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Industrial Revolutions 5.0: Implications to Libraries and Librarians

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ABSTRACT

Purpose: *This study critically examines the concept of Industrial Revolution 5.0 and its implications for academic libraries and librarians. While existing literature largely associates Industrial Revolution 5.0 with manufacturing and industrial systems, research addressing its relevance to libraries remains fragmented and predominantly descriptive. The study aims to analyze the core values, enabling technologies, challenges, and opportunities of Industrial Revolution 5.0 within the academic library context.*

Methodology: *A qualitative structured literature review was adopted using content analysis. Thirty peer-reviewed studies published between 2020 and 2025 were retrieved from major scholarly databases, including Google Scholar, Taylor & Francis, SpringerLink, ScienceDirect, ProQuest, and indexed journals. The selected literature was analyzed thematically, focusing on human-centric values, sustainability, resilience, emerging technologies, and the evolving professional roles of librarians.*

Findings: *The findings reveal that Industrial Revolution 5.0 represents a shift from technology-driven automation to a human-centric, value-based paradigm. Technologies such as artificial intelligence, cloud computing, big data analytics, blockchain, the Internet of Things, and next-generation connectivity are reshaping library services, professional identities, and service delivery models. While libraries in developed countries demonstrate readiness for adoption, institutions in developing contexts face constraints related*

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to skills, infrastructure, funding, and policy support. The literature also exposes gaps in ethical governance and contextual adaptation.

Implications: *The study positions academic libraries as value-driven knowledge ecosystems rather than passive technology adopters. It highlights the need for context-sensitive strategies, ethical frameworks, and continuous professional development to ensure meaningful and inclusive implementation of Industrial Revolution 5.0 in academic libraries.*

Keywords: Industrial Revolution 5.0; Industry 5.0; Libraries; Librarians; Human-centric technologies; Emerging technologies

1. INTRODUCTION

In contemporary times of technological revolution, the world have witnessed different industrial revolutions that is happening today. These revolutions will fundamentally change the way of live, the way of thinking and the way of working with each other's in both domestic and international spheres. Now we are stepping into Industrial revolutions which consistently reshape our social institutions including libraries (Ashiq, 2024a). These revolutions redefining that how knowledge in the libraries are produced, accessed and managed. The libraries are transforming from mechanization to digitalization in the evolving technological change. This transformation has marked conceptual departure from automation-centric paradigm towards human-centric, resilient and sustainable approach (Hussain, 2020a). Since 2020, the word Industrial revolutions 5.0 has gained enormous traction in industrial, manufacturing discourses, however its implications for libraries remain under-theorized. The existing literature predominantly describes enabling technologies without critically examining how IR 5.0 redefines librarians' professional identity or addresses contextual constraints in developing nations. Although IR 5.0 is frequently framed as human-centric, the existing literature often adopts an overly optimistic, technology-deterministic perspective. Limited attention is given to power asymmetries (Rajkumar et al., 2025), digital labor intensification, and ethical risks associated with increased automation. In both advanced and developing countries, where libraries face chronic underfunding and limited digital infrastructure, implementing IR 5.0 may exacerbate inequalities rather than resolve them. Therefore, IR 5.0 adoption in libraries must be critically aligned with contextual realities, institutional capacity, and ethical governance frameworks rather than treated as a universal solution. Therefore, this study aims to address the following research objectives:

Research Objectives

- To critically examine the core values and enabling technologies of IR 5.0 in the context of libraries.
- To analyze how IR 5.0 reshapes the roles and competencies of librarians.
- To identify implementation challenges faced by libraries, particularly in developing countries.
- To propose actionable strategies for effective adoption of IR 5.0 in library environments.

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1.1. What is IR 5.0

IR 5.0, or the Fifth Industrial Revolution, is a recent term used by the European Union (EU) on several occasions; the present revolution will undoubtedly bring positive changes to economic and social transitions in the society in which we live and interact (Hussain, 2020) . The purpose of this revolution is to bring efficiency and productivity to our daily routine. IR 5.0 is also called the Fifth Industrial Revolution. It is a new phase of Industrialization in which humans and advanced technology will work together (Hussain, 2025b) . This revolution reflects a shift from an economic to a social value and well-being approach. As part of this revolution, AI-driven robots will work alongside humans to improve workplace processes. It not only encompasses the manufacturing process but also enables technologies such as artificial intelligence, Automation, the Internet of Things, Data, Machine learning, and virtualization (Oyedokun, 2025). The most critical aspect of IR 5.0 technology is to put worker well-being at the heart of the production process. Unlike in IR 4.0, it is assumed that the fifth Industrial Revolution will bring prosperity beyond jobs and growth. In their article, they explained that in Industrial Revolution 5.0, people will work with robots and intelligent machines (Ajani & Oladokun, 2024a).

