gross Domestic Product
GPS	:	Global Positioning System
NRI	:	Network Readiness Index
RFID	:	Radio Frequency Identification
TVET	:	Technical and Vocational Education and Training
UAV	:	Unmanned Aerial Vehicles
VDCS	:	Village Dairy Cooperative Societies
WEF	:	World Economic Forum
WSN	:	Wireless Sensor Network

Industry 4.0 in Cooperatives: Challenges and Opportunities

K.K. Tripathy[1], Manisha Paliwal[2], Saba Sayed[3]

ABSTRACT

Industry 4.0 has received much interest globally over the past few years. Industry 4.0 aims to reach more improved internal efficiency levels and sustainability, and a greater degree of automation. Big Data, Cyber-Physical Networks (CPS), the Internet of Things (IoT), the industrial Internet, artificial intelligence, cloud computing, and others are major themes in Industry 4.0. All these elements are specifications that are elements of the visionary framework of Industry 4.0.

Cooperatives as economic institutions founded on society's ideals, cooperatives also have a significant need to enhance human welfare. With time, however, the presence of cooperatives has decreased. Several reasons have prompted the number of operational Indian cooperatives to decrease: both internally and externally. Due to the shortage of funding and other business problems, technology implementation is often challenging for cooperatives. Many technological problems negatively impact cooperatives' sustainable business efficiency. The implementation of Industry 4.0 will, however, solve different problems with technology. Aspects of Industry 4.0, such as big data, the Internet of Things, and the smart factory, play a positive role in encouraging the adoption of information technology (I.T.), which leads to sustainable business efficiency. Also, the framework and method of the business reinforce the constructive partnership between Industry 4.0 and the application of I.T.

Researchers carried out an extensive literature review of published research studies, case studies, Government reports, proceedings of workshops, seminars, etc., to analyze the collective action efforts undertaken by Cooperatives in India and international countries about Industry 4.0. An attempt has been made in this study to analyze various efforts undertaken to understand how features of Industry 4.0 can be effectively used in cooperatives. It explores the logic in Industry 4.0 for the members of cooperatives for their development. This paper also suggests the ways and means of areas in which cooperatives may take up the technology in Industry 4.0.

Keywords:

Digitalization, Cooperatives, Innovations, IoT, Big Data, Digital Technologies

1. Introduction

Ever since the early evolution at the beginning of the industrial revolution in the 18th century, the news industry has seen significant progress. Most of the items, including weapons, equipment, food, clothes, and shelter, have been produced by hand or by working animals for centuries. This improved with the adoption of industrial methods at the end of the 18th century. Industry 1.0's development had been an enormous quick challenge leading up to the fourth revolution of industry, the future modern age.

The term Industry 4.0 stands for the fourth industrial revolution, the next step of a manufacturing technology's life cycle in the enterprise and management of the whole value chain.

1.1 Industry 1.0 to 4.0: The History of the Modern Ages

Industry 1.0 The late 18th century opened the industry of mechanical manufacturing plants. Machines powered by water and steam were built to assist workers in the mass processing of products (Chaitanya, 2020). In 1784, the first weaving loom was introduced. With the growth of manufacturing Productivity and size, small companies have evolved from servicing a smaller range of clients to vast organizations providing a greater number of owners, administrators, and workers. Industry 1.0 can also be considered to be the emergence of an industry community that emphasizes consistency, Productivity, and scale in equal measure.(Nardo et al,2020,Thangaraj et al.,2018)

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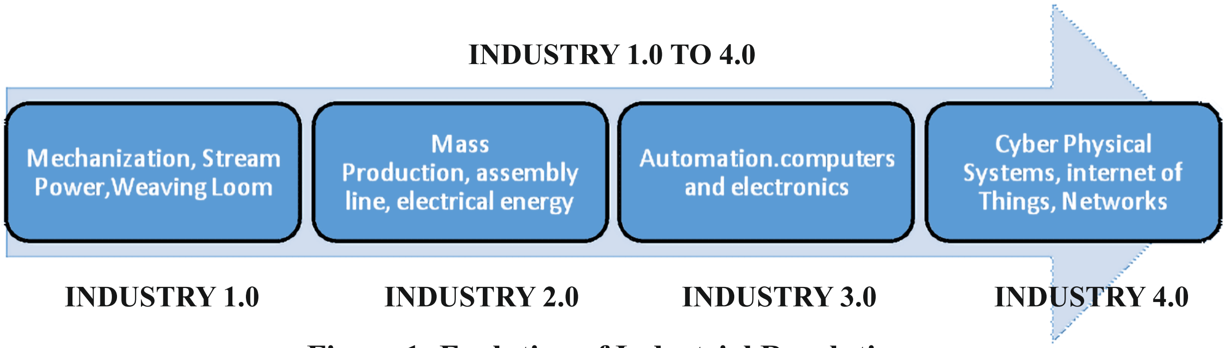


Figure 1: Evolution of Industrial Revolution.

Industry 2.0 The second revolution, Industry 2.0, began at the start of the twentieth century. The invention of computers operating on thermal power was the principal contributor to this revolution. As the main fuel source, electrical power has always been used. In terms of expense and skill, electrical devices were more effective to run and sustain versus water and steam-based machines that were comparatively slow and starving for energy. During this period, the first assembly line was also constructed, further streamlining the mass manufacturing process. A common practice was the mass manufacturing of products using the assembly line (Yin et al., 2018).

This period also saw the growth of the culture of business incorporated into the management curriculum of Industry 1.0 to increase the performance of production lines. The fundamental mechanisms contributing to higher efficiency and performance were enhanced by numerous supply management methods, such as labour division, just-in-time production, and lean manufacturing concepts.

Industry 3.0 Over the last few decades of the twentieth century, the second technological revolution leading to Industry 3.0 was driven and motivated by developments in consumer electronics. The innovation and development of a range of electronic components, including transistors and integrated circuits, automatically mated the machines, resulting in reduced effort, improved speed, better precision, and even complete elimination of the human agent. One of the landmark developments that created automation through electronics was the Programmable Logic Controller (PLC), first developed in the 1960s. The introduction of electronic hardware into production processes has also produced a need for information systems to allow this electronic equipment to boost the demand for application development (Chen et al., 2017). The digital systems have also allowed many management processes, in addition to managing the machines, such as enterprise resource planning, inventory management, shipping logistics, inventory flow scheduling, and factory-wide monitoring. Using electronics and I.T., the entire business was more industrialized. With the developments in the electronics and I.T. industry ever since, development processes and technological systems have continually developed.

