**Educational Administration: Theory and Practice**
2024, 30(06), 5308-5318
ISSN: 2148-2403
https://kuey.net/

**Research Article**

# Technological Conversion in Cooperatives: Conquering Barriers and Increasing Opportunities

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**Citation:** Priyanka Srivastava, et.al (2024). Technological Conversion in Cooperatives: Conquering Barriers and Increasing Opportunities, *Educational Administration: Theory and Practice*, 30(6) 5308-5318
Doi: 10.53555/kuey.v30i6.10662

**ARTICLE INFO**

**ABSTRACT**

The advent of the next industrial revolution, characterized by advanced technologies such as Automation, artificial intelligence, the Internet of Things (IoT), and sustainable practices, Presents both challenges and opportunities for cooperatives. This research explores how Cooperatives can effectively leverage these emerging technologies to enhance operational
Efficiency, member engagement, and sustainability while preserving their core values of. The Study examines various sectors—including agricultural, financial, and energy cooperatives using the data base of Scopus, Google Scholar, PubMed, and Dimension AI. The inclusion and exclusion criterion has been defined in the paper. This study links key hindrances to technology adoption and proposes strategies to overcome them. It also investigates the role of digital platforms in fostering member participation and decision making and assesses the impact of sustainable practices enabled by new technologies. This research aids to a deeper understanding of the junction between cooperative principles and technological advancement, offering a roadmap for cooperatives to navigate the future industrial landscape effectively.

**Keywords**: Cooperatives, Automation, Artificial Intelligence, Internet of Things (IoT), Sustainability practices.

## Introduction

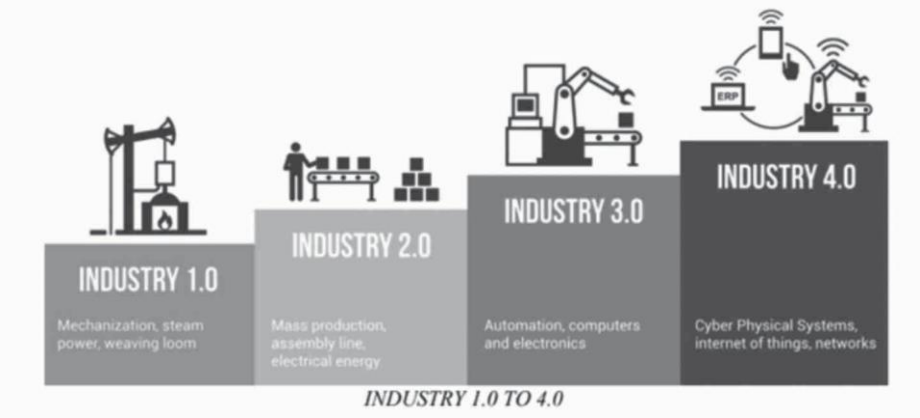
The news industry has come a long way since its early days at the start of the industrial revolution in the 18th century. For centuries, the majority of the items, such as clothing, weapons, gear, food, and shelter, have been made by hand or by using animals. When industrial methods were adopted at the end of the 18th century, this got better. The development of Industry 1.0 was a tremendously rapid challenge that paved the way for the upcoming modern age, or the fourth industrial revolution. The fourth industrial revolution, or "industry4.0," refers to the management of the entire value chain and the subsequent stage of a manufacturing technology's life cycle in an enterprise.
Digitalisation is an important aspect for cooperatives as it helps them navigate a changing landscape and retain clients.
Digital technologies can help cooperatives including:-

a) online Selling of goods and services
b) Managing relationship
c) Improving member participation and communication with stakeholders
d) Handling large member administration
e) Improving accountability and transparency

Digitalisation can have a positive effect on variety of sectors .They help to attain a significant role in market share and rural development
In this era of change, Cooperatives can play an important role in ensuring labor inclusion and democratic ways of running businesses. Cooperatives are not only faced with the opportunities and challenges posed by the digitization of processes for managing work routines or those related to selling services and/or products to their customers. They are also concerned with how digital Tools can support (or hinder) the connections

between people and the democratic participation within organizations considering the limitations and risks of using said tools in terms of security, privacy, and the digital divide

**History of Cooperatives- Figure 1**




*INDUSTRY 1.0 TO 4.0*

**Industry 1.0**
The past due 18th century opened the industry of mechanical production flora. Machines powered with the aid of water and steam had been built to help workers in the mass processing of merchandise (Chaitanya, 2020)
**Industry 2.0**
Electricity has become the dominant source of energy with the aid of the centre of the Twentieth century. It turned into simpler to make use of than water and steam, and it allowed Companies to awareness electricity sources on particular devices. Machines have been eventually Evolved with their personal electricity resources, making them greater transportable.