Leveraging advanced technologies such as big data analytics, robots, and human workers will enable more effective work. Modiba & Ngulube (2024) suggest that "Industry 5.0 is compelled by various industries technologists, philosophies, and others to focus on the human factors and technologies in the manufacturing systems". In their article, Ekwueme et al.(2024) explain that IR 5.0 refers to a revolution in which humans and machines work together to enhance manufacturing productivity and efficiency. Oladokun et al. (2025) postulated that IR 5.0 is regarded as the edge of the intelligent factory. This revolution enables communication between robots and humans using electronic components. In their article, they opined that IR 5.0 is a human-centric, sustainable, and resilient concept that will prevent repetitive tasks from human workers. The scholars further elaborated those intelligent robots will penetrate manufacturing supply chains and production workflows to unprecedented levels, transforming the manufacturing system more profoundly.

1.2. Conceptual Framework of IR 5.0

In their research, Xu et al.(2021) report that the main focus of IR 5.0 is based on three interconnected core values: human-centeredness, sustainability, and resilience. The core value of IR 5.0 is explained in Figure 1, below:

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Figure 1 Core values of Industry 5.0. Source: **(Xu et al., 2021)**

1.3. Human-centered

In a human-centric process, humans perform the leading role, not technology. Here, technological progress is shifting to a human and society-centered approach. In other words, human needs and interests are at the center of the production process. Similarly, in a human-centered approach, there should be a safe, inclusive working environment that supports human physical and mental health. In this core value, the fundamental rights of workers, such as human dignity, autonomy, and privacy, are safeguarded (Enakrire et al., 2024). In a human-centred approach, librarians are crucial. In this core value, a librarian can become a knowledge facilitator. Similarly, countries shift towards integrating advanced technology with human values as technology evolves. Hence, librarians in the era of IR 5.0 become advocates for inclusivity, ethics, and well-being (Oyedokun, 2025).The librarian's value becomes essential in empowering individuals with digital and information literacy in a technology-driven world. In this phase, librarians will guide users through vast digital resources to ensure access to accurate, diverse, and inclusive information. Librarians in these revolutions can curate the knowledge that reflects societal needs and aspirations. Similarly, librarians, through their role as information managers, build a resilient community better equipped to navigate and recover in times of crisis. Librarians can also safeguard individual rights in an increasingly data-driven environment. Librarians can also create a collaborative space—both physical and virtual. In the era of IR 5.0, librarians are not just custodians of knowledge but champions of more advancement aligned with human dignity, societal well-being, and autonomy (Noh, 2023).

1.4. Sustainability

Sustainability is a crucial pillar of Industry 5.0, requiring industries to operate within the planet's ecological boundaries. This approach emphasizes circular processing, where natural resources are reduced, reused, and recycled to minimize waste and protect the environment. By adopting these practices, industries can drive sustainable development and foster a circular economy that produces resources more efficiently and responsibly." Sustainability is the core value of IR 5.0, enabling industries to operate within ecological boundaries and follow circular processes to protect the environment (Ashiq, 2024). Librarians play a significant role in promoting sustainability within an organizational framework. They will facilitate access to knowledge about sustainable practices, circular economies, and environmental stewardship. They can also educate people to reduce waste, recycle resources, and reuse eco-friendly materials. They should also curate resources that inform societies and industries to sustain an ecological environment through energy-efficient technologies and the responsible use of materials. Librarians contribute to a broader culture; they should provide eco-friendly, valuable information for a sustainable future (Hussain & Shahid, 2022).

1.5. Resilience

In industrial production, resilience refers to the need to develop robustness to ensure systems can withstand disruptions and continue functioning effectively during crises. This resilience is critical for maintaining the stability of supply chains, safeguarding critical infrastructure, and providing reliable support to industries and communities in the face of unforeseen challenges or emergencies. Librarians play a significant role in this core value; as stewards of knowledge, they can curate information that supports crisis preparedness and recovery (Hussain, 2020). In times of crisis, they can facilitate essential information during emergencies. Similarly, they can

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provide access to reliable, timely resources through digital applications during emergencies. Librarians can also help build resilient communities to navigate accurate information during crises. As information managers and educators, librarians are champions of a resilient society, aligning their work with the broader goals of Industrial Revolution 5.0 (Rajkumar et al., 2025).