Industry 4.0 In the 1990s, the Internet and telecommunications industry boomed, which transformed the way we interacted and shared data. This also resulted in technological breakthroughs in the automotive sector and conventional development practices that combined the real and virtual world boundaries. This frontier has been further disrupted by Cyber-Physical Systems (CPSs), resulting in several recent technical disruptions in the sector (Saldivar et al., 2015). With virtually minimal physical or spatial boundaries, CPSs empower devices to interact more smartly with one another. Industry 4.0 uses cyber-physical networks to exchange, evaluate and direct intelligent behaviour for different industrial operations. CPPs often allow an industry from a remote location to be digitally visualized, tracked and controlled, thereby bringing a new dimension to the development process (Wang et al., 2016). It brings computers, individuals, systems, and processes into a common interconnected framework that made it extremely effective for smooth functioning. If the cost-of-technology curve gets wider each day, technological disruptions can occur at many reduced costs and fundamentally change the manufacturing environment even more rapidly. Industry 4.0 is still at an early stage, and the companies are still in the transitional state of the new systems' implementation. To remain competitive in the market, industries must implement new technologies as soon as possible. This paper reviews various collective action efforts were undertaken to understand how features of Industry 4.0 can be effectively used in cooperatives. This study aims to understand the extend of digitalization through Industry 4.0 also to explore the logic in the application of Industry 4.0 in the working of cooperatives for their development with the help of Indian cooperative cases.

2. Review of Literature

2.1 Industry 4.0

This part of the literature presents the paper, which includes what exactly is Industry 4.0 and how it aims at creating a transparent, smart manufacturing infrastructure for the implementation of technologies. It also focuses on issues and challenges in various sectors.

The definition of Industry 4.0 encompasses not only direct production in the sector but also the whole supply chain from suppliers to consumers, as well as all business operations. Industry 4.0 is a 21st-century technological innovation that allows industries to produce intelligent goods and services while cutting prices and rising performance. The human aspect is critical for the process, and the research is focused on the current study in the field. The paper introduces the smart factory concept for automated services, thus increasing the efficiency of operations (**Chaitanya Vijay Bidnur, 2020)**

The aim of Industry 4.0 is not only to reach a better degree of organizational efficiency and competitiveness but also to greater automation **(Haseeb et al., (2019**). This study has attempted to address the various issues and challenges about technology advancement in the area of Industry 4.0. Based on the findings, the paper reveals that industry 4.0 aspects such as big data, the Internet of Things, and the smart factory play a constructive role in supporting I.T. adoption, which leads to long-term market success.

The fundamental concept of Industry 4.0 is still in its infancy, with the incorporation of physical networks on a cyber network (**Aulbur and Singh, 2014) in India.** A substantial portion of the manufacturing sector is still in the development process, with technologies restricted to devices that run independently of one another. A lack of maturity is a big factor for the poor acceptance and deployment of Industry 4.0 technologies (**Oesterreich et al., 2016). The b**enefits of Industry 4.0 through sustainable business models are manifold (**Carla Gonçalves Machado et al., 2020).** It focuses on the discussion of sustainable production and Business 4.0, as well as the relations between the two principles. The results suggest that the Industry 4.0 area is real but not established and that it is developing as a result of the emergence of modern business frameworks and the incorporation of value chains.

2.2 Technology and Industry 4.0

The literature in this section describes the various aspects of Industry 4.0, such as big data, the Internet of Things, and the smart factory, and how they play a positive role in encouraging the adoption of information technology (I.T.), which leads to sustainable business efficiency.

Vaidya, Ambad, Bhosle (2018)explored the nine pillars of Industry 4.0, including Big data and analytics, Industrial of Things, cloud computing, artificial intelligence, autonomous robots, etc. These pillars will change independent and improved operations to a highly integrated, automatic, and optimized method. As a result, conventional manufacturing relationships among suppliers, users, and consumers, as well as between humans and computers, become more productive and improve. Faster processors, intelligent devices, compact sensors, and less costly equipment for storage and transmission of data could enable devices to connect and benefit from one another. The nine pillars will help to identify the issues and challenges faced in the implementation of Industry 4.0. It also suggests that as this concept of Industry 4.0 increases, new streams of research in this field should be built, including recent analysis sources, such as open and coordinated supply chain, data gathering from manufacturing lines, and utilization of the data for the usage of efficient equipment.

To boost operating performance and maintenance control, conventional equipment is being turned into self-aware and self-learning devices byIndustry 4.0 with the communication around them.The key criteria of Industry 4.0 are real-time data management, recording of inventory status and locations, as well as maintaining guidelines for managing manufacturing processes**(Lee et al.,2014**).

With the introduction of Information and communication technologies (ICT), the industries have got opportunities to compete in international markets**(Bahrin et al.,2016)**. Along the lines of such developments, the automation industries are playing a vital role in the introduction of technologies about industry 4.0. In industries, automated robots have recently been developed and used to perform risky tasks for individuals, accomplish quicker and more efficient manufacturing procedures, and minimize the price of goods. Since competition is growing in today's market, manufacturers want smarter systems to make smarter decisions. The Indian automobile industry is at the forefront of introducing Industry 4.0's main elements. Automotive industries have been compelled to implement key components of Industry 4.0, such as robotics, due to emerging technologies, an increasing number of parts, growing innovation, and rising labour costs. In India's automotive sector, there are 58 robots per 10,000 workers (**Roehricth, K.,2016)**

2.3 Industry 4.0 and cooperatives

The technological changes in the developing markets have put pressure on the cooperatives to react to the fast-moving changed environment. While cooperatives today have experienced setbacks in their progress, to strive, it seems important for them to survive and put tremendous effort. **Setianingsiha et al. (2020)** it is for the cooperatives to catch up with the significant efforts put up by the Industrial Revolution 4.0. The question that cooperatives encounter in this fourth industrial revolution age is to find a way to emerge as a vital player in developing the economic growth of the country.

Innovations give agricultural cooperatives the ability to introduce other unique activities, such as precision farming, in addition to opportunities for optimization. **Griepentrog et al. (2016),** in their paper, carried out a study on precision farming. In their study, they stated that The culture of cooperatives promotes the development of supply chains or the formation of societies through a broadly rich and diverse market ecosystem (members, staff, consumers, vendors, associates, etc.). Hence, this transition influences the cooperative value chain, optimizes some practices, and revolutionizes others. **Setyawati (2017)** concluded in her paper that, since cooperatives do not have trained human resources, it is normal for cooperatives to become inactive. The failure of cooperative H.R. to change to technology innovations is another aspect that leads many cooperatives to halt operation. Poor management and H.R. factors are one of the reasons. For sustainable growth, cooperatives need to improve in areas of financial management and information systems, along with H.R. aspects. Collaboration between cooperatives and small businesses, the introduction of new models, and management skills could be sustainable strategies for building cooperative enterprises and establishing cooperatives can be based on the collaboration that has proved this interaction to offer benefits to both(Mazzarol,T. et al.,2013,**Loubere and Zhang, 2015)**