**Industry 3.0**
In the previous few many years of the twentieth century, the invention and manufacture of Digital gadgets, such as the transistor and, later, included circuit chips, made it feasible to extra absolutely automate individual machines to supplement replace operators.
**Industry 4.0**
In the Nineties, the Internet and telecommunications industry boomed, which transformed the manner we interacted and shared data. This also resulted in technological breakthroughs within the automobile region and conventional development practices that mixed the actual and digital world obstacle.

**Objectives**-The paper reviews how cooperatives can effectively
1) Use emerging technologies to enhance efficiency and add value driven activity
2) Role of Digitalisation in cooperatives
3) Explore development of technology in various sectors
4) To measure key hindrances to technology adoption strategies to overcome them and increase new opportunities

## Review of Literature

**Industry 4.0** -This part of 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 sector.
Chaitanya Vijay Bidnur (2020) in his paper "A Study on Industry 4.0
Concept" explored the origin as well as evolution of the Industry 4.0 model. 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 current study in the field. The paper introduces the smart factory concept for automated services, thus increasing the efficiency of operations.
Haseeb et al., (2019) in their research paper concluded that the aim of Industry 4.0 is not only to reach a better degree of organisational e fficiency and competitiveness, but also greater automation. This study has attempted to address the various issues and challenges pertaining technology advancement in the area of Industry 4.0. Based on the findings the paper reveal that, industry 4.0 aspects such as big data, the Internet of Things, and the smart factory play a constructive role in supporting IT adoption, which leads to longterm market success.

Aulbur and Singh (2014) in their research paper discussed about the reasons by which India is reportedly lagging behind its global counterparts where Industry 4.0 implementation is considered in manufacturing industries. 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.

### Technology and Cooperatives

The literature in this section describes the various aspects of cooperatives , 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 (IT), which leads to sustainable business e fficiency.

Vaidya, Ambad, Bhosle (2018) explored the nine pillars including Big data and analytics, Industrial of Things, cloud computing, arti ficial Intelligence, autonomous robots etc. These pillars will change independent and improved operations to a highly integrated, automatic, and optimised method. As a result, conventional manufacturing relationships among suppliers, users, and consumers, as well as between human and computer, become more productive and improve. The nine pillars will help to identify the issues and challenges faced in the implementation cooperatives.

Lee et al. (2014) in his paper 'Service innovation and smart analytics for cooperatives and big data environment' described that in order to boost operating performance and maintenance control, conventional equipment is being turned into self-aware and self- learning devices with the communication around them. The paper examines how big data had changed the services of manufacturing industry.

Bahrin et al.(2016) in their research paper reviewed new inventions in the field of automation technologies. They emphasized that with the introduction of Information and communication Technologies (ICT), the industries have got opportunities to compete in international markets. On the lines of such developments, the automation industries are playing a vital role in introduction of technologies pertaining to cooperatives.

### Industry 4.0 and Cooperatives and Technology

This part of literature describes the implementation of Industry 4.0 in cooperatives. It discusses how cooperatives' sustainable business efficiency is negatively impacted by many technological problems. The implementation of Industry 4.0 will, however, solve different problems with technology.

Setianingsiha et al. (2020) in his paper emphasized how crucial 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. While cooperatives today have experienced setbacks in their progress, in order to strive, it seems important for them to survive and put tremendous efforts.

Griepentrog et al. (2016) in his paper carried out a study on precision farming. In their study they stated that new innovations give agricultural cooperatives the ability to introduce other unique activities, such as precision farming, in addition to opportunities for optimisation. 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 HR to change to technology innovations is another aspect that leads many cooperatives to halt operation. Poor management and HR factors are one of the reasons.