2. TIMELINE OF INDUSTRIAL REVOLUTIONS

2.1. Industrial Revolution 1.0

The Industrial Revolution 1.0 dates to the mid-18th century. In other words, it took place from 1750 to 1850. During these revolutions, sectors such as mining technology, transportation, manufacturing, and Agriculture emerged as areas of consideration. Great Britain pioneered the first industrial revolution, where handmade production occurred from 1720 to 1840 (Hussain, 2020). These revolutions paved the way for manufacturing and entrepreneurship to be set up to promote a free-market economy. Numerous universities were established during this period (Davies, 2024). Libraries during these revolutions grew in size, but library administration needed to be strong enough to promote acquisitions due to inadequate funding. Librarians in this revolution served as gatekeepers for limited users (Kuranga et al., 2025). The groundwork for public library systems was laid during the first industrial revolution. Specialized libraries emerged in the mid-18th century, and wealthy industrialists and scholars began funding them. In short, the role of libraries and librarians was passive and did not get immense recognition.

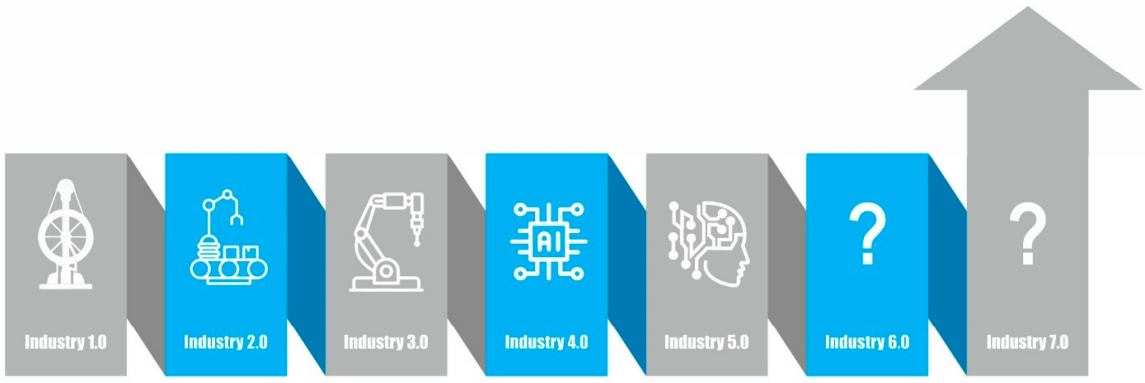

***Figure 2: The Timeline of Industrial Revolutions Source*:(Author's own design)**

2.2. Industrial Revolution 2.0

The Second Industrial Revolution began in the mid-1850s and lasted until 1940. Under this revolution, rapid advancements in science and technology occurred. Electricity, steel production, chemical manufacturing, and transportation systems got immense recognition during this time. The expansion of public libraries in North America and Europe marked a significant revolution in educating and empowering the working class. Philanthropists like Andrew Carnegie expanded funding for public libraries, and it is argued that more than 1,000 public libraries were established to bridge the knowledge gap. Libraries became critical hubs for storing, organizing, and disseminating industrial knowledge to support industrial growth (Hussain, 2020). The Dewey Decimal Classification was introduced in 1876 by Melvil Dewey,

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and librarianship became a recognized profession. The role of libraries expanded to support the skilled labor, technical expertise, and scientific research of educated workers. In short, the libraries helped to drive economic growth to support industrial advancement on a larger scale (Hussain, 2025).

2.3. Industrial Revolution 3.0

The Third Industrial Revolution (IR 3.0), also known as the digital revolution, began in the late 20th century, specifically in 1970. The revolution gave birth to digital technology; before this, the focus was on analog and mechanical technology. However, this was marked as the era of computing technology. Innovations like computers, the internet, and telecommunications reshaped society, opening new horizons. This revolution also has profound implications for both libraries and librarians. Libraries began digitizing physical collections to preserve them and make them available online. Digital databases became essential parts of libraries (Hussain, 2020). An electronic catalog was initiated in the libraries to show what concerns libraries have about the desired subjects. Librarians became information specialists, and all library operations were transformed from physical collections to computerized records using automation systems. Library automation and integrated library systems were introduced to help librarians streamline library operations. In short, the third industrial revolution radically transformed the physical objective into dynamic digital hubs. Libraries were widely expanded through technology during the Third Industrial Revolution (Hussain, 2022).

