THE CO-OPERATIVE UNIVERSITY OF KENYA

Proceedings of The Eighth Co-operative University of Kenya (CUK) Annual Scientific Conference & The Third Co-operative Movement stakeholders' Conference,

"THE JOINT CO-OPERATIVE CONFERENCE 2025"

ON

Co-operatives Build a Better World: Re-energizing the Collective Power of Co-operatives in Africa

July 22nd-24th, 2025

Isaac K. Nyamongo - Editor

CO-OPERATIVE 5.0: LEVERAGING THE FIFTH INDUSTRIAL REVOLUTION FOR SUSTAINABLE CO-OPERATIVES

George Matto[1] and Ezekiel Mghweno[2]
[1]Department of ICT, Moshi Co-operative University, george.matto@mocu.ac.tz
[2]Department of Business Management, Moshi Co-operative University, ezekiel.mghweno@mocu.ac.tz

ABSTRACT: The Fifth Industrial Revolution, also known as industry 5.0 or 5IR, presents a fundamental opportunity to transform the global economic landscape by integrating human capabilities with cutting-edge technologies. Leveraging on its capabilities, the industry 5.0 has been employed in various sectors such as health, manufacturing, and libraries. While that is the case, little is known from the literature point of view on the extent to which industry 5.0 have been adopted in cooperatives, and the ways in which their adoption enhances sustainable cooperatives. Against this backdrop, the study was conducted to explore the impacts of cutting-edge technologies of the industry 5.0 on creating sustainable cooperatives. The study was qualitative in nature in which interviews with key informants and a systematic review of literature were conducted. Findings show that the cutting-edge technologies that make up industry 5.0 have generally not being adopted in cooperatives. Some of the reasons being insufficient financial resources, lack of awareness, fear and/or resistance to change, and lack of access to required infrastructure. The study, however, found that the adoption of cutting-edge technologies within cooperatives have got several potentials such as reduction in operational expenses, enhancing efficiency, and facilitating faster and more efficient information exchange for cooperatives. Further, the study found that the lack of adoption of cutting-edge technologies in the surveyed cooperatives signifies that they are yet to become co-operative 5.0. It is therefore recommended that cooperative leaders should change their mindset, undertake ongoing capacity building, and prioritize on investment in digital infrastructures.

Keywords: Cooperatives, Cooperative 5.0, Industry 5.0, ICT, Cutting-edge technologies.

INTRODUCTION

The evolution of industrial revolutions, which has currently gone through the first to the fifth, has significantly impacted societies, economies, and the nature of work. The first industrial revolution was characterized by mechanization of production by the construction of railways and discovery of steam engines (Schulze, 2019). Then the discovery of electrification which led to mass production and rapid transport of people, products, and ideas led to the second industrial revolution (Sife and Matto, 2022). The third industrial revolution was featured by the introduction of computers and the internet leading to automated production (Schwab, 2016; Pozdnyakova et al., 2019). The fourth industrial revolution constituted the integration of intelligent digital technologies into manufacturing and industrial processes. It includes a range of technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Big Data, robotics, and 3D printing (Sife and Matto, 2022; Pozdnyakova et al., 2019; Schwab, 2016).