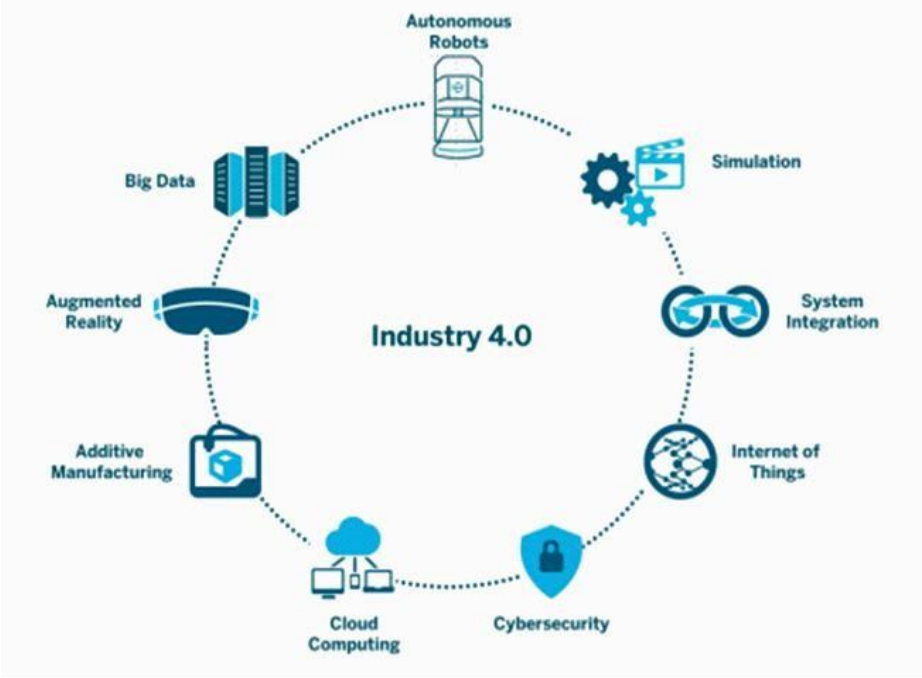
## Research Methodology

The author has carried out an extensive literature review of published research studies, case studies, govt. reports, proceedings of workshop, seminars, etc to analyse the collective action efforts undertaken by Cooperatives in India and in various sectors with regard to Industry 4.0 and cooperatives.. Given the research objectives formulated, the methodology of this paper is based on secondary data.

### Why Industry 4.0and Cooperatives?

4.0 is transforming conventional equipment into self-aware and self-learning gadgets with communication surrounding them to improve operating performance and maintenance control (Lee et al., 2014). Industry 4.0 intends to build a transparent, smart manufacturing infrastructure that will allow for the adoption of industrial knowledge networks (Bahrin et al., 2016). Industry 4.0's primary criteria are real-time data management, inventory status and location recording, and maintaining guidelines for managing production operations. (2015) (F.Almada-Lobo).

**Industry 4.0 technology features and contributions towards digitalization Figure2**




## Big data and Analytics

Big Data analytics is a process used to extract meaningful insights, such as hidden patterns, unknown correlations, market trends, and customer preferences. Big Data analytics provides various advantages—it can be used for better decision making, preventing fraudulent activities, among other things. Big Data analytics is fuelling everything we do online—in every industry.

## Robots

Robotics and drones are two related fields that have seen significant growth and development in recent years. Robotics is the study of robots, which are machines that can be programmed to perform a variety of tasks. Drones, also known as unmanned aerial vehicles (UAVs), are a type of robot that can be controlled remotely and used for a variety of purposes, such as aerial photography, surveying, and delivery. Due to their advantages and capacity to adapt to varied jobs in industrial domains such as maintenance, inspection, and transportation, drones and robotics are having a significant impact on Industry 4.0

As a result,firmshave started to make investments in the functions of drones and robotics that can be connected into (IoT) to best Industry 4.0.

Robots and drones are both a hundred and eighty mechatronic structures able to autonomously finishing tasks.

The primary distinction between the 2 is that the time period "robots" is extra normal and encompasses each stationary and cell robots. Drones, however, can pass approximately.

Another difference is that robots have more autonomy and depend less on human enter. Finally, the usage of Robotics 4.0 and drones within the fourthtechnology region will allow for the advanced implementation of complicated jobs. Another vital function is the potential of Robotics /drones to have interaction cooperatively. The advantages of Robotics drones, consist of advanced mission conditions, increased productiveness, safety, and revolutionary answers to complex techniques.

## IOT

Industry 4.0 integrates the Internet of Things (IoT) with industrial strategies within the twenty first century to permit gadgets to exchange, interpret and use know-how to direct human intelligence. The Internet of Things (IoT) is a brand new idea this is getting momentum within the emerging Wi-Fi communication scenario.