2.4. Industrial Revolution 4.0

The Fourth Industrial Revolution, or IR 4.0, began in Germany in 2011, when physical and digital technologies were combined to enhance industrial growth in the most sophisticated ways. A few popular technologies, such as the Internet of Things, Cloud Computing, and Artificial Intelligence, emerged in IR 4.0 (Hussain, 2023b) . The technological shift has brought tremendous revolutions for both libraries and librarians. Libraries remain active, and traditional library functions have been transformed into digital-driven services (Hussain, 2020). Librarians are now leveraging advanced technology to meet and complete their patrons' changing needs in the virtual world. Librarians in these revolutions remain as information navigators and have become educators in digital literacy. In short, these revolutions brought libraries to new heights (Adigun et al., 2024).

2.5. Industrial Revolutions 5.0

Now, we are entering Industrial Revolution 5.0, which focuses on artificial intelligence and on human beings working together. This revolution will focus on bringing personalization back into the product market. It is assumed that the latest industrial revolution will bring greater differences in manufacturing and mass production. Some scholars argue that humans and machines will work together to create a streamlined, efficient approach to promote goods and services more effectively. Most scholars believe that IR 4.0 and IR 5.0 are two sides of the same coin. Still, it is believed that IR 5.0 will be written in both human-centered and value-centered ways. IR 4.0 will be written in history books as technology rises. It has been argued that for the last two decades, an enormous surge has occurred in advanced technology, and the credit goes to IR 4.0 technology while it's been a monumental change in meeting increased market demands during the era of IR 5.0 as the current revolutions is more about giving a customized and personalized experience for consumers(Ajani & Oladokun, 2024) . Industry 5.0 will integrate digital technologies and human labor to accelerate and improve production

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efficiency. The only difference between IR 4.0 and 5.0 is that IR 5.0 will keep humans at the forefront of the manufacturing process. The present revolution will work through three angles: a focus on humanity, a shift in manufacturing, and personalization. The main focus of this revolution is to bring humanity back into focus. In this revolution, humans are expected to take on design responsibilities. Here, humans will work on two fronts, such as designing a product using technology for other humans. This revolution will offer opportunities for higher-value jobs (Apriliyanti, 2022) .

3. LITERATURE REVIEW

Recent scholarship conceptualizes IR 5.0 as a human-centric response to the limitations of Industry 4.0, emphasizing worker well-being, sustainability, and societal value. Studies highlight technologies such as artificial intelligence, cloud computing, big data analytics, blockchain, IoT, and advanced connectivity as foundational enablers. However, library-focused studies remain sparse and largely extrapolate industrial models without sufficient contextual adaptation. Prior research on libraries within IR 4.0 emphasizes automation, digitization, and efficiency (Hussain, 2020). In practice, adopting IR 5.0 in libraries should follow a phased, context-specific approach. Cloud computing can support personalized digital services and remote access, while big data analytics may inform user-centered collection development. Blockchain technologies can enhance digital rights management and interlibrary collaboration, whereas IoT applications may improve space utilization and resource monitoring. However, successful implementation requires staff training, ethical data governance, and institutional readiness (Masrek et al., 2026). Without these foundational elements, technological integration risks becoming symbolic rather than transformative. IR 5.0 demands critical engagement with ethics, inclusivity, and resilience (Ajani & Oladokun, 2024). Existing studies inadequately address librarian skill transformation, policy readiness, and socio-economic disparities between developed and developing contexts. This gap underscores the need for an integrative and critical synthesis rather than descriptive summaries. The literature further highlights the role of IR 5.0 and its connection with libraries in detail below:

3.1. IR 5.0 and Libraries

A blend of human-centric and advanced AI-driven technologies characterizes IR 5.0. The technology of the present revolutions is based on collaboration between humans and intelligent machines to enhance creativity, ethics, and sustainability. Industrial Revolution 5.0 has the potential to transform libraries and librarianship. Libraries have evolved with advanced technology, becoming a hub of personalized learning and community centers. AI-driven technology will help librarians create interactive, immersive information retrieval systems. Industrial Revolution 5.0 mainly focuses on human-machine collaboration, making libraries more supportive of education and sustainable digital engagement (Hussain & Khan, 2025). The present revolution is broadly based on a few enabling technologies, such as cloud computing, big data analytics, Blockchain, the Internet of Things (IoT), and 6G networks. These technologies have been mentioned with following subheadings:

3.2. Cloud computing

Cloud computing has been an essential part of IR 4.0; however, it has been argued that, in the current revolution, it is poised to further transform library operations in the most sophisticated manner. Using these services, libraries will not only improve delivery, accessibility, and sustainability but also adopt a human-centric approach. Libraries will offer seamless services