The fifth industrial revolution, also known as 5IR or industry 5.0, is based on the technological principles established during the fourth industrial revolution (Breque et al., 2021). The industry 5.0, however, shifts its focus towards enhancing human capabilities and overall well-being. While the fourth industrial revolution focused on automation and data-driven decision-making, the fifth industrial revolution went beyond the purely automated and data-driven approach by integrating the unique capabilities of both humans and machines, thereby creating a harmonious relationship (Xu et al., 2021; Ekwueme et al., 2024). The collaboration between human creativity and cutting-edge technologies such as AI, robotics, and IoT are the essential components of the fifth industrial revolution. With the industry 5.0, new inventions such as collaborative robots (cobots) that work alongside humans to increase efficiency have been made (Liu et al., 2024). Leveraging on its capabilities, the industry 5.0 have been employed in various sectors such as health, manufacturing, and libraries. A study by Basulo-Ribeiro and Teixeira (2024) indicated that Industry 5.0 have been employed in the healthcare sector to improve patient care and treatment through the implementation of connected medical devices and telemedicine, which also facilitate remote monitoring and diagnosis. This advancement enhances the efficiency and effectiveness of the healthcare system by automating administrative tasks and allowing for real-time data analysis to support informed decision-making. In the manufacturing sector, Grewal et al. (2021) highlight that Industry 5.0 tackles issues related to the supremacy of robots, which were expected to dominate the manufacturing landscape. With innovations such as cobots in industry 5.0, robots collaborate with humans to enhance efficiency and productivity in the workplace. In libraries, the advent of industry 5.0 introduces the integration of cutting-edge technologies that profoundly digitally transform libraries and revolutionize their functions (Lahkar, 2024). For instance, libraries leverage technologies like IoT and sensors to create "smart bookshelves" that facilitate real-time inventory management to safeguard physical collections (Lu and An, 2025) and employ blockchain technology to ensure the integrity and authentication of digital archives (Tella et al., 2022). Cooperatives, as defined by Ugwuanyi (2017), are autonomous associations of individuals who voluntarily come together to fulfil their shared economic, social, and cultural needs and aspirations through a jointly-owned and democratically-managed enterprise. Although there are different types of cooperatives, Agricultural Marketing Co-operative Societies (AMCOS) and Savings and Credits Co-operative Societies (SACCOS) dominates in Tanzania. Their prominence is reflected in both their large numbers and extensive memberships. For instance, data from the Tanzania Cooperative Development Commission (TCDC) shows that as of June 2023, out of a total of 7,349 cooperatives in Tanzania, 4,279 were AMCOS and 2,042 were SACCOS. The remaining 1,028 cooperatives comprised of all other types of cooperatives (TCDC, 2023). A study by Minzar and Mishra (2024) noted that the rapid advancement of technologies holds the potential to improve cooperatives' operational efficiency, enhance member services, and facilitate better decision-making. Additionally, the study noted that digital technologies begun to be embraced in the cooperative sector to gain competitive advantage. These cutting-

edge technologies once integrated with human-centric values, constitutes the industry 5.0 (Xu et al., 2021). Therefore, basing on a study by Minzar and Mishra (2024), industry 5.0 has the potential to deliver significant benefits to cooperatives. However, there remains a significant gap in the existing literature regarding the extent to which industry 5.0 have been implemented in cooperatives. This is in line with Ntunga (2021) who argued that the co-operatives digitalization situation is not well established in Tanzania as in many other African countries. Understanding the nexus between industry 5.0 and its adoption in cooperatives is crucial for not only informing strategic decisions but also ensuring that integration of such technologies aligns with cooperative values, principles and their founding goals. In light of this, the study was carried out to investigate the impacts of industry 5.0 on cooperatives sustainability.

The concept of "Co-operative 5.0": Co-operative 5.0 is a concept derived from industry 5.0. This concept emphasizes the importance of integrating cutting-edge technologies with human-focused values to foster sustainable cooperatives. As a result, the study postulates that co-operative 5.0 is founded on three key pillars: cutting-edge technologies, human-focused, and cooperative sustainability focus, as illustrated in Figure 1.

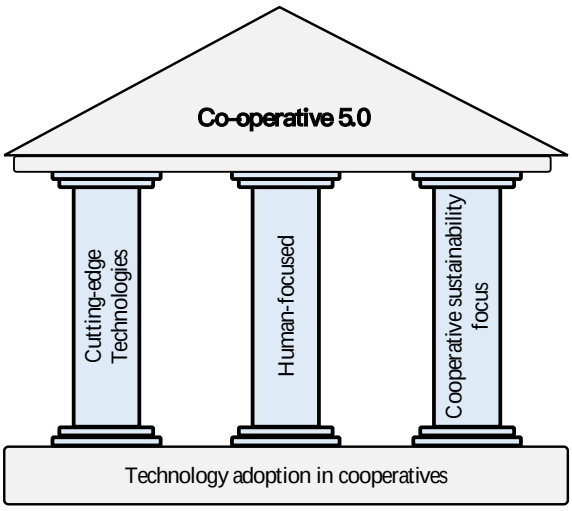

Figure 1: Three pillars of co-operative 5.0

The first pillar, which is "cutting-edge technologies", is based on the advanced technologies pertaining to the industry 5.0. As noted by Minzar and Mishra (2024), cooperatives have begun to adopt digital technologies. However, to remain competitive and relevant in today's rapidly changing digital landscape, it is essential for them to go beyond basic digital solutions and incorporate cutting-edge technologies such as AI, big data, blockchain, robotics, sensors, and IoT. These advanced technologies not only enhance operational efficiency and decision-making but also enable cooperatives to deliver more personalized services, strengthen member engagement, and improve transparency and accountability (Matto and Njau, 2025; Minzar and Mishra, 2024). By embracing such technologies, cooperatives can keep pace with