The significant precept of this theory is the ubiquitous life of a number of gadgets or artifacts around us, which include Radio-Frequency identification (RFID) tags, sensors, actuators, smart phones, etc.

## The Cloud

The cloud-primarily based IT interface acts as the technological pillar for linking and communicating the various additives of the Industry 4.0. (Technology Centre (M. Landherr, 2016). Organizations require improved statistics sharing for business 4.0 Attainment of response instances in milliseconds or a good deal faster across structures and groups (Rüßmann et al., 2015).


**Figure3**

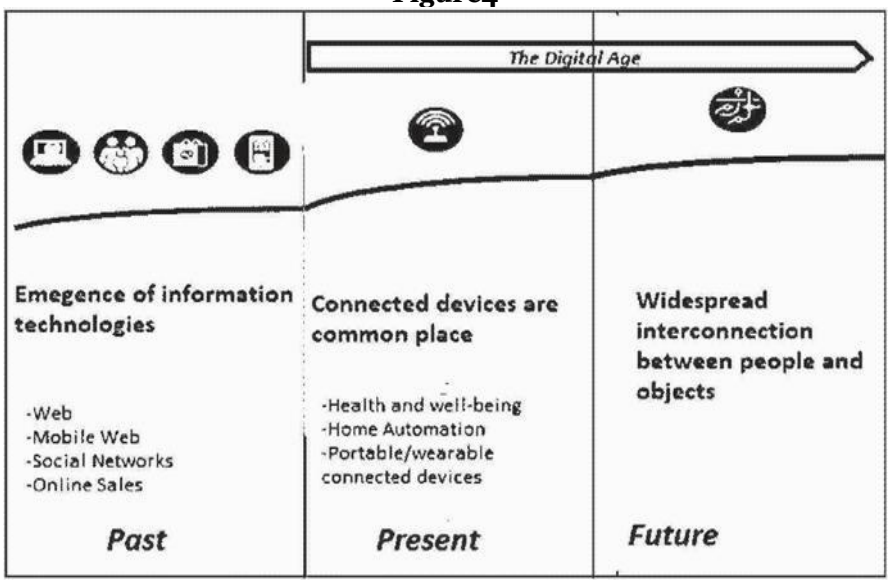
**Application of Technology in Cooperatives**

Cooperatives, as economic institutions founded on the ideals of the society, actually have a significant need to beautify human welfare. But cooperatives are getting less common. The number of functioning Indian cooperatives has reduced for a selection of motives, both internally and externally. Parallel to this, movement need to be taken to analyse cooperatives that, till recently, had been still deeply worried in society, a good way to recognize trends and techniques assisting the cooperatives to growth their operations. Cooperatives come upon on this fourth commercial revolution age is to find a way to grow to be a critical player in growing the financial boom The technological changes within the growing markets have placed a strain on the cooperatives to react to the quick shifting changed surroundings. While cooperatives these days have experienced setbacks of their setbacks of their development, with a view to attempt, it seems crucial for cooperatives to catch up with development, it seems crucial for cooperatives to catch up with the significant efforts placed about by way of the technological revolution.

We have reached a contemporary virtual phase in 2008, with transition developing due to Improvements in digital technologies and immediately in influencing society. As a end result, new clever gadgets are becoming popular and in the future, customers will be gradually connected, among each other and with their devices, with the automation of the connectivity between human beings and objects.

Digital technology is enabled through developments that allow these equipment to function, which include the Internet of Things, the cloud, and systems for storing facts.

**Figure4**




## Cooperative Perspective

The extensive use of information and communication technology [ICT] by the industrial sectors traditional practices related in the field of production is rapidly redrawing the borders real world and virtual world theory [ CPPSs]

They are a virtual network of social machines structured in fashion close to that of social networks. They are connected to IT to Mechanical and Electrical components and then interact through a network with each other . RFID technology had been an early version of this technology. Innovation in the field of agriculture and agricultural cooperatives have the ability to introduce unique activities in farming.

