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# **Tanzania Modern Librarians in Research and Development Enquiry: A Literature Review**

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## **Abstract**

The modern and advanced development in Information and Communication Technology (ICT) has influenced various changes in the universe and resulted to phases of paradigm shifts and affected individuals, groups, organisations, institutions and states. The globalization of everything has similarly modernized and impacted the academic libraries and librarians. Modern academic libraries strive and undertake this development in facilitating sharing of research data and outputs with its potential stakeholders for Research and Development (R&D). Librarians and have to adapt new and emerging technologies, deploy the web technologies for cyberspaces, smart or digital library information and services, transform to embedded librarians for dynamic collaboration and partnership with stakeholders in sharing experience, research data and products for innovative R&D. Professionalism and personal competencies are the panacea for the modern librarians to remain relevant in the new environment. Technology and knowledge gaps lead to challenges that the modern libraries have to address and sustainably maintain their visibility, collaboration and sharing of research data and products for R&D. More important, modern libraries have to fully embrace the digital innovations, promote linkages and collaboration with R&D institutions or centres. Moreover, they have to integrate various innovative policies which foster sharing of research data and products and to make technology and innovative R&D among the core components of the university functions.

**Keywords:** Modern libraries, emerging technologies, cyberspace, research and development, information technology, Tanzania

## **Introduction**

The modern and advanced development in Information and Communication Technology (ICT) has influenced various changes in the universe and resulted to phases of paradigm shifts and affected individuals, groups, organisations, institutions and states (Lubanga & Mumba, 2021). The industrial sector has moved drastically to the fourth industrial revolution phase and to a large extent this has been contributed by technology and initiatives in Research and Development (R&D). The proactive and modern libraries which undertake the research outputs as the panacea for development have tremendously deployed technology and developed a collaborative network with potential sectors and stakeholders for which these research works are shared (Nitecki & Davis, 2019; Mwilongo, 2021). Research and development is regarded as a creative activity

performed on a systematic grounds to improve collection of knowledge which encompasses the knowledge of man, culture, society and the use of collected knowledge to create new applications (Lubanga & Mumba, 2021). In this regard, modern librarians have to undertake the role played by R&D and develop new or improved research outputs dissemination, services and organise for easy collaborative and sharing to meet stakeholders' expectations and demand for development based on the sustainable and Strategic Development Goals (SDGs) (Lubanga & Mumba, 2021; Mwilongo, 2021). Modern environment and globalization of everything have similarly affected librarians and academic libraries. Librarians have to behave differently from the previous concepts of librarianship as in order for the higher learning institutions to survive and thrive in the future. Librarians have to change and adapt the tremendously evolving external environment (Jantz, 2017; Lubanga & Mumba, 2021). Modern academic librarianship has to consider R&D and innovation in fostering development as the digital environment has impacted and caused uncountable transformations in library products, services and practices (Emezie, 2018). In this age, technology and knowledge management are the two things that have changed a librarian to a modern librarian (Kappi & Chidanandappa, 2018).

### **Background to the Modern Librarians in R&D**

The concepts of modern librarians in R&D can be traced back in the 19<sup>th</sup> Century when most of the developed regions established the use of higher learning institutions in supporting economic development through research works. The prominent developments we can see today from various places over the universe are partly contributed by investments in research in higher learning institutions and the efforts of the academic libraries in research data management and dissemination (Pasipamire, 2017; UNESCO, 2019; Huang *et al.*, 2021). Among other countries, the United States of America (USA), China, Japan and South Korea ever since 1980s have seriously involved academic library research collection for the industrial, innovation and technological development in achieving the global market economy (Khan, 2015; UNESCO, 2019; Huang *et al.*, 2021). Along the same notion, it is empirically evident that R&D have significantly lifted most of the European Union (EU) regions following the initiatives contributed by academic libraries in research data management and collaboration (UNESCO, 2019).