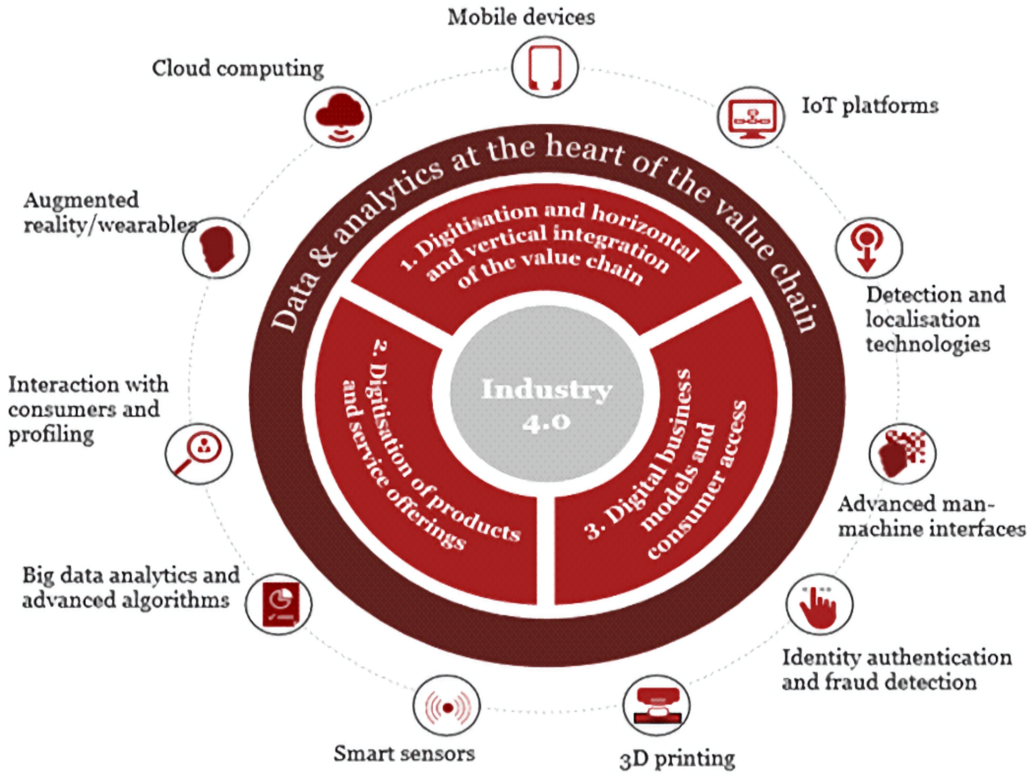
3. Research Methodology

The authors have carried out an extensive literature review of published research studies, case studies, govt. Reports, proceedings of workshops, seminars, etc. to analyze the collective action efforts undertaken by Cooperatives in India and international countries concerning Industry 4.0. Given the research objectives formulated, the methodology of this paper is based on secondary data.

Section 1 and 2 provide the introduction and context of the paper along with the literature review. Section 4 gives briefly narrates the purpose of usage and features in Industry 4.0. Section 5 describes how Industry 4.0 evolved across the globe; Section 6 describes the readiness of India, and Section 7 describes the application of Industry 4.0 in Cooperatives.

4. Why Industry 4.0?

To boost operating performance and maintenance control, conventional equipment is being turned into self-aware and self-learning devices by Industry 4.0 with the communication around them(Lee et al., 2014). Industry 4.0 aims at creating a transparent, smart manufacturing infrastructure for the implementation of industrial knowledge networks (Bahrin et al., 2016). The key criteria of Industry 4.0 are real-time data management, recording of inventory status and locations, as well as maintaining guidelines for managing manufacturing processes. (F. Almada-Lobo, 2015)



F7gure 2: Industry 4.0 technology features and contributions towards digitalization.

Source: Industry 4.0: Building the digital enterprise, 2016 global industry 4.0 survey, PwC engineering, & construction

4.1 Big Data and Analytics

To facilitate real-time decision-making, the analysis and systematic examination of information from several multiple sources would become essential for manufacturing equipment and applications, as well as business and consumer management systems (Rüßmannet al., 2015).Big Data consists of four aspects, according to Forrester's definition: the amount of data, data variety, the rate at which new data is generated and analyzed, as well as the importance of the data(K. Witkowski, 2017).Previous evidence was statistically analyzed to classify the threats that occur earlier in the industry in different industrial methods, as well as to identify existing problems and potential solutions to eliminate them from arising in the future.(Bagheri et al.,2015).

4.2 Autonomous Robots

In industries, automated robots have recently been developed and used to perform risky tasks for individuals, accomplish quicker and more efficient manufacturing procedures, and minimize the price of goods. Since competition is growing in today's market climate, manufacturers want smarter systems to make smarter decisions (Bahrin et al., 2016).

Table 1. Autonomous robots used in different industries (Sipsas et al., 2016)

Sr.	Name of Robot	Company	Function of Robot
1.	Kuka LBR iiwa	Kuka	Lightweight robot for critical manufacturing activities
2.	Baxter	Rethink Robotics	Intelligent robot for the purpose of packaging
3.	BioRob Arm	Bionic Robotics	Usage for humans in the near vicinity
4.	Roberta	Gomtec	6-Axis industrial robot used to automate flexibly and efficiently.

4.3 Simulations

In operation, simulations can be used quite widely to exploit real-time data in a computer environment that can involve computers, goods, and humans to replicate the physical environment, thereby minimizing system startup times and boosting quality (Rüßmann et al., 2015).For virtual designing and for visualization of cycle times, energy usage, or durable factors of a production facility, 2D and 3D simulations can be developed. In addition to shortening the downtimes and modifying them, the use of models of manufacturing processes can also minimize production errors during the startup period (Simons et al., 2017).With the aid of simulations, decision-making efficiency can technically be improved effectively and quickly (G. Schuh et al., 2014).

4.4 The Internet of Things

Industry 4.0 integrates the Internet of Things (IoT) with industrial strategies in the 21st century to allow devices to exchange, interpret and use knowledge to direct human intelligence. It often involves cutting-edge technology such as additive engineering, robotics, artificial intelligence, virtual reality, and other computational technologies (Atzori, 2010).The Internet of Things (IoT) is a new concept that is gaining momentum in the emerging wireless communication scenario. The central principle of this theory is the ubiquitous existence of several items or artefacts around us, such as Radio-Frequency Identification (RFID) tags, sensors, actuators, smartphones, etc., which can communicate with special addressing schemes (E. Hozdić, 2015).

4.5 The Cloud

The cloud-based I.T. interface acts as the technological pillar for linking and communicating the various components of the Industry 4.0 Technology Centre (M. Landherr, 2016).Organizations require improved information sharing for business 4.0 i.e. attainment of response times in milliseconds or much faster across platforms and businesses (Rüßmann et al., 2015).'Digital manufacturing' is the notion of linking various computers to the same cloud to exchange details with each other, which can be generalized to include systems from the production floor as well as from the whole plant (E. Marilungo, 2017).

5. Industry 4.0: Across the globe

Germany

The Industry 4.0 paradigm was founded in Germany in the early part of the 21st century. Industry 4.0 transforms existing factories into self-controlled and self-adaptive scientific and technological structures (Smart Factories) through the use of technology and automation of industrial applications, enabling intellectual value chains to be developed. The idea of Industry 4.0 also has an impact on environmental issues (Olah,2020).

In 2012, the German Government introduced an implementation strategy identified as 'High-Tech Policy 2020.' Annually, this initiative provides billions of euros to implement the new developments in the automotive sector (Liao et al., 2017). In 2018, for its latest cars, Volkswagen launched the 48V radical electric, VTG turbocharger and Miller combustion mechanism, and mild hybrid diesel systems.

South Korea

"Innovation in Manufacturing 3.0", a strategy initiated by the South Koreans in 2014, outlined four directions and tasks for Korean manufacturing development (Ministry of Trade Industry and Energy of South Korea, 2014). A new automated vehicle, the Hyundai Genesis sedan, has been developed by Hyundai, which is good at detecting moving vehicles, preventing crashes, operating on narrow lanes, and identifying traffic signals and speed limit signs.