This had led to the development of:-

-Supply chain

-Selecting up of new societies

-Diversified marketing system

-Development of cooperatives value chain

-Precision farming innovations are popular and several cooperatives have embraced them

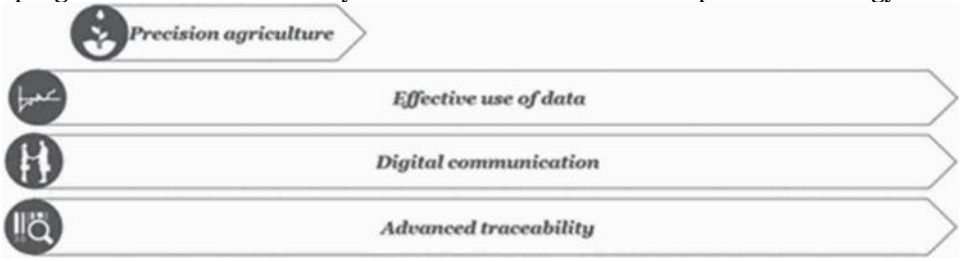
They offer drone tracking and surveillance facilities for their members

**Role of technology in agricultural cooperatives**:-

In order to pursue new practices and facilities several digitalisation projects have come into existence. Digital technology is seen as a possible advancement in some areas of farming for quality improvement and agricultural growth. Emerging technologies of GPS has also been introduced. In order to pursue new practices various digital transformation practices are being initiated.

Role of technology helps in optimising methods of manufacturing, distribution network, management and quality control by efficient usage of information. GPS's drones are used extensively in this field.

An example of IFFCO digitalisation in cooperatives through technology machine learning and artificial intelligence promotes country's economic growth. Various projects such as E-Chou pal, Agri Sector, Kisan Suvidha are in progress. Automated Milk System in Amul is also an example of technology in cooperatives.




**Use of Technology in Precision Agriculture Figure5**

**An IOT FARM MEETING by IFFCO-Kisan Figure6**

**Role of technology in the finance industry**

Technology has completely transformed functioning of finance functions work, making it an essential part of the finance industry. It has revolutionised every element of finance, encompassing continuous accounting, automated systems, advanced analytics, data quality, and even how transactions are carried out. Technology is crucial in supporting profitability too. In our Annual Trends Survey Report, 94% of respondents highlighted it as 'important' or 'very important'. More than half (54%) recognised that technology helps them with faster task completion, allowing employees to get more done during the working day.

The use of era to transform and improve financial processes is known as economic era (or 'Fintech'). It consists of a huge range of digital merchandise and platforms that make use of current technologies like blockchain, massive records analytics, and synthetic intelligence. These innovations are constantly enabling finance teams to be increasingly greener. Developments such as net banking, mobile bills, peer-to-peer lending, roboadvisory offerings, and cryptocurrencies, among others, have drastically modified the finance sector.

The targets of those pioneering inventions are frequently to decorate patron stories, streamline processes, and sell monetary inclusion. Fintech company's task installed economic institutions by turning in contemporary services that meet the converting desires of customers.

Fintech has enabled underprivileged groups and rising countries to interact inside the worldwide economic ecosystem through democratising get entry to to financial services. As a end result, conventional banking and price structures have been upended, and it has revolutionised how individuals manage their price range.

**Role of technology in Energy Cooperatives**-

Technology plays a key function inside the energy sector in lots of approaches, which includes:

Energy efficiency: Technology can assist lessen energy call for and improve electricity reliability.

Renewable energy: Technology is helping to enhance renewable energy assets like wind, solar, and hydropower.

Energy control: Technology can help optimize electricity production and control of strength and natural sources.

Environmental effect: Technology can help reduce the environmental effect of strength use.

Safety: Technology can assist enhance protection in the energy zone, such as by way of supplying engineers with brief get right of entry to to technical statistics.

Automation: Technology can assist automate time-consuming tasks, permitting people to cognizance on more complicated jobs.

Industrial metaverse: Technology can assist simulate wind farms before development, allowing people to model specific situations.

## Role of Technology in Enhancing Operations and Efficiency of Cooperatives

Technology plays a pivotal function in transforming the operations and performance of cooperatives. The particular technological advancements, their packages within cooperative systems are highlighted as-

1. Digital Communication Platforms Applications:

Use of gear like Slack, Microsoft Teams, and Zoom for internal communication.

- Implementation of intranet structures for sharing facts and updates.

Benefits:

Improved Communication: Facilitates actual-time communication amongst contributors, irrespective of geographical region.

Increased Member Engagement: Members can participate in discussions, meetings, and decision-making techniques more without difficulty.