the contemporary world, meet the evolving needs of their members, and in so doing this pillar constitute an integral element in the framework of co-operative 5.0. Concerning the second pillar, "human-focused", while embracing integration of the cutting-edge technologies in cooperatives, it is important to consider solutions that prioritize the needs, experiences, and overall well-being of human. This approach emphasises the necessity for technological advancements to go beyond mere functionalities. As said by Ekwueme et al., (2024), by incorporating human-focused principles, technologies become tools not just for efficiency, but for promoting empowerment, inclusivity and the overall wellbeing. It advocates for the creation of solutions that are empathetic, ethical, and socially responsible, thereby ensuring that technological advancements truly enhance lives instead of simply optimizing processes. As a result, cutting-edge innovations adopted in cooperatives should aim at fostering cooperative productivity where human impact is at the centre. With regard to "cooperative sustainability focus" which is the third pillar, any integrated technology or innovations should prioritize cooperative sustainability as a fundamental principle. This means that tools and technologies adopted in cooperatives should not be adopted merely for the sake of improving efficiency or productivity. Instead, they should be assessed based on their capacity to enhance social equity, economic resilience, and democratic governance which, as per the International Co-operative Alliance (2016), are essential ingredients of sustainability within the cooperative model. By prioritizing on sustainability in their technological choices, cooperatives can ensure that innovation aligns with their core values, thereby enhancing their capacity to support members, respond to future challenges, and make significant contributions to sustainable development.

METHODOLOGY

The study employed a qualitative research approach in which data was gathered through key informant (KI) interviews and literature review. A comprehensive interview with selected 17 KIs was conducted. Informants were selected purposefully due to their direct knowledge pertinent to the study's objectives. The selected KIs came from a variety of institutions as detailed in Table 1. Majority of them were drawn from the Kilimanjaro and Kagera regions of Tanzania. The selection of the two regions was linked to their historical role in co-operative development in the country. The regions spearheaded co-operative movements leading to, among others, the formation of the first co-operative unions, including the Kilimanjaro Native Co-operative Union (KNCU) and the Kagera Co-operative Union (KCU) (Mruma, 2014). Kilimanjaro and Kagera regions have continued to support vibrant cooperative movement to date. For example, they are among the regions with significant cooperatives capitals, amounting to TZS 27,643,617,822 and TZS 2,533,835,268 for Kilimanjaro and Kagera regions respectively (TCDC, 2023). This makes them particularly relevant to the focus of this study, which seeks to investigate the impacts of industry 5.0 on cooperatives sustainability.

Table 1: Categories of participants involved in the study

S/N	Category of participants	Institution	Region	Number

1	Co-operatives experts	Moshi Co-operative University	Kilimanjaro	2
2	ICT experts	Moshi Co-operative University	Kilimanjaro	2
3	Member, ICT Unit	Tanzania Co-operatives Development Commission	Dodoma	1
4	Member	Wazalendo SACCOS Ltd	Kilimanjaro	2
5	ICT expert	ELCT-ND SACCOS Ltd	Kilimanjaro	1
6	Board Chairperson	Buhandangabo AMCOS	Kagera	1
7	Member	Ibosa AMCOS	Kagera	1
8	Board Chairperson	Bujugo AMCOS	Kagera	1
9	Co-operative Officers	KDCU - Karagwe	Kagera	2
10	Member	Ihembe AMCOS	Kagera	1
11	Board Member	Kamahungu AMCOS	Kagera	2
12	Board Chairperson	Buyango AMCOS	Kagera	1
Total				**17**