China

In 2015, two actions were initiated simultaneously by China's Government, i.e. the 'Internet Plus' and 'Made in China 2025' policies. To improve China's industrialization, ten main facets of the manufacturing industry are given priority (China State Council, 2015).In 2018, the Government declared the abolition of legislation forcing car makers like General Motors to partner with a local group to open factories in China. China hopes the move will enable international firms to bring other sophisticated technologies into China to satisfy electric transportation requirements.

Singapore

In 2016, with an investment of $19 billion, the Singapore government unveiled its RIE 2020 Plan (Research, Innovation, and Enterprise). Eight primary vertical businesses for the Plan were defined by the modern manufacturing and engineering domain (National Research Foundation 2016). In 2018, Singaporean industries adopted machines that would help allow small alterations to completely automate hydroponic farms, increasing the crop yield.

Malaysia

In Malaysia, by conducting numerous strategies to enable market players to adopt Industry 4.0 through the introduction of automation and smart manufacturing, the Government has taken proactive steps. The Government put light on several new incentive programs in the 2017 budget to boost the development and acceptance of Industry 4.0 and innovation in Malaysia. Supermax Company Bhd, for example, was a gloves production sector that will be funded by the Government under automation and Industry 4.0 in manufacturing by stimulus schemes to stimulate industry growth. Malaysia's former Prime Minister, Datuk Seri Najib Razak, has introduced a government proposal to introduce TVET (Technical and Vocational Education and Training) in the industry. This would be to facilitate the future growth of Business 4.0 by growing the workforce's skills. Within the scheme, the Government contributed RM50 million to increase their quality and Productivity of the workforce that will assist in the economic growth of the country. Thirty per cent of the Human Resources Development Fund (HRDF) funds are committed to this Plan solely for TVET.

6. Readiness of India for Industry 4.0

The World Economic Forum (WEF)'s analysis is used to demarcate different countries' implementation of the Networked Readiness Model. The WEF researched different nations and ranked them on a scale of seven points. To measure the nation's transformation to the digital world, the Network Readiness Index (NRI) is used as an indicator. It measures how well the country is emerging in the technological background and whether these innovations are truly useful in the development of the nation. New Innovation, which is largely focused on emerging technology and innovative business models, will transform the essence of the digital transition.

The 2020 index outlined a range of core concerns, namely

- increasing demand on firms and organizations to incorporate innovative innovations, competitiveness with an increasingly rising digital population,
- the emergence of new forms of practice and
- Leadership and governance structures to embrace digital technologies and seize the rising demand.

India ranked 88 out of 134 countries according to the network readiness index criteria listed above, whereas in the case of access to technology and ICT usage, India Ranks 76.

Table 2: Network Readiness Index (NRI)

Network Readiness Index (Countries)	NRI Ranking	Technology	Network Readiness Index (Countries)	NRI Ranking	Technology
Sweden	1	2	Canada	13	12
Denmark	2	5	Japan	15	21
Singapore	3	10	China	40	44
Netherlands	4	3	Sri Lanka	83	84
Switzerland	5	1	India	88	76
United Kingdom	10	8	Pakistan	111	98

Source: NRI 2020, Final report (https://networkreadinessindex.org/nri-2020-analysis)

According to the German Engineering Federation (VDMA), there is a six-dimensional model for determining business readiness, which requires six dimensions:

1. Policy and business	2. Smart Factory	3. Smart operations
4. Smart Goods	5. Information systems	6. Employees

Two dimensions apply to the real world, namely, smart factories and smart goods, while two others (smart operations and information systems) represent the digital view of physical dimensions. Industry 4.0, according to this definition, is the convergence between the physical and digital environments.

Based on the current German Business Federation (VDMA), Industry 4.0 readiness is measured using six dimensions and their elements. The use of emerging media, current transparency, and community exchange are also taken into consideration. The following elements are included in the six components indicated above:

1. Policy and business encompasses management of policy, expenditure, and innovation;

2. Digital modelling, infrastructure facilities, data use, and I.T. structures are all part of a smart factory.

3. In the implementation stage, smart innovations like analytics of data and ICT enabled technologies;

4. Knowledge sharing, I.T. encryption, Cloud storage, autonomous processes and are all examples of smart operations.

5. Information systems include data-driven activities, sales shares, and data assets utilized;

6. Employees involve knowledge gaining and skillsets for workers.

6.1. Status of Industry 4.0 in India

Based on a strong emphasis on Industry 4.0 through the "Make in India" strategy for future growth, India is the sixth-largest manufacturing country. By 2022, the Government plans to increase the share of manufacturing in GDP from the existing 16-17 per cent to 25 per cent. Many regulatory changes, such as GST adoption and FDI policy liberalization, have been implemented by the Government.

India is reportedly lagging behind its global counterparts where Industry 4.0 implementation is considered. A substantial portion of the manufacturing sector is still in the development process, with technologies restricted to devices that run independently of one another. The fundamental concept of Industry 4.0 is still in its infancy, with the incorporation of physical networks on a cyber network (Aulbur and Singh, 2014).

India appears to be building the right model to establish its "small factories" on, as shown by its success in two crucial supporting Industry 4.0 innovations, namely IoT and Big Data. In the manufacturing sector, the use of the IoT industry accounts for 60% of the IoT market of India.

Make in India accounts for 32% of the total global market share (Nishimura, T, 2018). About $2 billion markets have emerged in India for big data analytics. This number is increasing at a faster pace making it around $1.6 billion by the year 2025.

The big data analytic market in India is projected to be and is expected to rise at a CAGR of 26%, hitting around.

The Indian automobile industry is at the forefront of introducing Industry 4.0's main elements. Automotive industries have been compelled to implement key components of Industry 4.0, such as robotics, due to emerging technologies, an increasing number of parts, growing innovation, and rising labour costs. In India's automotive sector, there are 58 robots per 10,000 workers (Roehricth, K. 2016).

Table 3: 2019 Robot Count in Manufacturing Industries (Count of Installed Industrial Robots per 10,000 employees

Name of Countries	Count	Name of Countries	Count
South Korea	855	China	187
Japan	364	UK	71
Germany	346	Brazil	10
United States	200	India	4
Canada	165		

Source: International Federation of Robotics, Industrial Robots

The Indian automobile sector has started to adopt Industry 4.0. Bajaj Auto, for example, started automating its activities in 2010. It currently employs 100–120 "Co-bots" (collaborative robots) in its manufacturing processes. Maruti Suzuki hires approximately 1700 robots to operate seven process shops and five assembly lines. With the aid of 437 robots, Ford can run its assembly lines and body shop at its Sanand factory. Hyundai has taken action to reduce labour costs by implementing 400 robots. Tata Motors has over 100 robots on its Tata Nano production lines. Renault is trying to avoid accidents by automation. An intelligent system is used by a multinational corporation headquartered in Mumbai to link all devices and analyze the pace of work and performance. The system facilitates waste avoidance and production flow organization. Another packaging company in Bengaluru has linked machines across a network that offers a monthly dashboard of machine status.