Enterprise Resource Planning (ERP) Systems Applications:

- Integration of ERP structures like SAP, Oracle, and Microsoft Dynamics to control various commercial enterprise processes.
- Modules for finance, human resources, supply chain, and consumer relationship control.

Benefits:

Streamlined Processes: Centralizes statistics and automates recurring duties, lowering manual mistakes and improving performance.

- Better Resource Management: Provides real-time insights into useful resource allocation and utilization.

Block chain Technology

- Applications
- Use of block chain for obvious and at ease report-maintaining.
- Smart contracts for automating agreements and transactions.

-Benefits

Enhanced Transparency: Ensures all transactions are recorded and verifiable, fostering agree with amongst contributors.

Security: Protects facts from tampering and unauthorized get right of entry to.

Artificial Intelligence (AI) and Machine Learning (ML) - Applications:

- AI-driven analytics for predicting marketplace trends and member needs.
- Chat bots for member help and engagement.

-Benefits:

- Data-Driven Decision Making: Provides insights based totally on information analysis, helping cooperatives make knowledgeable selections.
- Personalized Member Experience: can tailor services and communications to character member possibilities.

Mobile Applications

- Applications
- Development of cellular apps for member services, together with bills, vote casting, and accessing cooperative sources.

-Benefits:

-Accessibility: Members can get admission to services and records on-themove, growing comfort and participation.

- Engagement: Mobile apps can include capabilities like notifications and updates, maintaining participants informed and engaged.

Cloud Computing

- Applications:
- Adoption of cloud-based totally answers for information garage, collaboration, and software as a provider (SaaS).
- Benefits:

Scalability: Easily scale assets up or down based on call for.

- Cost Efficiency: Reduces the want for bodily infrastructure and upkeep.

Internet of Things (IoT) - Applications:

- Use of IoT gadgets for tracking and handling assets, such as energy usage, stock stages, and gadget renovation.
- Benefits:
- Operational Efficiency: Real-time tracking and records series enhance useful resource control and decrease downtime.
- Predictive Maintenance: IoT gadgets can predict when renovation is wanted, preventing costly breakdowns.

Technological conversions in cooperatives can offer numerous benefits, inclusive of progressed performance, better verbal exchange, and more advantageous information control.

## Barriers and Limitations

1. Financial Constraints

- Initial Investment: The cost of obtaining new generation can be prohibitive for lots cooperatives, especially smaller ones with limited budgets.
- Ongoing Costs: Maintenance, improvements, and training can upload to the economic burden.

2. Lack of Technical Expertise

- Skill Gaps: Many cooperatives might also lack the necessary technical talents amongst their contributors or team of workers to put in force and keep new technology.

Training Needs: Continuous schooling is needed to maintain up with technological advancements, which may be time-ingesting and luxurious.

-Resistance to Change:

- Cultural Barriers: Members and workforce can be proof against changing hooked up practices and adopting new technology.
- Fear of Job Loss: There can be issues approximately era changing human jobs, main to resistance from personnel.

4. Infrastructure Limitations:

- Connectivity Issues: In rural or far off regions, loss of dependable net and different infrastructure may be a considerable barrier.
- Hardware Limitations: Existing hardware might not be well matched with new technologies, requiring extra investment.

Data Security and Privacy Concerns:

- Cyber security Risks: New technology can introduce vulnerabilities that need to be controlled to defend sensitive data.
- Compliance: Ensuring compliance with statistics safety policies may be complicated and useful resource-in depth.

6. Governance and Decision-Making:

- Consensus Building: Cooperatives regularly function on a consensus primarily based selection-making model that can slow down the adoption of recent technology.
- Leadership: Effective management is vital for riding technological change, and a lack of it can be a good sized barrier.

7. Interoperability Issues:

Compatibility: New technology need to be well matched with current systems and strategies, which may be difficult.

- Standardization: Lack of standardization can lead to fragmented structures which are difficult to combine.

8. Regulatory and Policy Barriers:

- Compliance: Navigating the regulatory landscape can be difficult, particularly while adopting new technologies that might not be completely understood by way of regulators.
- Supportive Policies: Lack of supportive government guidelines and incentives can avoid technological adoption.

Addressing the Barriers

1. Financial Support:
- Seek offers, subsidies, and occasional-interest loans particularly designed for technological enhancements in cooperatives.
- Explore partnerships and collaborations to percentage charges and sources.