Different interview guides were developed for the different categories of participants. The development of interview questions was informed by the existing literature relevant to the study's focus. Some of the questions posed include: *Are there any technologies adopted in your cooperative? If yes, what are they, and if no, why? Has the cooperative adopted any advanced digital technologies? If yes, what are they, and if no, why? Is it feasible for cooperatives to adopt advanced digital technologies? What benefits could the advanced digital technologies have on co-operatives?* Interviews were carried out both in person and through phone calls. When phone calls were used, the average duration of interview sessions was between 20 to 25 minutes. Conversations with participants were captured using a voice recorder and a notebook. Participants were made aware of the voice recorder's usage and provided their consent for it. For ease of communication, interviews were conducted in both English and Swahili. All recorded interviews were transcribed, and the Swahili transcripts were translated into English prior to analysis. Data was managed and organized with the help of NVivo qualitative data analysis software. Analysis of data was done thematically to identify meanings, patterns, and insights derived from the interviews. The results of the analysis were organized into thematic categories presented in the findings and discussions section. In order to attain generalization and external validity, the research used secondary data gathered from a comprehensive literature review of journal articles, conference proceedings, reports, and case studies to corroborate the findings from interviews. This method is acceptable in qualitative research as suggested by Decrop (1999). The reviewed literature was sourced from leading scholarly databases including DOAJ, JSTOR, AJOL, and EBSCO. Relevant search as well as inclusion and exclusion criteria were developed and employed to obtain the required literature.

FINDINGS AND DISCUSSIONS

Technology adoption in co-operatives: The study sought to establish whether cooperatives in the study area embrace technology. The reason for it was grounded on the facts suggested by Matto and Njau (2025) that technology has the potential to support cooperatives in enhancing decision making, improving operational efficiency, fostering transparency and elevating the quality of delivered services. Furthermore, determining whether cooperatives embrace technology is crucial, as it serves as a foundation for the three pillars of co-operative 5.0 proposed in the framework illustrated in Figure 1 to be upheld. Findings revealed that while some cooperatives have begun to utilize digital solutions to manage operations, others have not yet done so. In an interview, one participant noted, "*Our cooperative society is using a core banking solution (CBS) which helps us to manage transactions electronically*". This indicates that there are digital solutions employed in cooperative societies. Similar kind of findings are echoed in the existing literature, such as Ntunga (2021), which indicates that cooperative institutions have started to adopt digital technologies. While some cooperatives use digital technologies, it was also noted that there are others that still operate with manual systems. This was revealed during key informant interview with another participant who stated, "*…the cooperative society to which I belong has not yet adopted computerization. The situation is quite similar in most other cooperatives in our area.*" Triangulation of this findings with previous studies indicated similar results. For instance, Ntunga (2021) found that a significant number of cooperatives, particularly those in rural areas, continue to operate using manual or semi-manual accounting systems. Likewise, a report from the Tanzania Cooperatives Development Commission (TCDC) reveals that of the 801 SACCOS licensed in the country by the end of 2022, only 206 (approximately 25.7%) were using Information and Communication Technology (ICT) systems, while the remaining 595 (about 74.3%) relied on manual systems (TCDC, 2023). While many Tanzanian cooperatives, particularly in rural areas, still rely on manual processes or simple tools such as digital weighing scales and desktop banking systems (Matto & Njau, 2025), international and regional examples illustrate the transformative potential of Cooperative 5.0 technologies. In West Java, Indonesia, cooperatives utilise blockchain to trace agricultural products, enhancing transparency and increasing farmer income. AI tools assist in planting decisions based on climate trends (Abdullah et al., 2022). In the Emilia-Romagna region of Italy, agricultural cooperatives have begun to employ IoT sensors, AI-driven crop analysis, and blockchain tracking to modernise food production and distribution. A noteworthy example is the SmartAgri Co-op initiative. Member farms employ IoT devices to monitor soil moisture, weather patterns, and crop health in real time (Shabur et al., 2025). In Africa, new initiatives are demonstrating similar progress. SACCOs in Kenya are trialing AI chatbots to enhance customer service and loan screening (Co-op News, 2025). In Kenya's tea sector, cooperatives are testing blockchain to improve supply chain transparency and efficiency. According to Ronoh, Omieno, and Odawa (2025), this technology enables decentralised data sharing and smart contracts that automate transactions, verify product origin, and build stakeholder trust. The study reveals blockchain's potential to reduce fraud and enhance coordination among geographically

distributed farms. These examples underscore the importance of visionary leadership, strategic partnerships, and supportive policies. They provide a roadmap for Tanzanian cooperatives to bridge the digital divide and pursue inclusive, sustainable innovation.