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and personalized access to digital resources and online content from anywhere (Hussain, 2020). Cloud-based computing services will allow libraries to automate processes, integrate vast datasets, streamline catalogs, and access an efficient information retrieval system. Librarians can harness data-driven insights to better understand the users' needs (Adigun et al., 2024) . Cloud-based computing services can attract library patrons to foster global knowledge-sharing networks. Libraries can also use cloud computing services to support their patrons with augmented and virtual reality. It can also be used to reduce their environmental impact by minimizing on-site hardware and energy use. Librarians can become digital literacy educators beyond mere knowledge curators by leveraging cloud-based computing services. Librarians can also inform their patrons about ethical data management and the safe use of cloud resources and guide users in these areas (Ajani et al., 2024). Librarians can make their library services a digital hub, a sustainable learning place, and a human-centered place in the human-centered ethos of Industry 5.0.

3.3. Big data analytics

Big data analytics is an extensive, diverse collection of structured, unstructured, and semi-structured data that grows exponentially. Such a dataset is complex and massive, making it difficult to control (Hussain & Shahid, 2022). Big data comprises three Vs: volume, velocity, and variety. Volume is a vast amount of data collected from multiple sources; velocity is the generation of data at high speed, which can be processed for timely insights; and variety refers to data in different formats, such as audio, video, and text, which require a flexible system for analysis. In library setup, big data encompasses vast amounts of digital information that libraries can use to enhance their services promptly. In Industrial Revolution 5.0, the role of big data is undeniable (Apriliyanti, 2022). Libraries can provide personalized user experiences and allocate resources in the digital age. Keeping user preferences in mind, libraries can leverage big data analytics to enhance the user experience with their digital collections and enable patrons to create customized experiences tailored to their needs (Hussain et al., 2025). The libraries can track popular topics, optimize resource allocation, and forecast future demands. Librarians can become data-savvy information specialists, enabling them to proactively meet their patrons' anticipated needs. Librarians can also interpret data to guide decision-making, design user-driven services, and promptly improve library operations (Hussain, 2024). Data privacy, ethics, and transparency are the core values of Industrial Revolution 5.0; librarians must serve as data stewards, protecting user data to deliver services across diverse communities (Ajani et al., 2024). By embracing big data, it is a librarian's responsibility to become agile and responsive and foster a welcoming environment to achieve the human-centered goals of IR 5.0.

3.4. Blockchain technology

In the surge of Industry 5.0 Revolutions, the role of blockchain technology is admirable. It can hold transformative potential for all kinds of libraries. Blockchain technology helps improve security, enable collaboration, and manage digital resources and services. Utilization of this technology will put libraries on the right track (Abid, 2021). It can be used to secure ownership of libraries' digital assets, such as e-books, multimedia files, and electronic journals. Through blockchain, a librarian can decentralize a ledger that preserves their history for long-term digital preservation. It can also be used to promote interlibrary loans and enable libraries to participate in a trusted environment where materials can be tracked, shared, and accessed globally, efficiently, without the risk of loss or unauthorized duplication. Blockchain technology can also enhance patrons' privacy and data security. It can also help the libraries

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comply with stringent data protection regulations (Hussain, 2025). By using blockchain technologies, librarians can reduce vendor costs. Through blockchain technology, a library can align with the human-centered approach of IR 5.0 (Panda et al., 2024). It is helpful to empower library operations to be more secure, adaptive, and interconnected. Blockchain is the most robust technology for resource sharing and digital preservation, supporting patrons and librarians in the evolving digital landscape (Oyedokun, 2025).

3.5. Internet of Things (IoT)

The use of the Internet of Things in library services has become a need of the hour, particularly in the era of IR 5.0. The IoT refers to the network of interconnected devices and sensors. The primary purpose of IoT is to collect, exchange, and analyze data, and to provide real-time automation and insights. Undoubtedly, the use of IoT has been witnessed since the advent of advanced technologies. However, it is believed to reshape and revolutionize library services by enhancing efficiency, user experience, and the research standards of library users (Ajani & Oladokun, 2024b).Most libraries in advanced countries have installed intelligent sensors to monitor and optimize environmental conditions. Modern libraries are equipped with robust security measures to protect their patrons' resources and services. These sensors have been deployed to monitor temperature, humidity, and lighting to preserve the physical books and archives. Radio Frequency Identification (RFID) and IoT-enabled devices are installed inside the libraries to streamline the management of physical collections. Such sensors enable real-time tracking of items, reducing material loss. Some new services, such as self-service kiosks and automated check-in and check-out in libraries, reduce patrons' wait time and enhance the efficiency of circulation services (Hussain, 2020). It can also be utilized to deliver personalized recommendations to users and inform them about the availability of study areas or resources. IoT systems have both prospects and challenges for librarians. Most librarians need to learn about advanced technologies like IoT; it is their responsibility to become proficient in managing IoT systems. Librarians should ensure the privacy and data security of their patrons using IoT. In the era of the fifth industrial revolution, librarians should elevate their library services by creating more adaptive, user-centered, and specialized offerings to drive their institutions to new heights. Using IoT in library services will align the industry with 5.0 human-centric values by fostering innovative, accessible, and appropriate library environments (Abid, 2021).