2. Skill Development:
- Invest in education applications to construct technical know-how amongst members and team of workers.
- Leverage on-line publications and workshops to offer non-stop mastering possibilities.

Change Management:
- Implement trade management techniques to cope with resistance and build a lifestyle of innovation.
Communicate the advantages of technological conversions definitely to all stakeholders.

Infrastructure Improvement:
- Advocate for higher connectivity and infrastructure help from neighborhood and country wide governments.
- Invest in scalable and adaptable hardware answers.

Enhanced Security Measures:
- Implement robust cybersecurity protocols and frequently update them.
- Ensure compliance with information protection guidelines thru normal audits and assessments.

6. Effective Governance:
- Foster sturdy management to drive technological tasks.
- Streamline choice-making techniques to facilitate faster adoption of new technology.

7. Interoperability Solutions:
- Choose technologies that provide compatibility and integration with current systems.
- Advocate for enterprise standards to ensure seamless interoperability.

Policy Advocacy:
- Engage with policymakers to create a supportive regulatory surroundings.
- Participate in enterprise agencies and cooperatives to advice for favorable regulations.

By addressing these barriers and limitations, cooperatives can successfully navigate the challenges of technological conversions and reap the benefits of modern technology.

## Conclusion & the Way Ahead

The innovation movement constructed on smart technology is changing cooperatives and fostering development. From the standpoint of accomplishing growth, technological improvements will resource in growing efficiency in operations and opening exciting possibilities for constant engagement of clients. Owing to the dearth of funding and other business troubles, technology implementation is mostly a challenging job for cooperatives. Cooperatives' sustainable commercial enterprise efficiency is negatively impacted through many technological issues. The implementation of Industry 4.0 will, but, resolve different issues with generation.

Aspects of Industry 4.0 along with big facts, the Internet of Things, and the smart factory, play a wonderful function in encouraging the adoption of statistics technology (IT), which leads to sustainable enterprise efficiency. Diversifying the practise, innovating and participating with others and the usage of rising generation are all important to carry out greater effectively and sustainably.

Industry 4.0 in cooperatives cannot be triumphant on a stand-on one’s own basis and need to be supplemented by using members' energetic participation. In the development of adopting and handling of digital gear, the contributors of cooperatives need to function with certain competencies such as technical knowledge and capabilities, choice to make a contribution and/or be given and functionality of taking part effectively. Thus, capabilities of Industry 4.0 can improve the first-class, amount and get right of entry to services of cooperatives and its contributors at huge. It is going without pronouncing that if the cooperatives have a ubiquitous platform, every member will be able to avail benefits accumulated out of such activities.

While call for generation has extended, majority of cooperatives face challenges in adopting and successfully the use of it. Cooperatives, alternatively, see technological change as a venture. They are trying to set easy

dreams and following a flexible method, progressing grade by grade, in order to effectively cross virtual. Cooperatives have to fulfil the demands of different stakeholders in their marketplace network, and the stakeholders are encouraging them to head digital:

Members anticipate that their relationships with cooperatives be monitored in almost real-time the usage of emerging technology, as well as to have meaningful insights to new gear. They need advice and assistance in incorporating technology like precision agriculture.

Members are criticising the new paradigm internally. They want more consumer-friendly yet adaptable techniques, by and large to promote enterprise increase.

Consumers and 0.33-party companies are transferring so that you can hold pace through a more automation of workflows.

Certain cooperatives are a part of distribution network, where operations are aided by way of the use of virtual technology that enable for simpler communication.

To reply to and help cooperatives' transformational change, IT structure should develop as-

- Conversion of IT fashions into facts aggregation structures for all data resources (sources, procedures, mobile gadgets, etc.) – usage of records structures.
- Execution of Big Data systems as required enjoyable the needs of excessive records flow and actual-time computing.
- Existing operations (advisory systems, distribution networks, and so forth.) where rising media presents new gear and processes.
- Innovative offerings (facts usage, as an example), at the opportunity of the outsider exploring majority of the fee chain.

The integration of these technological advancements within cooperative structures leads to numerous benefits, including improved communication, streamlined processes, and increased member engagement. By leveraging technology, cooperatives can enhance their operational efficiency, foster greater transparency, and provide a more personalized and engaging experience for their members. This, in turn, helps cooperatives to remain competitive and sustainable in an increasingly digital world.

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