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Fourth Industrial Revolution (4IR) and Innovative Library and Information Service Delivery

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Abstract: *Fourth industrial revolution is associated with a lot of changes that intends to enforce digitalization, network and virtualization in every aspect of life. It has to do with automation and data exchange in manufacturing technologies which are based on digital technology. The fourth industrial revolution is considered as a phenomenon offer by digital technology revolutions that foster libraries to assume new thinking towards information service delivery. Libraries now use Internet of Things (IoT), artificial intelligence, smart phones, social media, cloud computing, robots in combination with RFID technology and data of bibliographic record to give access to the patrons and general users quality library services through cutting-edge technology. Such kind of newest technology is considered to be the part of the fourth industrial revolutions. More so, the 4IR will bring about a change that will enhance new competences and also result in adjusting and updating of Library and Information Science curriculum that will correspond with the current trends/ Implication of the 4IR challenges traditional boundaries of disciplines. It requires interdisciplinary and collective competencies that integrate knowledge and skills from the fields of machinery production, electronics and information technologies.*

Keywords: fourth industrial revolution (4IR), innovative library and information service delivery

INTRODUCTION

The Fourth Industrial Revolution (4IR) represents the great tectonic shift of our time. It is creating new possibilities for improving people's lives. Disruptive technologies like machine learning, artificial intelligence, and big data are changing the way we live, the way we work and do business, and the way we govern. As a continent that continues to be impacted by historically low levels of development, Africa can and must take advantage of technological advances to industrialize, pursue inclusive growth, and attract investment. It must also be at the forefront of driving new solutions to our developmental challenges, like access to health care and education. South Africa is preparing itself to take the great quantum leap into the future, and in doing so to ensure that technological advances benefit all, and not a select few (Ramaphosa,2019). By 2030, we aim to be a nation that has fully harnessed the potential of

technological innovation to grow our economy and to uplift our people. To this end, we have established a Presidential Commission on the Fourth Industrial Revolution to develop an integrated national response strategy. The commission is composed of representatives of tech startups, academia, cybersecurity specialists, researchers, social scientists, trade unionists, and other representatives from key economic sectors. This commission, which is due to report in early 2020, has various workstreams on issues such as infrastructure and resources, research, technology and innovation, human capital, industrialization, and policy and legislation. Our focus is threefold. First, we need to respond with agility and purpose. Like the self-learning artificial intelligence we have today that was unthinkable a decade ago, we must be adaptive and responsive to the pace of change (Ramaphosa,2019).

Several studies have revealed that fourth industrial revolution has started. It is an era that is using both digital and human element in the workforce. The technology and socioeconomic developments of the modern society is widely discussed and how it will affect the library agenda, policies and the way forward (David-West, 2021). According to Anshari, Syafrudin and Fitriyani (2022) the Fourth Industrial Revolution deploys smart sensors, Cyber-Physical Systems (CPS), Internet of Things (IoT), Internet of Services (IoS), big data and analytics, Augmented Reality (AR), autonomous robots, additive manufacturing (3D Printing), and cloud computing for optimization purposes.

Philbeck and Nicholas, (2019), Macpherson, (1962) in David-West (2021) Industrial Revolutionism are simply eras that introduced and developed technologies, that has to do with changes in technologies that are connected to digital transformation. The first industrial revolution, started in United Kingdom in the 18th century. The steam pressure and mechanical manufacturing was introduced. This however brought a change in the output. This brought about greater productivity that led to urbanization and relevance of democratic government using middle class to western hemisphere. In the educational sector the IIR brought a vision for a new kind of curriculum that has to do with diverse degree options and new general education programs that gave in-depth knowledge about upcoming discipline. The second industrial revolution dated in the period between 1867 and 1914 is a subsequent wave of systems change that brought about the believe that science and technology are the way forward to a better life. The revolution brought a step change in standardization, technical complexity and precision in manufacturing as well as large-scale technological infrastructure, such as electricity and new forms of public transportation based on internal combustion. Also, innovations such as steamship, telephone, gas turbines, artificial intelligence and mass production in the education sector, it brought about new powerful technologies that produce a large crop of new innovative educational institutions. This era was intended to enable industrial classes and open up opportunities for education to be accessible to all. The Fourth Industrial Revolution brings digital transformation by enabling everything to be connected by cyber-physical systems that are smart enough to communicate with one another using common internet-based protocols, to analyze data to detect failure, to configure themselves, and to adapt to changes. Without a doubt, embracing 4IR will result in considerable productivity improvements as processes become faster and more effective, resulting in higher-quality

products at lower costs. However, this raises concerns about the impact of this innovation on the human workforce (Anshari, Syafrudin & Fitriyani 2022).