Matrix Tools and Solutions (Matrix), a Pune-based firm, develop product prototypes and assists with the implementation of emerging technology for the transformation of manufacturing methods. Kirloskar Brothers (KBL) employs 3D printing and the Internet of Things (IoT) in its manufacturing processes, especially casing in foundries. They also hire tonne in the handling of water in factories. The plants are managed from a distance using a remote management system. Raymonds' enterprises are rapidly incorporating emerging technology. To produce textiles, the organization has introduced robots, big data, and material science technology (TNN and Agencies, 2016).

Healthcare has benefited from emerging technologies in a variety of aspects. The growing utilization of electronic health records, telemedicine, the system for health management and online health resources has enhanced the usage of patient data and facilitated visualization of health information and electronic medical records digitization trends. At Fortis and Max hospitals, robot-assisted surgery is practised.

Although the nation was quickly changing, industries in India tend to be optimistic about their growth prospects. According to the eighth Digital I.Q, in a survey conducted by PwC, 71 per cent of Indian respondents are optimistic about digital development shortly. In India, as in the rest of the world, there is a heavy emphasis on technology for increasing sales, improving consumer service, and reducing costs. The survey revealed that while industries are extremely focused on organic growth and cost reduction initiatives, many industries in India tend to be solely focused on growth.

This indicates that businesses are progressing to digitalization but have yet to incorporate technology to enhance their growth as per the recent Global Digital I.Q. The survey, the challenge now is how to work effectively in a digital environment.

Table 4: Technologies that are making substantial investments in India

Technologies	Per cent	Technologies	Per cent
Internet of Things	64 %	Robotics	27 %
Artificial intelligence	42 %	Virtual reality	16 %
Blockchain	7 %	3-D printing	10 %
Augmented reality	10 %	Drones	3 %

Source: PwC, Global Digital IQ® Surveys

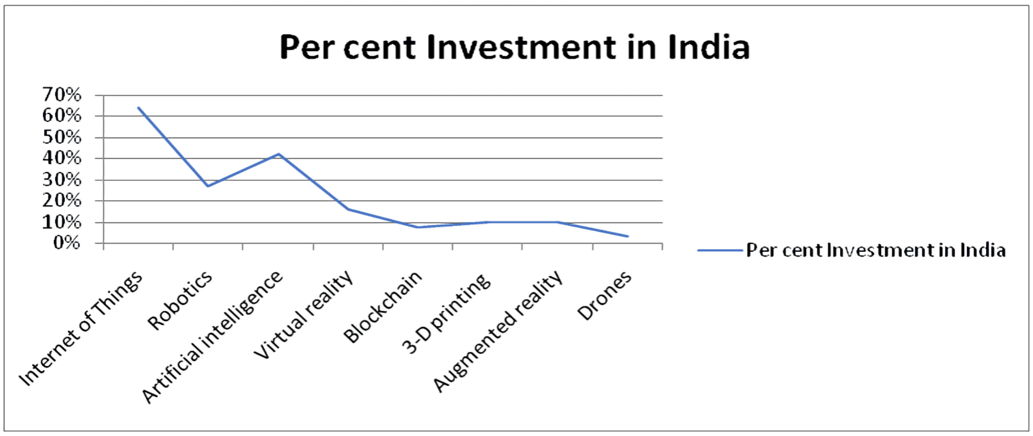


Figure 3: Technologies that are making substantial investments in India

As shown in the figure 3, in India, businesses started to be investing heavily in artificial intelligence (A.I.), the Internet - of - things (IoT), and robotic systems, but, in the next three years, the emphasis would undoubtedly turn to virtual reality and blockchain. The growing emphasis on IoT and robotics also suggests a shift of attention toward cost reduction.

7. Application of Industry 4.0 in Cooperatives.

Cooperatives, as economic institutions founded on the ideals of the society, also have a significant need to enhance human welfare. With time, however, cooperatives are becoming less common. The number of functioning Indian cooperatives has decreased for a variety of reasons, both internally and externally. Parallel to this, action must be taken to investigate cooperatives that, until recently, were still deeply involved in society, to recognize trends and methods helping the cooperatives to increase their operations so that they can be used to enhance the sustainability of other cooperative enterprises.

The question that cooperatives encounter in this fourth industrial revolution age is to find a way to emerge as a vital player in developing the economic growth of the country. The technological changes in the developing markets have put pressure on the cooperatives to react to the fast-moving changed environment. While cooperatives today have experienced setbacks in their progress, to strive, it seems crucial for cooperatives to catch up with the significant efforts put about by the Industrial Revolution 4.0 (Setianingsiha et al., 2020).

We reached a modern digital phase in 2008, with transition growing due to improvements in digital technologies and directly influencing society. As a result, new smart devices are becoming popular, and in the future, users will be gradually connected, between each other and with their devices, with the automation of the connectivity between people and objects.

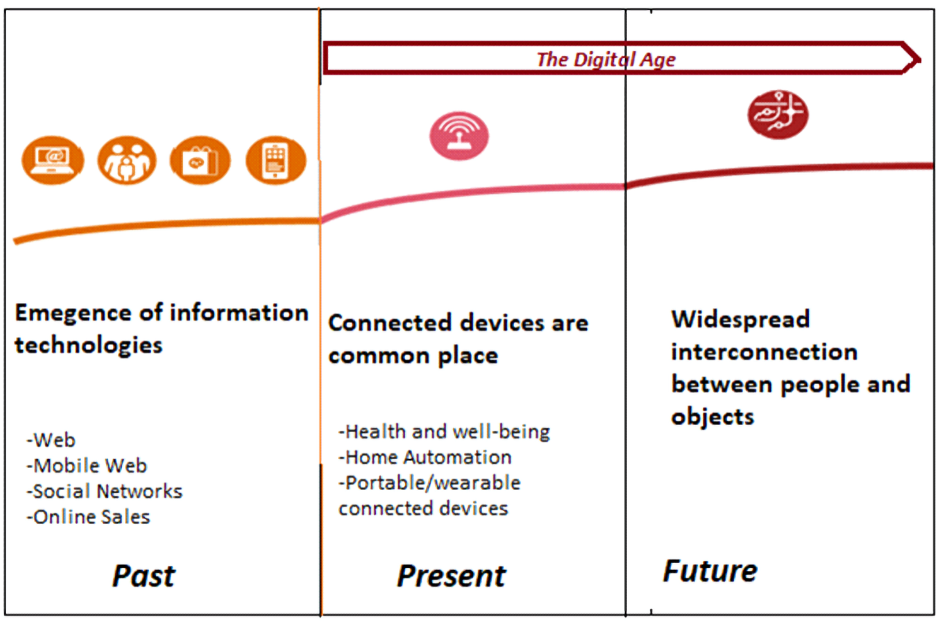


Figure 4: Industry 4.0 – Building the digital enterprise
Source: PwC Report

Digital technology is enabled by developments that allow these tools to operate, such as the Internet of Things, the cloud, and systems for storing data.

The pervasive use of information and communication technology (ICT) by the industrial sector and conventional production practices is rapidly redrawing the borders between the real world and the virtual world through what is defined as cyber-physical production systems (CPPSs).CPP's is a virtual network of social machines structured in a fashion close to that of social networks. To put it plainly, they connect I.T. to mechanical and electronic components that then interact through a network with each other. A very early version of this technology was the Radio Frequency Identification (RFID) technology that had been in since around 1999 (Deloitte AG, 2015).