Types of digital technologies adopted: The study went further to establish the type of technologies used by cooperatives that have adopted digitalization. To put it into context, the focus was to determine whether these cooperatives have adopted cutting-edge technologies or continue to rely on conventional ones. The results indicated that cooperatives in the study areas still depend on conventional digital technologies. This was highlighted during an interview where participants were asked if their cooperatives had integrated advanced digital technologies such as IoT, AI, Big Data, and robotics. In response to this inquiry, one participant remarked, *"...the technology that our AMCOS is using is merely the digital scale that was brought here by the Union to help us weigh coffee brought in by farmers*." In a similar vein, another respondent noted, "*I am not very much aware of the technologies you are referring to but what I know is that our SACCOS is using computers to process daily transactions... we don't have mobile application yet*." Furthermore, another participant, an ICT expert, commented, *"...state-of-the-art technologies such as the one you have mentioned require a high investment cost. Most of cooperatives either cannot afford or their members may not see the value for money in investing on those advanced technologies*." The responses from participants reveal one thing in common: cooperatives continue to rely on conventional digital technologies, with no or very little adoption of cutting-edge technologies. Despite the rapid advancement of digital technologies, particularly in areas like robotics and AI, cooperatives have not yet adopted these emerging technologies. This finding aligns with the study conducted by Matto and Njau (2025), which aimed at exploring the potential opportunities and challenges of AI adoption in SACCOS. That research revealed that none of the surveyed SACCOS had implemented AI solutions, highlighting a significant gap between technological potential and practical application within the cooperative sector.

Challenges in adopting cutting-edge technologies: Several challenges hindering the adoption of cutting-edge technologies in cooperatives were reviewed during interview with participants. Among the most commonly indicated challenges included lack of financial resources, which limit the ability of cooperatives to invest in advanced technologies. Furthermore, a lack of awareness about cutting-edge technologies emerged as among the challenges hindering their adoption. Without a clear understanding of how advanced technologies can improve the operational efficiency of cooperatives they are less likely to invest in such technologies. In addition to lack of financial resources and unawareness, participants expressed concerns on the fear and/or resistance to change as a significant barrier to adopting new technologies in cooperatives. They expressed concerns that new digital tools may disrupt traditional practices and cause uncertainties. This resistance is often rooted in discomfort with unfamiliar systems, fear of job displacement, revealed underperformances, or scepticism about the effectiveness of new technologies. Such views create a challenging environment for innovation, making it difficult for cooperatives to move beyond traditional

practices and embrace advanced digital technologies. A cooperative member explained this situation as follows, "*There exists a significant resistance to adopt new technologies in many cooperatives... some cooperative leaders are hesitant to adopt new technologies due to perceived risks like potential job losses. In some cases, corrupt leaders deliberately resist technology adoption because they know that technologies will increase transparency and accountability which could ultimately expose their unethical practices... also, some incompetent employees in cooperatives resists introduction of advanced technologies out of concern that these tools could reveal their lack of competence or render their roles obsolete.*" The study established further that many cooperatives lack the basic digital infrastructure, such as internet connectivity, required for the successful adoption of cutting-edge technologies. Since many of the cutting-edge technologies rely heavily on internet, the absence of reliable internet access in some cooperatives poses a major obstacle in the adoption of advanced digital technologies. Beyond the issue of internet connectivity, some cooperatives also lack other fundamental modern hardware and digital platforms necessary for implementing advanced innovative solutions. These were reflected during the interview with the chairperson in one of cooperative's board who stated, "*...we know nowadays there are modern computers than the ones we are using, but we have not been able to obtain them yet. We are still using old model computers. Internet is also a very big challenge in our cooperative society. In most cases, we don't have it at all.*"

Impacts of cutting-edge technologies on cooperatives: Although not generally adopted, respondents recognized that advanced technologies could bring several benefits to their cooperatives. For example, these technologies were noted to potentially lower operational costs, improve efficiency, and facilitate faster and more efficient information exchange within and outside cooperatives. Reflecting specifically on SACCOS, a participant said, *"I know technologies like artificial intelligence can assist not only in linking SACCOS with CreditInfo or other credit reference bureaus, but also in evaluating the eligibility of loan applicants to expedite loan requests decisions, thereby automating tasks traditionally performed by loan committees".* This means that an integration of AI in savings and credits cooperative societies streamlines the process of verifying the eligibility of loan applicants, eliminating the reliance on the current manual verification procedures which are known to be costly, slow and inefficient as suggested by Oforo and Mbogo (2023). Another participant who is a member of AMCOS noted that, "*One of the challenges that we encounter is the lack of access to market information for our agricultural produces. We really don't know the global market prices. This makes brokers to take advantage of our ignorance to buy from us at prices they set themselves*." This tells that if advanced technologies such as machine learning could have been employed, could help cooperatives have access to global market information, thereby help cooperative members make informed decisions with regard to their agricultural products. Thus, advanced technologies have the potential to strengthen the role of cooperatives in fostering social and economic development, while improving service