On the other hand, the public has engaged with the academic libraries for technological innovations, search for related research outputs and knowledge enquiry. In this way the public has otherwise established a comprehensive and strong relationship in fostering economic development (Bandura *et al.*, 2019). The integration of academic libraries research data, the collaboration between higher learning institutions and the public and development sectors have impacted the economic development in many regions (Khan, 2015). It is not surprising that the industrial sector is in partnership with academic libraries, particularly on the research outputs and R&D programmes for sufficient absorption of new technologies, knowledge and skills. The sophisticated research and innovation strategies are given high priority in the partnership (Ndaruhutse & Thompson, 2016). On a different note, Khan (2015) establishes that about 27% - 57% of the Australian per capita income and industrial development is contributed by the endeavors of academic libraries research outputs being integrated in the industrial R&D programmes. The Australian economy is anticipated to improve gradually as the efforts on institutional research work is seriously taken on board for progressive economic growth of the country. However, and in some few cases, countries with fewer universities are not benefiting from the initiatives emanating from the academia. For instance, in Singapore, the industrial and

economic development in the country is not significantly earmarked because of limited publications and research works grasped from the few universities (Khan, 2015).

The African academic libraries are contributing to the development in their countries. However, these initiatives remain largely unrecognized by international stakeholders in development (Lynch et al., 2020). In Africa, some academic libraries have established initiatives in research and development to support the states' economic growth. For instance, in Ghana the academic libraries have responded to the United Nation (UN) 2030 agenda for sustainable and Strategic Development Goals (SDGs) on various sectors including economic, environmental and social development (IFLA, 2020; Lynch *et al.*, 2020). According to the International Federation of Library Association (IFLA) and institutions, among other countries, Nigeria, Namibia, South Africa, Tunisia and Kenya have indicated the contribution of academic libraries in research and development for the 17 agendas set by UN and the African Union (AU) ambitions for the academic libraries capacity in fostering development (IFLA, 2020). Other African academic libraries are not featured in this endeavor. For instance, in Zimbabwe, academic libraries are not ready to offer research and development services. Libraries lack the necessary capabilities related to comprehensive laws and policies, manpower, dynamic technological infrastructures and collaborative partnership to support research and development activities (Nhendodzashe & Pasipamire, 2017).

Modern academic libraries and librarians have to innovatively adopt the globalization enquiry of research outputs by collaborating with sectors, including but not limited to industries and decision and policy makers for development (Lubanga & Mumba, 2021). In light of this, academic libraries have to be aggressive and review their research output policies and services to remain relevant, maintain a place and be functional in R&D programs (Tella, 2020a). In a very special note, the 5<sup>th</sup> East African Community (EAC) (2016) Development Strategy for the period of 2016/17-2020/21 outlines the broad strategic development objectives that the community will pursue in five years. The overall goal of the 5<sup>th</sup> EAC Development Strategy is to build a firm foundation for transforming EAC into a stable, competitive and sustainable lower-middle income region by 2021. Among the key priorities of the EAC is to transform institutions at the regional and partner state levels. In this regard, the community aims at bringing together the academia, public and private sectors to create linkages for sustainable development (EAC, 2016). The linkages have to focus toward academia research data management, sharing and dissemination to the public and private sectors for economic, innovation and new products development.

In Tanzania, academic libraries for so long have been engaged in collecting research works, managing and disseminating to the academic community and researchers. For instance, the University of Dar es Salaam has an East Africana collection of various publications including research works which is always used by researchers and postgraduate students (University of Dar es Salaam Library, 2021). Research outputs related to engineering, technology and innovation can be shared with industrial sectors for innovations and new product development (Mwilongo, 2021). However, efforts to such endeavor have not yet earmarked, though it is well known that in Tanzania research data transfer procedures were developed in 2010 to enable sharing of research works between Tanzania and foreign institutions and any other stakeholders (Mushi, Mwantimwa & Wema, 2020). In the study by Mushi, Pienaar and Deventer (2020) on identifying and implementing relevant research data management services for the library at the University of

Dodoma, they insist and recommend researchers and university management to collaborate and make their data accessible to the community for improving research and development. Moreover, academic libraries have to sincerely collaborate and join efforts with various research and development institutions or agencies including the Research on Poverty Alleviation (REPOA), Economic and Social Research Foundation (ESRF) and Tanzania Commission for Science and Technology (COSTECH) in meeting the community and stakeholders needs in research and development (Mwilongo, 2021).