Innovations give agricultural cooperatives the ability to introduce other unique activities, such as precision farming, in addition to opportunities for optimization (Griepentrog et al.,2016). The culture of cooperatives promotes the development of supply chains or the formation of societies through a broadly rich and diverse market ecosystem (members, staff, consumers, vendors, associates, etc.). Hence, this transition influences the cooperative value chain, optimizes some practices, and revolutionizes others.

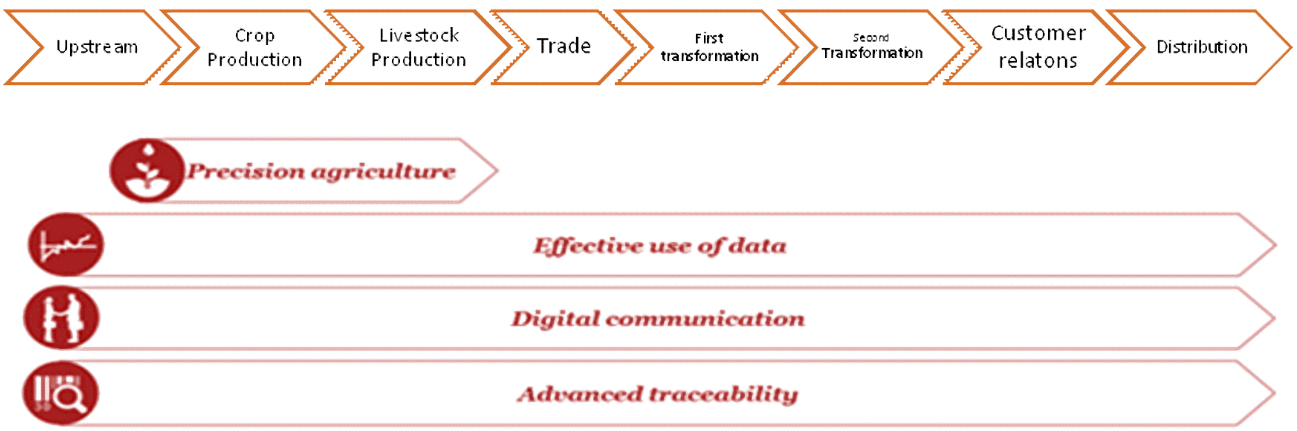


Figure 5: Use of Industry 4.0 in Precision Agriculture

Source: Gartner, IBM

Precision farming innovations (GPS, drones, sensors, and connected devices) are now very popular, and several cooperatives and their members have embraced them. Their acceptance, though, is largely in the form of a "catalogue of services", and the prospects of global convergence seem minimal for the time being. When innovations develop, cooperatives apply to the catalogue.

Cooperatives offer drone tracking and surveillance facilities for their members. To remotely assist and educate farmers on farm management, cooperatives use information from milking machines and automation systems.

There is access to both upstream and downstream technology, and various implementations are feasible. Connectivity remains a concern, and innovations are strongly pursued by the cooperatives. For instance, the LoRa (Low Range) Network might allow connected devices to share information at low data rates.

Cooperatives are the backbone of the economy so that the welfare of their families and groups is the way for the society to strengthen. Concerning the role of cooperatives for the interests of their members, the advantages of cooperatives have been reported in many types of research (Goel, 2019).The presence of cooperatives not only gives services to cooperative members but also to individuals who are not cooperative members. However, the presence of cooperatives is rare in the Industrial Revolution Age 4.0 that cannot be distinguished from the growing number of market rivals. There is no denying that the concept of cooperative cooperation, founded on the sense of independence and recognition of its members, does not appear in a changing environment of complex and competitive economic systems.

The failure of cooperative H.R. to change to technology innovations is another aspect that leads many cooperatives to halt operation. Poor management and H.R. factors are one of the reasons.Setyawati (2017) concluded that, since cooperatives do not have trained human resources, it is normal for cooperatives to become inactive.

Cooperative limitations are also observed in areas of financial management and information systems, along with H.R. aspects. There have been researches in this respect that explicitly explore ways to improve sustainability and build cooperative enterprises. The technique for sustaining and establishing cooperatives can be based on the collaboration between cooperatives and small businesses that have proved this interaction to offer benefits to both(Mazzarol, 2013). Loubere and Zhang (2015) clarify that attempts in China to retain cooperatives are performed by the role of the Government in developing new cooperative measures. The introduction of new models and management skills and H.R. was part of each of these findings.

7.1 Industry 4.0 in Agriculture Cooperatives

With many of the cooperatives examined, the advancement of digital technology was seen as a core concern amongst these five major developments influencing the modern age (demographics, emerging countries, urbanization, the environment, and technology) (Figure 6). Generally speaking, the agriculture sector is more linked than normal and has traditionally lead the way in the introduction of emerging technology such as GPS. To pursue new practices and facilities, the sector has initiated several digital transformation projects.

Figure 6: Developments influencing the modern world

The cooperatives demonstrated how difficult it is to truly understand the implications of new technologies when it extends through all operations and changes all operations. Although digital technology is seen as a possible advancement in some areas, such as precision agriculture, it is rather widely shown as a driving force for quality improvement and agricultural growth. They have been motivated by the vast market community of agricultural cooperatives (owners, clients, vendors, other cooperatives, etc.) to be among the first to support the digitalization of information transfers with their numerous members. Most of the cooperatives either have adopted or are proposing joint work projects. Digital technology is often used by cooperatives to optimize the methods of manufacturing, distribution network, management, and quality control, mostly by the efficient usage of information

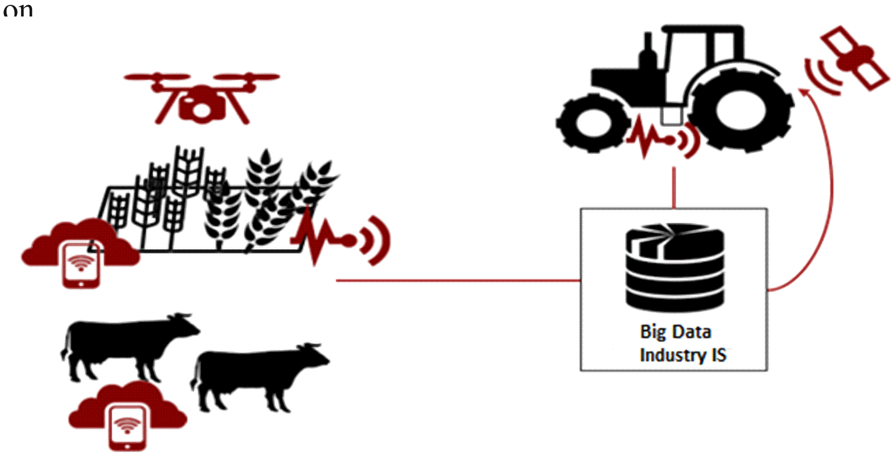


Figure 7: Concept of Precision Agriculture.
Source: PwC global report on the commercial application of drone technology

GPS and drones allow farmers to increase production and minimize their impact on climate change. Precision farming innovations (GPS, drones, sensors, and connected devices) are now very popular, and several cooperatives and their members have embraced them. Agricultural data helps farms to be scrutinized, while data analysis will help farmers keep one step ahead of them.