3.6. 6G and beyond

The sixth generation (6G) is another good feature of Industrial Revolution 5.0. It can be used to develop wireless-based interaction technologies supporting the cellular data network. In the library services, it can be used for Augmented and Virtual Realities. 6G can also be used for the Internet of Things and other administration support services. For Industry 5.0, 6G networks are expected to meet the needs of the intelligent information society. 6G provides quick internet services, and library patrons may get optimal benefits in minimal time. Libraries of today's era are based on high data rates for various applications (Hussain et al., 2025). 6G can also connect large smart devices in the industrial revolution 5.0. The emergence of 6G technology could dramatically transform library services. For information management and access, libraries in IR 5.0 will require unprecedented connectivity, fast internet, and intelligent devices to transfer data with near-zero latency. In the age of 5IR, libraries will mainly require a data-rich environment. In real-time virtual reality, 5G can enhance learning by offering virtual tours to library users and virtual access to global archives. Similarly, 6G enables library users to access robust services that bridge digital divides regardless of their location. In the Automation

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process, the role of 6G is undeniable; it can perform manual library operations more effectively (Noh, 2023).The 6G is more user-centric and aligns with the human-focused ethos of Industry 5.0 through more sophisticated methods.

4. METHODOLOGY

This study adopts a content analysis approach of qualitative structured literature review design. The literature was retrieved from Google Scholar, Taylor & Francis, SpringerLink, ScienceDirect, ProQuest, and Scopus- and Web of Science–indexed journals. This review includes peer-reviewed literature published between 2020 and 2025, reflecting the emergence of IR 5.0 discourse. Keeping in minds the relevancy of IR 5.0 and its connection with academic libraries, the researchers followed the ethical rules of qualitative research and clearly mentioned the inclusion and exculpation criteria, for detail see the table 1, below:

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Peer-reviewed journal articles and book chapters published between 2020–2024	Non-academic sources and opinion pieces
Studies explicitly addressing IR 5.0 or Industry 5.0	Studies focusing solely on Industry 4.0 without conceptual linkage to IR 5.0
Literature linking IR 5.0 with libraries, information services, or knowledge institutions	Duplicated or incomplete publications
Studies only in English language were reviewed and included	Studies in languages other than English were excluded
Studies relevant to academic libraries were included	Studies not related to academic libraries were excluded
Google Scholar, Taylor & Francis, ScienceDirect, ProQuest, Springer Link	All other research databases were excluded

Thirty studies met the criteria and were analyzed using thematic content analysis focusing on values, technologies, librarian roles, and challenges.

5. ANALYSIS AND SYNTHESIS OF LITERATURE

In this section, the scholar critical evaluate the structure analysis of the reviewed literature on Industrial revolution 5.0 and its implications for libraries and librarians. It further highlights the dominant assumptions of 5IR that closely aligns with academic libraries through the conceptual framework related to human-centric, resilience and sustainability of the libraries. The study covers 30 publications on 5IR published between 2020 and 2025. As the 5IR in academic libraries are still in formative stage and there has persisted a big gap on this domain. Mostly, the published literature originates from engineering, manufacturing and industrial system. The scholar identified the core value for IR 5.0 which is consistently framed around three core values such as human-centric, sustainability and resilience. Only few scholars encompass the issue of 5IR in academic library discourse which indicates an imbalance between technological discourse and institutional application in the library domain. From methodological point of view, the literature is dominated by opinion pieces, conceptual papers,

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and narrative reviews, while empirical studies, particularly from developing countries remain scarce. The study further highlights that there is diversity restriction regarding methodological findings which underscores the need for more context-sensitive and grounded research in developing countries to highlight the issues on broader scale.