Philbeck and Nicholas, (2019), Macpherson, (1962) in David-West (2021) asserted that the third industrial revolution began in 1950s leading to the invention of computers and internet. It is characterized as computerization and web-based interconnectivity, the expansion and access to education rose to a greater prominence with globalization of academic research accelerated by online technology. The duplication of new education institutions and new curriculum alter the first two industrial revolution enable the workforce capacity upgrade and to implement the massive expansion of the economy and manufacturing that arose in the twentieth century.

Mazur, (2019) as cited in David-West (2021) expressed that the third industrial revolution brought education to an environment where access to information is immediate and free, shifting focus towards active learning pedagogies that place premium in collaboration within diverse teams and peer learning environments. The 4IR is the prevalent and developing environment in which disruptive technologies and trends are changing the way we live and work. The impact of the 4IR technologies is still unknown. It is certain that it will bring a profound change in every aspect of human endeavor. The need for Library and Information Schools to respond to it is very necessary. It will afford students the opportunity to develop capacity in the fast-emerging area.

Spotti and Windelband (2020), Grim, (2020) in David-West (2021) stated that the fourth industrial revolution is associated with a lot of changes that intends to enforce digitalization, network and virtualization in every aspect of life. It has to do with automation and data exchange in manufacturing technologies which are based on digital technology. More so, the 4IR will bring about a change that will enhance new competences and also result in adjusting and updating of Library and Information Science curriculum that will correspond with the current trends/ Implication of the 4IR challenges traditional boundaries of disciplines. It requires interdisciplinary and collective competencies that integrate knowledge and skills from the fields of machinery production, electronics and information technologies.

In the new technologies' robots, artificial intelligence and biotechnologies are bound to replacing human factor in work. The 4IR has already begun in Europe and in the United States. There is the fact that it will bring about unemployment. Frey & Osborne(2013) in David-West (2021) in their study support that 47% of jobs in US maybe at risk of automation in the near future. This will bring about a future where many of the elements of what we consider as industry labour force within large companies will no longer exist. Emerging technologies has transformed the way library and information services are been delivered to users.

David-West, (2021a) in David-West (2021b) indicated that there is an urgent need for NUC to respond in implementing a new curriculum. Substantial changes to the Library and Information Science curriculum would be reasonable strategy, to allow for students to develop capacity in the rapidly emerging data science, artificial intelligence and Robots etc. Similarly, emphasis

should be placed on computer application, computer programming, software development, JavaScript and network system etc. as a way of 4IR literacy.

Bayne & Jandric, (2017), Zeruodi, (2020) in David-West (2021) expressed that the new emerging technologies will also bring about a paradigm shift on how educators teach, with the evolution of online, artificial intelligence, new guidelines are needed to provide a theoretical basis for digital pedagogy. This emphasize that digital education is more than a purely technical concern, as it changes the dynamics of space and create new types of learning cultures that challenges our motions of what it means to be human. The use of robots in industries may have both positive and negative consequences for human lives. On the negative sides robots maybe considered as a threat for human labour in the sense that, the use of robots significantly reduces labour cost and the like hood of human error can be reduced. Studies support that robots may lift productivity wages and total labour demand, but mostly for the benefit of higher skilled workers. However, individuals have to exploit their comparative advantages such as their cognitive skills and their capability to think out of the box, in order to manage complex situations, capabilities that maybe significantly strengthened by curriculum in countries where people are working with robots, their adaptation to automation is easier and higher in comparison with other countries, where adaptation to automation is slower.