Digital technology is a core concern for farmers and cooperatives across all technology breakthroughs; they have already embraced. In adopting emerging technology such as GPS, which they have used on their tractors since the 1990s, farmers have led the way. Today, the number of farmers with tablets and smartphones has been growing since 2013.Technology transformation has quickly accelerated and puts the user at the core of the technology. Digital transition refers to how, with the advent of I.T. technology, culture has changed:

1960: the first machine.

1992: the creation of the Internet.

1994: the advent of internet purchases.

1995: development of social networks.

1999: the creation of the mobile Network.

Sensors offer valuable farm-related information to farmers, and integrated devices ease everyday tasks. These include land sensors to monitor markers of the soil (rainfall, humidity, etc.), Onboard sensors on tractors or drones for crop health tracking, plant identification, sensors on livestock for geolocation and surveillance. To ease everyday operations, farmers often use a range of connected devices like milking and feeding robots that allow tracking of livestock, linked devices that require the sowing of multiple hybrid seeds in the same row based on the soil conditions, and smart farming with automated solutions. In combination with external data, the efficient need for sensor-generated data ensures that farms can be tracked in real-time. Farmers will plan for a variety of circumstances and maximize performance by reviewing the information, allowing them to remain away ahead in making smart choices.

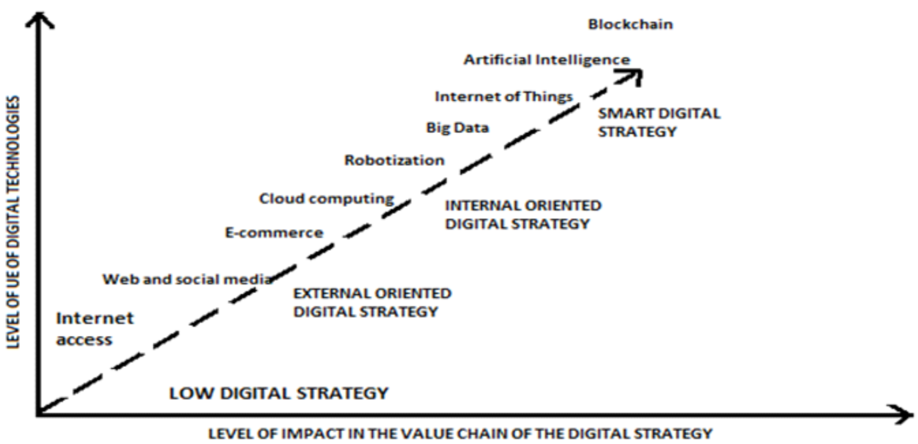


Figure 8: Digital transformation process in agri-cooperatives.

As shown in figure 8, an incremental digital transformation of the agri-cooperatives is usually followed. The y axis shows the digital extension of new technology adoption and its effect upon the supply chains of cooperatives (Production, distribution, packaging, advertising, and promotions in the field (x-axis).

7.2 Digitalization in IFFCO through Industry 4.0

Agriculture is being recognized as the key part of the 2019-2020 Union budget. To supply guaranteed income for small and marginal farmers, the Government of India has decided to spend extensively in the agriculture sector. It has made Niti Aayog a national research centre for the design and conduct of programs and research on future technology, including machine learning and artificial intelligence, to promote our country's economic growth (Srivastav et al., 2019).

Uzhavan app, Ag mobile, CCMobile app, IFFCO Kisan are a few of the built applications that take into account the need for hourly farming requirements. Several significant projects, such as e-choupal, the Agri sector, Kisan Suvidha, and the more recent e-NAM, have long attempted to position agriculture as the catalyst. There was a lack of coordination of accurate knowledge to the farmers as more focus was put on hardware than software. This has led to the formation of an agricultural information cloud with IoT and RFID (radio frequency identification) technology convergence. The farming industry has recently visualized the incorporation of IoT and agricultural activities in the production and conceptualization of innovation for plant factories. A lighting sensor and a video sensor, for instance, will display the light intensity distribution in real-time and track the size of the plant. This will aid in deciding the stages of growth and development of plants.

Global positioning systems (GPS) data and wireless sensor nodes (WSN) have also acted as important tracking resources to track and compare parameters. It has been found that geo-referencing approaches using unmanned aerial vehicles (UAV) and drones have a beneficial influence on crop production and pesticide monitoring. The information stored in such sensors and agriculture equipment and tools was regularly exchanged with farmers via a GPRS-connected cell phone. On-field sensors such as flipping on/off a pump/valve when the water level in the field exceeds a certain specified threshold can be tracked and managed remotely by farmers to making crucial decisions using deep learning techniques concerning crop management.

IFFCO Kisan, a joint venture between IFFCO, the fertilizer major, and Bharti Airtel, the telecoms giant, is all set to ramp up its national high-tech farm project. IFFCO Kisan would rely on a single range of roughly half a dozen crops as part of the scaling-up Plan.

IFCCO uses sophisticated technologies such as the Internet of Things (IoT), Artificial Intelligence (A.I.), and precision farming to set up high-tech farms, as reported by Morup Namgail, Head (Agtech), IFFCO Kisan. IFFCO currently has around ten big projects underway in various locations around the nation, affecting about 15,000 farmers. The organization is enthusiastic about the early outcomes of certain big ventures and has developed a crop-specific approach to extend the activities of high-tech farms. These ventures have been launched by IFFCO Kisan in cooperation with major product and agro-based entities.

Another big initiative is to manufacture pure organic Ashwagandha in Madhya Pradesh's Ratlam district in collaboration with The Himalaya Drug Company. As part of this mission, IFFCO Kisan agtech has encouraged the usage of IoT soil monitoring equipment, vegetation index satellite imagery analysis, and soil moisture stress reverse image mapping to automatically identify pests and diseases and to prepare for optimum irrigation.

According to the latest Nasscom survey, the agritech sector received close to $248 million in funding during June 2019, up from about $73 million in 2018. This represents a 300 per cent increase in less than a year. The industry seems to have been expanding rapidly, but the business still has a good time to go before it reaches the last mile farmers.

Figure 9: An IoT FARM MEETING by IFFCO-Kisan

7.3 Automated Milk System in Amul

Most of the praise for the increase in milk demand belongs to the start of Operation Flood, the world's largest dairy growth initiative, in the 1970s, termed as the 'white revolution', the first of its kind. Presently, India has $1.2 trillion in the dairy sector, which has emerged as a huge market compared to the European Union and the

United States. Over the recent years, it is rising gradually, and India contributes more than 18 per cent of the overall supply of milk across the globe.

Unlike the West, India's dairy farmers remain poorly organized, resulting in uneven milk content and composition. To optimize their processes, they lack precise, meaningful information. Milk producers, who own only two cattle maximum, have failed to increase their Productivity in the world's largest dairy market. According to IFCN Dairy Research Network., the yield is upto 1,249 kg per cow annually, as in the U.S., where the size of the farm on average is almost eight times more per cow (Bazmi, 2018).