standards, transparency, and accountability, which are essential aspects for sustainable cooperatives.

Emergence of Co-operative 5.0: Given that many cooperatives have not yet embraced digital technologies, and the few that have adopted have not embraced cutting-edge technologies—such as AI, blockchain, big data, advanced robotics and IoT—it is clear that they are still at the early stages of technology adoption. Referring to the co-operative 5.0 framework illustrate in Figure 1; the adoption of technology serves only as a foundation upon which the three pillars of co-operative 5.0 are established. The integration of advanced technologies is a fundamental pillar of the Co-operative 5.0 framework. Thus, the indicated lag in implementation of advanced technologies in cooperatives signifies that are yet to become co-operative 5.0. The Co-operative 5.0 framework emphasizes not only the adoption of advanced technologies but also stresses on the importance of aligning these innovations with human-centred values and sustainability. The human-cantered and sustainability pillars could not be established as they are based on the adopted advanced technologies in the first pillar. Therefore, the current state of technological underdevelopment suggests that cooperatives still have a considerable journey ahead to fully evolve into co-operative 5.0.

CONCLUSION AND RECOMMENDATIONS

As in several other application areas, the industry 5.0 offers unprecedented opportunity to modernize cooperatives thereby making them more sustainable, inclusive, and resilient. However, the adoption of technologies making up the industry 5.0 is currently very low in cooperatives. While some cooperatives have started embracing digital technologies, a considerable number of them still rely on traditional manual systems. The study found that those that have adopted digital solutions continue to rely on conventional digital technologies, with no or very little adoption of cutting-edge technologies. Some of the underlying reasons for that being insufficient financial resources, lack of awareness, fear and/or resistance to change, and lack of access to required infrastructure. The three pillars in the co-operative 5.0 frameworks; cutting-edge technologies, human-focused, and the cooperative sustainability focus emphasizes the importance of integrating cutting-edge technologies with human-focused values to foster sustainable cooperatives. However, the lack of adoption of cutting-edge technologies in the surveyed cooperatives signifies that they are yet to become co-operative 5.0.

In order for cooperatives to transit fully into co-operative 5.0, the study proposes a number of recommendations as follows:

i. Change of mindset: Co-operative leaders and stakeholders need to change mindset and consider cutting-edge technologies as an opportunity rather than threat.
ii. Capacity Building: There is a need for cooperative leader, members and all other involved stakeholders to continue building their capacity with respect to advanced technologies and their adoption in cooperatives. Institutions mandated to offer cooperative trainings should also get fully engaged in the said capacity building sessions.

iii. Investment in digital infrastructures: leaders in cooperatives should consider investing in digital infrastructures as the considerable investments is essential to ensure that cooperatives are equipped with the necessary tools and systems to support modern innovations.

iv. Improvement of digital landscape: the government through relevant organs should also consider improving the digital landscape in the country. This should include improving internet connectivity, developing favouring policies and providing subsidies for ICT equipment to encourage broader adoption.

v. The Cooperative 5.0 Readiness Framework should be used as a tool to help Cooperatives start or improve their digital transformation journey. This structured guide enables Cooperative leaders to assess their current abilities, pinpoint areas for growth, and create strategic actions to become organizations that focus on technology integration, human needs, and sustainability.

REFERENCES

Abdullah, A., Satria, A., Yandra, M. H., Dikky, I. R. (2022). Blockchain-enabled supply chain finance for specialty coffee cooperatives in West Java. *Jurnal Manajemen Agribisnis Indonesia, 10*(2), 112–123. https://repository.ipb.ac.id/handle/123456789/16176

Basulo-Ribeiro, J., & Teixeira, L. (2024). The future of healthcare with industry 5.0: preliminary interview-based qualitative analysis. *Future Internet*, *16*(3), 68.