Fourth Industrial Revolution (4IR) Concept

Frederick, (2016) in Chigwada and Chisita (2021) expressed that the Industrial Revolution started during the eighteenth–nineteenth centuries in Europe and America in the iron and textile industries when the steam engine was invented. The Second Industrial Revolution took place from 1870 to 1940 prior to World War II (1939–1945) when steel, oil, electricity, and electric power were used for mass production, telephone, light bulbs, phonograph, and internal combustion engine were developed. Frederick (2016) noted that the phrase 'industrial revolution' is a buzzword that many readers undoubtedly encountered in their school history lessons and likely associated with a time-period lasting from the late eighteenth century to the mid-nineteenth century where small homebased industries gradually succumbed to larger scale production in industrial shops. The industrial revolution was set into motion by technological changes in the form of invention of machines which could manufacture products faster and more efficiently than the home-based craftsperson. The Third Industrial Revolution is regarded as the digital revolution where there was advancement of technology from analogue electronic and mechanical devices to the digital technology from 1980. There was the advent of personal computers, internet, and information communication technology (ICT).

Examining the impact of industry 4.0 on academic libraries is a book that showcases the emerging issues in the Fourth Industrial Revolution. The industry 4.0 era has affected all types of organisations and libraries were not spared in the process. This book provides answers to questions on how academic libraries can adapt to the emerging technologies so as to remain relevant in the institutions of higher learning where they are regarded as the hub of learning, teaching and research. Academic librarians should understand the new services and products that were brought about by the Fourth Industrial Revolution which is also regarded as 4IR or

industry 4.0. Therefore, this book documents original research on the issues, opportunities, challenges and the effects of industry 4.0 on academic libraries. The target audience of this book are professionals, librarians, students, lecturers and researchers working in the field of library and information science, archives and records management, communication sciences, education, and information technology. The publication documents the changes that are taking place in the 4IR and what librarians should do to move along with those changes. The book summarizes the emerging trends and contemporary issues in academic librarianship. The impact of the book would be in providing reference information to students in the library and information science (LIS) schools in institutions of higher learning with the information sources required to gain knowledge and skills of twenty-first century librarianship. Lecturers would also benefit since they would have a reference source in contemporary issues in LIS. Academic librarians would gain the skills and knowledge that are required in offering services in the 4IR. The areas that are covered in the book include the 4IR and libraries, redesigning library spaces such maker space, learning commons, research commons, etc., reference services in the 4IR, electronic information services in the 4IR, research support services, information seeking behaviour in the 4IR, marketing of library services in the 4IR, and capacity building in the 4IR (Chigwada and Chisita 2021).

Mahmood and Hussin (2018); Bloem, et al., (2014) in Mahmood and Hussin (2018) asserted that most of the early technological innovations stemmed from the British. This early technology evolves from time to time on demand as it develops with researchers renovating each study result to produce more efficient technology. The impact of this revolution called the industrial revolution has changed over time the library services. The Industrial Revolution basically is a theory and an improvement that has deeply transformed our society and economy. The industrial revolution history is the main turning point where almost every aspect of everyday life is influenced by it. Some historians argue that the industrial revolution is due to the social and institutional change that took place with the end of Great Britain's system of feudalism after the end of the 17th century English civil war. The late 18th and early 19th centuries is the industrial revolution period when major changes in transportation, agriculture and manufacturing had a major impact on Britain’s socioeconomic and cultural. Here are the reasons for the changes to the industrial revolution: • 1st Industrial Revolution: The source of energy from water and steam technology has generated the mechanical manufacturing industry. • 2nd Industrial Revolution: The discovery of electric energy is witnessing the extensive use of electricity in the industry. • 3rd industrial revolution: The production of digital and industry technology led to the use of computers and the internet. Digital technology also produces new technologies to replace old energy sources. • 4th Industrial Revolution: The 3rd industrial revolution invasion by using supercomputer technology extensively. Data and information are a major source of technological development by producing great technology. In the middle of 2016 the industrial revolution was introduced and in 2017 it began to be said by various industries in the manufacturing, agriculture, education, science and technology sectors, management and so on. Basically the 4th industrial revolution is the digital industry and basically involves the Internet of Things (IoT) in almost all aspects of everyday life and is different from the first industrial revolution focused on the use of vapor-powered machines, second to electricity, and third to the use of information technology (IT). When the digital

industry has become mature, information is available everywhere, anytime and anywhere. These are the collection of great data that available in every form of sources. The combination of large data, physical and analysis technology has changed the way of life. According to Berners-Lee and O'Hara (2013) in Mahmood and Hussin (2018), the internet is to connect people with technology that more effective and comprehensive, such as forums, email, and this coming years, social networking sites. It also relates how we work, communicate and how we learn something. Even though this 4th industry revolution is a threat to humanity, the fact is that if it is observed it can be a turning point to current technology with proper control.