Startups are moving ahead. To increase the dairy yield, the startups are transforming the poorly organized dairy market through techniques of automation, which uses advanced analytical tools and the Internet of Things (IoT). In the dairy market, IoT innovations span the whole value chain, from milk processing to transactions. Farm workers can monitor the health and yield of a cow through a wearable sensor and calculate essential elements such as milk volume and production, somewhat similar to a Fitbit for cows. Farmers can gain direct feedback using this information, which they will then correlate with their counterparts to enhance efficiency and raise sales.

This innovation also serves the consumers of farmers. Milk consumers, such as major dairy cooperatives, are capable of controlling the environments within which they store, transmit and sell milk. This enables them to have precise details on the quality and consistency of milk, each farmer's record of production, and fees owing to them, leading to better resource management.

Huge milk firms, too, are driven largely by automation. The nation's biggest dairy union, Amul, headquartered in Gujarat, has embraced digital technology to minimize milk wastes and help its significant expansion. 'By 2014, the Federation's modern automation and control technologies had enabled the consistent handling of million litres of milk.

Amul's turnover in FY20 grew 17% to reach Rs. 38,550cr, as shown in figure 10.

The AmulDMS (Distributor Management Software) has been introduced at 3,300 distributor points. More than 3,700 salesmen of such dealers use cellphones for booking purchases by Sales Force Automation (SFA). For 350 wholesale dealers, the Federation has also launched a mobile-based DMS solution to capture secondary sales data from remote areas and small wholesalers.

The Amul union has made significant progress in implementing the Amul Automatic Milk Collection System (AMCS) system at Village Dairy Cooperative Societies (VDCS). Until now, the initiative has reached a maximum of 13 village communities. The application has assisted in the convergence of the I.T. Supply Chain from Cow to Customer (C2C). Over 15 lakhs (1.5 million) messages are sent every day.

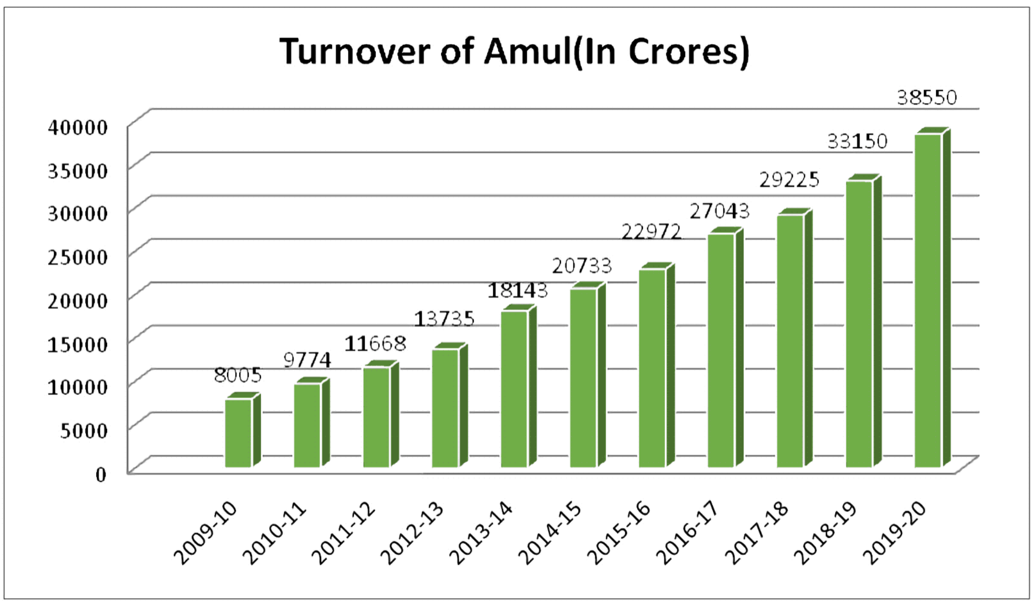


Figure 10: Growth of Amul

Source: Amul Official Website

The increasing production of Amul products made it convenient for the four million milk producers of the cooperative to boost their production and satisfy the needs for milk products. In such a market, collaborations between startups and existing firms are necessary to drive technology. Empowering accurate statistics and quicker pathways to income for India's dairy producers would also enable India to retain its status as the largest dairy industry in the world.

Farms are gradually being computerized. Producers are assisted in the management of their automatic milking systems, which produce data continuously. It is also possible to control farms remotely, to track changes in milk temperature, livestock health, the quantity of feed consumed, output volumes, milk flows, etc. Farmers can now handle certain facets of farming using smartphones.

8. Conclusion & the Way Forward

In several ways, the innovation movement built on intelligent technology is changing cooperatives and fostering development. From the standpoint of achieving growth, technological advancements will aid in increasing efficiency in operations and opening exciting opportunities for consistent engagement of customers. Owing to the shortage of funding and other business problems, technology implementation is often a challenging job for cooperatives. Cooperatives' sustainable business efficiency is negatively impacted by many technological problems. The implementation of Industry 4.0 will, however, solve different problems with technology.

Aspects of Industry 4.0, such as big data, the Internet of Things, and the smart factory, play a positive role in encouraging the adoption of information technology (I.T.), which leads to sustainable business efficiency. Diversifying the practice, innovating and collaborating with others, and using emerging technology are all essential to perform more effectively and sustainably.

Industry 4.0 in cooperatives cannot succeed on a stand-alone basis and need to be supplemented by members' active participation. In the progress of adopting and handling digital tools, the members of cooperatives must feature certain competencies such as technical knowledge and skills, desire to contribute and/or accept, and capability of collaborating effectively. Thus, features of Industry 4.0 can improve the quality, quantity, and access to services of cooperatives and their members at large. It goes without saying that if the cooperatives have a ubiquitous platform, every member shall be able to avail benefits accrued out of such activities.

While demand for technology has increased, the majority of cooperatives face challenges in adopting and successfully using it. Cooperatives, on the other hand, see technological change as a challenge. They are attempting to set simple goals and following a flexible strategy, progressing step by step, to effectively go digital. Cooperatives must satisfy the demands of different stakeholders in their market community, and the stakeholders are encouraging them to go digital:

- Members expect that their relationships with cooperatives be monitored in almost real-time using emerging technology, as well as to have meaningful insights into new tools. They want advice and assistance in incorporating technologies like precision agriculture.
- Members are criticizing the new paradigm internally. They need more user-friendly yet adaptable techniques, mostly to promote enterprise growth.
- Consumers and third-party providers are moving to keep pace through greater automation of workflows.
- Certain cooperatives are part of a distribution network, where operations are aided by the use of digital technologies that enable easier communication.

To respond to and help cooperatives' transformational change, I.T. structure must progress as:

- Conversion of I.T. models into data aggregation platforms for all data sources (resources, processes, mobile devices, etc.) – usage of information systems.
- Execution of Big Data platforms as required satisfying the needs of high information flow and real-time computing.

- Existing operations (advisory systems, distribution networks, etc.) where emerging media provides new tools and approaches.
- Innovative offerings (data usage, for example) at the possibility of the outsider exploring the majority of the value chain.

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(A Grant-in-aid Institution under Ministry of Cooperation, Government of India)

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