Conceptual gap is yet another aspect that has been highlighted by the scholar within this study. As mentioned in the literature and introduction section that IR 5.0 is defined as a human centric paradigm rather than technological centric, hence most of the studies covers the technological aspects rather than human values and institutional ethics. In academic libraries context, there is limited theory that how human-centric translates into librarians' profession identity, ethical responsibilities and decision-making authority. The literature indicates that there is still lacks integrative frameworks that link both IR 5.0 core values with core library functions such as knowledge organization, user education, access equity and community engagement. The previous studies also highlight that IR 5.0 is rooted in industrial production system and manufacturing whereas libraries are often treated as passive adopters of technology rather than as active social-technical systems. This gap limits the relevance of existing IR 5.0 models for academic libraries.

The geographic and contextual gap within previous researches shows that IR 5.0 skewed towards developed nations which are rich in economic and technology while on the other hand, libraries in developing countries are largely absent from IR 5.0 discussions. This creates a contextual gap that risks promoting adoption narratives because mostly studies highlight only challenges such as inadequate infrastructure, poor policy frameworks, limited digital competencies and lack of skilled labors. This geographical gap further exacerbates doubts in minds. The literature indicates that IR 5.0 rhetoric emphasizes human empowerment, hence academic librarians in advanced nations are competent with robust skills whereas academic librarians in developing nations lack these skills. This gap highlights the need to reconceptualize librarians not merely as technology users but as ethical mediators, resilient builders and digital mentors.

Many studies assumes that the integration of AI, IoT, blockchain, big data and RFID will inherently lead to improved societal outcomes and improved services, however such assumptions often overlook power asymmetries, labor intensification, data surveillance and algorithm bias. These issues are particularly relevant in information institutions. In the library context, such issues are related to intellectual freedom, user privacy consents and intellectual freedom. As we know that 5IR promotes human-centric approach thus reviewed literature rarely interrogates who define human values and whose interests are prioritized in technology-driven decision-making. It creates problem for academic librarians. Such assumptions create a critical gap for academic libraries and their foundational principles of equity, neutrality and trust. Similarly resilient is framed in technical terms such as system robustness, redundancy and continuity rather than as a social and institutional capacity which involve library staff adaptability, policy support and community engagement. This narrow interpretation limits the transformative potential of IR5.0 for academic libraries as educational institutions and civic center.

Moreover, resilience is frequently framed in technical terms—system robustness, continuity, and redundancy—rather than as a social and institutional capacity involving staff adaptability, community engagement, and policy support. This narrow interpretation limits the transformative potential of IR 5.0 for libraries as civic and educational institutions.

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6. CHALLENGES OF INDUSTRY 5.0 TO LIBRARY PROFESSIONALS

All new revolutions have both pros and cons. Similarly, IR 5.0 has both prospects and challenges for library professionals. New technology always requires new competency skills, as this revolution is more human-centric. It is the responsibility of library professionals to learn new skills. In advanced countries, humans work with robots, and robots and intelligent machines require more advanced skills. Besides soft skills, technical skills are also an issue for human workers. More time and effort are required to adopt innovative technology. Similarly, the library is a changing agent of new technology, so library staff must learn new knowledge about customized software, artificial intelligence, the Internet of Things, collaborative robotics, and real-time information skills to increase the efficiency and productivity of libraries. Every advanced technology requires investment, and these technologies are costly.

Similarly, human workers require new training to run these innovative technologies. Intelligent machines and skilled laborers need the day to enhance productivity and efficiency in 5IR; Libra could be a more productive organization, and librarians should consider the cost of machines and human skills while implementing these services. Security challenges are another crucial factor for 5IR, particularly for the library services. All new and innovative technologies, such as Artificial Intelligence, the Internet of Things, and the automation industry in 5IR, require robust security measures. Organizations must follow strict and trusted security measures before implementing new technologies. Libraries should adhere to the security of their data and information regarding their patrons before entering 5IR.

7. DISCUSSION

This study advances the discourse on Industrial Revolution 5.0 (IR 5.0) by critically examining its implications for libraries and librarians beyond technological determinism. Unlike earlier industrial paradigms that prioritized efficiency and automation, IR 5.0 foregrounds human-centricity, sustainability, and resilience as guiding values. The findings of this structured literature review demonstrate that libraries are no longer positioned merely as technology adopters but are increasingly conceptualized as socio-technical knowledge ecosystems in which human expertise remains central. The analysis reveals that IR 5.0 technologies—such as artificial intelligence, cloud computing, big data analytics, blockchain, and IoT—are predominantly framed in the literature as instruments for service personalization, operational optimization, and enhanced user engagement (Hussain, 2025). However, this study identifies a critical gap between conceptual enthusiasm and practical readiness. While developed countries demonstrate institutional capacity to experiment with these technologies, libraries in developing nations face persistent constraints in funding, infrastructure, and professional competencies. This finding aligns with broader critiques of the adoption of emerging technologies that caution against universalized implementation models. A key contribution of this study is clarifying how IR 5.0 redefines librarians' professional identity. Rather than diminishing human roles, IR 5.0 amplifies the importance of librarians as ethical mediators, data stewards, digital literacy facilitators, and community resilience builders. This role transformation contrasts sharply with Industry 4.0 narratives that emphasized automation and efficiency, often at the expense of human agency. The present findings suggest that successful IR 5.0 integration depends not on replacing librarians with intelligent systems, but on fostering