Fourth Industrial Revolution (4IR) and Library Services

Igbokwe-Ibeto, Okonkon and Onuzulike-Chukwuemeka (2022) believed that the world today is undergoing complex and dynamic industrial revolution. Government all over the world are coming up with different ways and methods of addressing the challenges posed by service delivery innovation. The Fourth Industrial Revolution (4IR) is one of the foremost innovations that the human mind has come up with to confront the rising challenges attendant on globalization and industrialization. The first industrial revolution used water and steam power to mechanise production. The second used electric power to create mass production. Ordanini & Parasuranam, 2011; Vargo & Robert, (2008) in Igbokwe-Ibeto, Okonkon and Onuzulike-Chukwuemeka (2022) expressed that the third used electronics and information technology to automate production. Now, a 4IR is building on the third, the digital revolution ensures speed and efficiency that fundamentally alters the way we live, work, and relate to one another in all areas of human endeavours. 4IR is helping to revolutionize the transaction of government business, libraries, knowledge and satellite technologies for communication and displace most human resources activities in organizations. Automated innovations in libraries are having significant effects on employment and work process patterns in the public sector organisations. Mistry & Jalal, (2012), Agbodike & Igbokwe-Ibeto, (2017) as stated in Igbokwe-Ibeto, Okonkon and Onuzulike-Chukwuemeka (2022) opined that Information and Communication Technology (ICT) has brought great innovations in the method and manner interaction, information sharing, inter-agency collaboration and government business transactions are conducted between and within public organizations, individuals and groups. It has brought countries and people of the world closer. Given the complex and hydra headed challenges African countries has had with their development efforts and service delivery innovation over the years, it is argued that electronic government could be of immense help in galvanising inclusive growth and development in Africa. Over the years, emphasis of electronic government has been on how public service delivery can be efficiently and effectively achieved. But little have been written and documented on how the 4IR can help realize the goals of inclusive growth and development in Africa. It is this apparent lacuna that this study seeks to fill. The main objective of this article therefore, is to theoretically and empirically examine how the 4IR can bring about the realization of the goals of inclusive growth and development in Africa and its antecedents and consequences. To analyse the issues central to this study, it is organized into the following compartments. Aside introduction, the first compartment chronicles conceptual and theoretical epistemology. The second carried out an overview of the nature of 4IR, e-government and development in Africa. The third engaged in the analyzing efforts at e-government and e-libraries.

Ukwoma and Iwundu, (2016), The University of South Australia, (2016), Bernard, (2017)as cited in Liman and Abdulkadir (2022) indicated that Libraries are essential to learning, research, generation and preservation of knowledge as well as dissemination of information. The fourth industrial revolution is considered as a phenomenon offer by digital technology revolutions that foster libraries to assume new thinking towards information service delivery. Libraries now use Internet of Things (IoT), artificial intelligence, smart phones, social media, cloud computing, robots in combination with RFID technology and data of bibliographic record to give access to the patrons and general users quality library services through cutting-edge technology. Such kind of newest technology is considered to be the part of the fourth industrial revolutions. However, evidence from literature indicates that many libraries in developing countries are still lagging behind in acquiring knowledge of digital technology. For example, Ansari's (2013) as stated in Liman and Abdulkadir (2022) study indicates that librarians in Pakistan find it difficult to keep pace with new technologies in providing library services. Similarly, Davies (2016) states that libraries in developing countries still find it difficult to download and search online resources, use web technologies, access online information, locate and navigate uniform resource locators (URLs) and perform basic Internet search.