Breque M, De Nul L, Petridis A. (2021). Industry 5.0: towards a sustainable, human-centric and resilient European industry. Luxembourg, LU: European Commission, Directorate-General for Research and Innovation.

Co-op News. (2025, January 20). *AI enhancing efficiency and customer experience in Saccos*. https://co-opnews.com/ai-enhancing-efficiency-and-customer-experience-in-saccos/

Ekwueme, L., Oluwaseun, B., Ifeoma, A. J. I. E., Ofodu, P., & Ambrose, S. (2024). Empowering Librarians in the Fifth Industrial Revolution: Navigating Skills, Challenges, and Strategies for Effective Library Services in Open and Distance Learning. *Lokoja Journal of Information Science Research*, *2*(1), 79-94.

Grewal, D., Gauri, D. K., Roggeveen, A. L., & Sethuraman, R. (2021). Strategizing retailing in the new technology era. Journal of Retailing, 97(1), 6-12.

International Co-operative Alliance (2016). Sustainability Reporting for Co-operatives: A Guidebook. https://ica.coop/sites/default/files/2021-11/ICA%20Sustainability%20Reporting%20Guidebook.pdf

Lahkar, B. M. (2024). Souvenir: 69th ILA International Conference on Building the Future: Transforming Libraries for Sustainability through Capacity Building. Department of Library and Information Science. Gauhati University.

Liu, L., Guo, F., Zou, Z., & Duffy, V. G. (2024). Application, development and future opportunities of collaborative robots (cobots) in manufacturing: A literature review. *International Journal of Human–Computer Interaction*, *40*(4), 915-932.

Lu, J., & An, H. (2025). Innovative Development Strategies for Smart University Libraries in the 5G Era. *technology*, *7*(1), 8-13.

Matto, G. and Njau, L. (2025). Potential of Artificial Intelligence in Improving SACCOS Operations: Opportunities and Challenges. Proceedings of the 4th International Conference on Co-operatives for Sustainable Development, organized by MoCU and CUK, 31 July – 02 Aug, 2024.
Minzar, M., & Mishra, M. K. (2024). Digital Transformation In Cooperatives: Opportunities And Challenges. *IOSR Journal of Business and Management*, *26*(10), 23-31.
Ntunga, G. E. (2021). Co-operatives and ICT integration in Tanzania: Opportunities and Challenges. 2nd International Conference Co-operatives and Industrialisation: Putting Members at the Centre
Pozdnyakova, U. A., Golikov, V.V., Peters, I. A., & Morozova, I. A. (2019). Genesis of the revolutionary transition to industry 4.0 in the 21st century and overview of previousindustrial revolutions. In Industry 4.0: Industrial Revolution of the 21st Century (pp.11-19). Springer, Cham.
Ronoh, H. K., Omieno, K., & Odawa, J. (2025). The capabilities of blockchain technology in enhancing supply chain management in the tea sector in Kenya. *Journal of Research and Academic Writing, 2*(1). https://doi.org/10.58721/jraw.v2i1.1068
Schulze, E. (2019). Everything you need to know about the Fourth Industrial Revolution. *CNBC.com*.
Schwab, K. (2016). The Fourth Industrial Revolution. New York: Crown Business.
Shabur, M. A., Shahriar, A., & Ara, M. A. (2025). From automation to collaboration: *Exploring the impact of Industry 5.0 on sustainable manufacturing*. *Discover Sustainability, 6*, Article 341.
Sife, A. S., & Matto, G. (2022). Realigning library and Information Services with the Fourth Industrial Revolution. COTUL Scientific Conference.
Tella, A., Amuda, H. O., & Ajani, Y. A. (2022). Relevance of blockchain technology and the management of libraries and archives in the 4IR. *Digital Library Perspectives*, *38*(4), 460-475.
The Tanzania Cooperative Development Commission (2023). TCDC Cooperative Statistical Report for Jan – June 2022/23. https://www.ushirika.go.tz/uploads/Statistical_bulletin_Jan_-_June__2023_(1).pdf
Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. *Journal of manufacturing systems*, 61, 530-535.

The Co-operative University of Kenya
P.O. Box 24814-00502, KAREN, NAIROBI
TEL: +254 202430127/202679256
Mobile(office): +254 724311606
Conference link: https://conference.cuk.ac.ke/