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meaningful human–technology collaboration. Despite the human-centric rhetoric associated with IR 5.0, the literature remains largely optimistic and insufficiently critical (Hussain, 2023). Ethical risks related to data privacy, algorithmic bias, surveillance, and digital labor intensification are acknowledged only marginally. This study argues that without robust ethical governance frameworks, IR 5.0 technologies may inadvertently exacerbate inequalities and erode trust in library institutions. Therefore, aligning technological innovation with institutional values and social responsibility is essential (Rahman & Hussain, 2026). Furthermore, the review highlights that IR 5.0 implementation in libraries is highly context dependent. In developing countries, where libraries often struggle with basic digital infrastructure, the adoption of advanced technologies must follow a phased and capacity-driven approach. Blind replication of models from technologically advanced contexts risks deepening the digital divide rather than promoting inclusivity. Consequently, IR 5.0 should be interpreted as a strategic vision rather than a prescriptive technological blueprint. In essence, this discussion extends existing literature by shifting the focus from descriptive accounts of IR 5.0 technologies to a critical evaluation of their socio-professional implications. By situating libraries within the broader human-centric ethos of IR 5.0, the study contributes a nuanced understanding of how libraries can remain relevant, ethical, and resilient in an increasingly intelligent yet unequal information landscape.

8. CONCLUSION

Various European countries have recently used the term 5IR, the 5th Industrial Revolution (5.0). It is a new phase of Industrialization in which humans and advanced technology will work together. This revolution reflects a shift from an economic to a social value and well-being approach. Unlike in IR 4.0, it is assumed that the fifth Industrial Revolution will bring prosperity beyond jobs and growth. Some scholars have their views that 5IR has three core values, such as human-centered, sustainability, and resilience; libraries strictly follow the three core values of 5IR. As IR above 5.0 is characterized by a blend of human-centric and advanced AI-driven technologies. The technology of the present revolutions is based on collaboration between humans and intelligent machines to enhance creativity, ethics, and sustainability. Industrial Revolution 5.0 has the potential to transform libraries and librarianship. Libraries have evolved with advanced technology, becoming a hub of personalized learning and community centers. AI-driven technology will help librarians create interactive, immersive information retrieval systems. Industrial Revolution 5.0 mainly focuses on human-machine collaboration; this collaboration will make libraries more supportive of education and sustainable digital engagement. The present revolution is broadly based on a few enabling technologies, such as cloud computing, big data analytics, Blockchain, the Internet of Things (IoT), and 6G networks. As every revolution has its pros and cons, libraries should also consider the pros and cons of the new revolutions. These are costly machines, smart devices, human skills, and data security, in other words. Unlike IR 4.0, it has been argued that 5IR will be more fruitful for different sectors than 4IR. Libraries will gain positive traction in the era of 5IR.

8.1. Implications for Libraries in Developing Countries

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Industrial revolution has gained tremendous attention in advanced countries, however, in developing countries, incorporating IR 5.0 in academic libraries have many barriers. This study explains that to overcome implementation barriers, libraries in developing contexts must take following steps for its implementations:

- Invest in continuous professional development and digital literacy training.
- Adopt phased and context-appropriate technologies.
- Collaborate regionally to share infrastructure and expertise.
- Advocate for national policies supporting digital knowledge institutions

8.2. Recommendations

Based on the findings of the study, the author proposed the following recommendations for the proper implementation of IR 5.0 in academic libraries:

- The finding recommends that academic libraries should develop national-level IR 5.0 policy frameworks for implementation.
- The findings recommend that academic librarians, policymakers, and stakeholders should embed ethics, sustainability, and resilience into library strategic planning while moving into IR 5.0
- The findings recommend that library and information science departments should introduce IR 5.0 competencies into LIS curricula.
- The study's findings recommend that researchers in library and information science departments or academic libraries conduct empirical case studies in developing countries to further highlight the opportunities and challenges relevant to IR 5.0.

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