A study by the African Library and Information Association and Institution (2016), (Joint Information System Committee, 2016) indicated in Liman and Abdulkadir (2022) that libraries in some parts of African countries still find it difficult to perform basic tasks of online searching, web technology, understand and use computer hardware and software and perform basic Internet search activities due to poor knowledge of digital technology. Despite these problems, digital technologies have opened up opportunities for libraries to engaging, inspiring, enabling and connecting in information sharing, media lit e r a c y, d i g it a l l e a r n i n g a b ilit y, communication, digital content creation, digital identification and information and communication technology (ICT) services. IFLA (2017) in Liman and Abdulkadir (2022) maintains that libraries require digital technology services in operating computers, ICTs and other digital facilities for development to meet up with the fourth industrial revolution expectations in providing effective and efficient information services. The American Library Association (2015) in Liman and Abdulkadir (2022) also maintains that the ability to access and successfully use digital information is central to library development and advancement with fourth industrial revolution.

Effect of Fourth Industrial Revolution on Library and Information Services

Smith, (2019) as indicated in Chigwada and Chisita (2021) expressed that the 4IR brought about a number of changes in the library and the major change agents are automation and AI. This led to the emergence of other issues such as diverse users, library automation, embedded librarianship, open science, the use of social media platforms, and the changing roles of librarians. Some librarians feel threatened by the revolution and they believe that some certain groups of employees are getting redundant and will be replaced with new workers with the required skills or with machines. The librarians should be able to answer the information needs of diverse users such as the millennial generation, generation X, Y, and Z, and patrons with special needs. Libraries are now promoting digital literacy to ensure that the patrons are able

to access and use the information using various technologies. All librarians' jobs require digital skills and the use of technology is now a basic requirement. During the digital literacy training sessions, librarians would be unpacking issues such as how to deal with the information overload and imparting skills on how to conduct sound research as well as dealing with fake news on the internet. There are some libraries that have adopted Industry 4.0 tools and applications in their day-to-day activities. There is an advanced robotic conveyer system that transports books from Bryant Park off-site storage area to New York Public Library underground. At Connecticut West Port Library, two librarians, Vincent and Nancy are responsible for teaching AI to library users. Some libraries are collecting data using social media tools, drones, cameras, and other Industry 4.0 devices to analyse and use it intelligently. The University of Pretoria employed Libby, a client service robot in May 2019 as a way of evolving in line with the 4IR. According to the University of Pretoria (2019) as stated in Chigwada and Chisita (2021), the robot is responsible for providing guidance, conduct surveys, display marketing videos, and answering questions in library services.

The 4IR brought about many changes which affect the way library services and products are offered. This calls for the need to continuously develop the knowledge and skills of librarians so that they stay abreast of the changes and know how they can positively impact the communities that they serve. There are new services in the research, teaching, and learning and these include big data, research data management, and open science such as open data, open access, open educational resources, and open methodology among other things. This shows that librarians are now taking new roles and responsibilities and they are now regarded as researchers and teachers. Librarians now teach information literacy to impart skills on how to access and evaluate information resources. Therefore, it is important that librarians should develop their skills to remain relevant in the Industry 4.0 era (Chigwada & Chisita 2021).

Priscaru, (2016), Manenti & Johnson, (2019), Ocholla & Ocholla(n.d) as cited in Botha (n.d), asserted that the adoption and utilisation of 4IR-related technology (robotics, user-experience, ask-a-librarian, social media, reference management tools, e-Resources, Research Commons, WiFi access) by libraries in Africa are commendable and provide evidence of the growing commitment and intention of the LIS sector to become increasingly more mature in respect of adopting technology to address disruptive change and to realisation of SDGs. However, it remains critical for libraries to conceptualise, strategise and embrace the 4IR in a holistic and sustainable manner in an effort to be aligned to the design principles and objectives of the 4IR. The afore implies that countries need to consider their entire book publishing and LIS ecosystem when embarking on an ICT strategy related to the 4IR. The adoption of 4IRrelated technologies without considering the wider book publishing and LIS ecosystem will lead to a fragmented approach and towards the 4IR and necessitate the duplication of both efforts and resources and would not contribute towards the achievement of SDGs. Libraries needs to be cognisant that their clients and the expectations of clients have changed dramatically both as a result of the 4IR and because of disruptive change. Libraries therefore needs to migrate to a digital ecosystem where the entire LIS sector are integrated and where the stakeholders and role-players in the publishing and LIS sector form nodes within the ecosystem. The integration of the various nodes within the LIS ecosystem will ensure that disparate technologies are

connected, and that big data can be generated throughout the entire ecosystem regarding the publishing of material, library clients as well as collections. It is only when the design principles of the 4IR relating to inclusivity, interlinkage and interconnection have been considered and addressed that the objective of an inclusive user-centric one-touch experience will be achieved within the LIS sector.

Fourth Industrial Revolution and Sustainable Development Goals

Baheti & Gill, (2011), Gunes et al., (2014), Schwab (2016) in Botha (n.d) explains that in its most fundamental form the 4IR entails the seamless integration of disparate devices within one or more ecosystem on the cloud. The integration of these disparate devices enables the flow of big data that needs to be analysed and contextualised to give effect to informed and accurate decision-making. Essentially, the 4IR is about interconnecting hardware and software as well as physical (and biological systems) by means of the Internet of Things and Devices as well as and People. The afore facilitates an array of continuously pouring live data from the ecosystem or value chain which facilitates access to real-time insight into and visibility of processes and hence enable informed 2 decision-making. The interconnected or inclusive nature of physical and cyber systems facilitates the incorporation of big data from the entire ecosystem as opposed to the implementation of isolated or "stand-alone" technologies. Although the 4IR requires a new way of thinking about libraries it is also evident that the 4IR is largely aligned with the objectives of the SDGs insofar as it makes library collections available to all with a click of a button. The afore emphasises the inclusive nature of the 4IR in the sense that it facilitates a "user-centric one-touch experience" for all library clients and hence create an environment where all have access to library collections. The inclusive nature 4IR and the ability to incorporate the entire publishing and library and information service (LIS) sector implies that it is fully aligned and contributes towards enhancing the reading ecosystem in Africa and hence facilitates the achievement of several SDGs. Evidently and according to the United Nations (2015) access to information and knowledge is a "cross-cutting" responsibility and have an impact on all of the SDGs. The United Nations (2015) continues by articulating the manner in which libraries including national libraries should contribute toward the realisation of SDGs.

Smolan & Erwit, (2012) in Mahmood and Hussin (2018) expressed that People not realized that the industrial revolution it touches their life, moreover, when it is closely related to data revenue. Each of these individuals currently produces and deals with data. Simple daily data is a social posting such as Facebook, twitter, Instagram or communication or connection via messenger or on WhatsApp, to important data such as financial reports, stock markets or currency exchanges involving millions of currencies. Data that keep flowing all the time is described as diverse and unlimited data known as Big Data. Big Data is an explosion of information coupled with the growth of ecosystems of mobile device with fast processor capabilities, high speed Internet access and maturity of data storage technologies. Big data can be defined as a data from traditional and digital sources collection inside and outside the organization that represents a source of ongoing analysis and discovery.

CONCLUSION AND RECOMMENDATIONS

The Fourth Industrial Revolution represents a fundamental change in the way we live, work and relate to one another. It is a new chapter in human development, enabled by extraordinary technology advances commensurate with those of the first, second and third industrial revolutions. These advances are merging the physical, digital and biological worlds in ways that create both huge success. The speed, breadth and depth of this revolution is forcing us to rethink how countries develop, how organisations create value and even what it means to be human. The Fourth Industrial Revolution is about more than just technology-driven change; it is an opportunity to help everyone, including leaders, policy-makers and people from all income groups and nations, to harness converging technologies in order to create an inclusive, human-centred future. The real opportunity is to look beyond technology, and find ways to give the greatest number of people the ability to positively impact their families, organisations and communities. Mailoane, (2021) as stated in Layton-Matthews & Landsberg (n.d) concludes that Strides are being taken in South Africa to integrate innovation and technology into library Sector service delivery strategies. For example, in August 2021, the Gauteng Provincial government launched a 4IR innovation strategy within the Gauteng Centre for Excellence. This will serve to build purposeful connections in supporting new businesses with digital infrastructural technologies. It will provide for transparent procurement platforms and also look at ways in which to advance competitiveness through the adoption of technologies. It will also support research goals around 4IR, especially in the area of service. It aims to identify the skills requirements for future digitalisation in work and social innovation. Finally, it will also explore 4IR governance issues and make recommendations for better governance via digital platforms. This is a direct response to the need to understand the implications of 4IR in public sector service delivery that were identified in the Industrial Revolution SA Digital Economy Summit, hosted by the Gauteng government. The strategy will serve to better support citizens in the spheres of youth development small and medium businesses, and also for employees within the department and library structural changes.

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