### **Modern Academic Libraries in Research and Development**

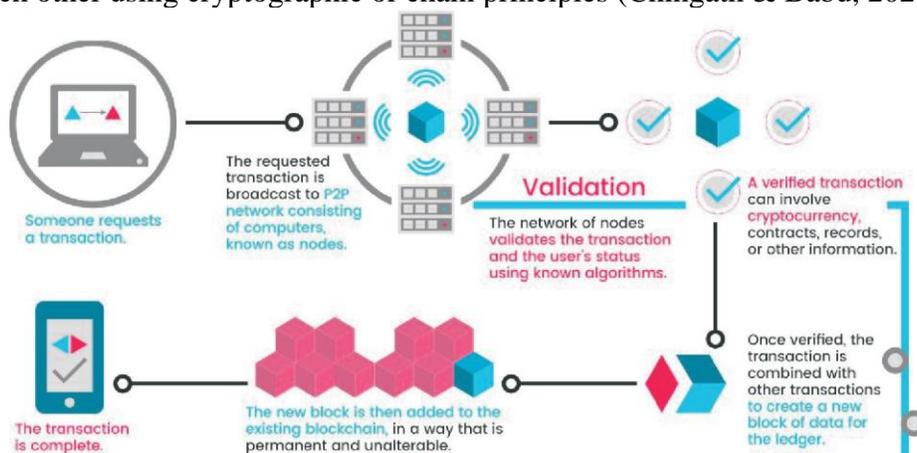
In the modern academic environment coupled with technological changes, means of information dissemination and communication networks influence the emergent of modern librarians who can extend their roles and become partners and leaders in making sure that research outputs are easily found, accessed, interoperated and reused (Lubanga & Mumba, 2021). Modern academic libraries collaboration among research and development institutions, industries, experts in technology and innovation are fundamental for communication networks (Nitecki & Davis, 2019). In this regard, modern librarians are regarded as intellectual entrepreneurs as they shift from service support to a partnership kind of service. Modern librarians have to be aware of the information marketplace and can be able to contribute into the development, marketing and use of information products (Hashim & Mokhtar, 2012). On this, the collaborating stakeholders have to share common interests of advancing science and scholarship relationships for new products development, sustainability and directives to the achievement of the strategic development goals (Nitecki & Davis, 2019; Masinde *et al.*, 2021).

The emerging technologies have opened a new page in modern academic libraries and librarians (Chingath & Babu, 2020). Emerging describes the process of coming into being, becoming important and prominent, rising up or come forth, become evident and then come into existence (Rotolo *et al.*, 2015). In this regard, emerging technology is an invention that is in an early stage of development and its technological characteristics and context of use and their related roles are still uncertain and non-specific (Atkinson, 2018). The academic libraries and librarians have to be competent with this endeavor and strategize the best ways that can fit in for entrepreneurship, research data management and collaboration (Mohammadi & Yegane, 2021). The emerging information technologies include among others; the Internet of Things (IoT), Big data, Artificial Intelligence (AI), Blockchain and Cloud computing. These technologies are crucial in modernising the academic libraries. For instance the Internet of Things (IoT) can assist librarians and information professionals to build up smart libraries (Atkinson, 2018; Pavithra *et al.*, 2019; Chingath & Babu, 2020; Mohammadi & Yegane, 2021). With smart library, all objects and devices can be interconnected and share information from the entire object within and outside the library to make a linked data technology. Various library users and other stakeholders can be connected to the library resources, services and have access at any place in 24/7. WorldCat presents a good example of linked data technology from which over 197 million bibliographic information, including authors, titles, descriptions, subjects, years, pages and other relevant information are shared all over the world (Kumar, 2016). The components of a smart library serve many functions in the library and are effective in terms of cost, big data management, security of the networked infrastructures and processed data shared through the smart devices.



**Figure 1:** *Smart Library*  
**Source:** Mohammadi and Yegane (2021)

Big data can facilitate organisation of large volumes of research data and make it possible for integration with the smart library using the IoT technology for sharing with stakeholders (Garoufallou & Gaitanou, 2021). With big data management, librarians can be able to analyse, systematically extract research data and reports and share for research and development (Tella, 2020a). On the other hand, blockchain technology provides a crucial means of sharing information which can be organised in blocks and verified by experts and be added into the sharing chain within the networked infrastructure. This technology has similarly found its way in modern libraries and librarians where research data management can be established in blocks with respect to its contribution or function in R&D. Each of these blocks of data is secured and bound to each other using cryptographic or chain principles (Chingath & Babu, 2020).



**Figure 2:** *Operation of Blockchain*  
**Source:** Chingath and Babu (2020)

Modern academic libraries have to effectively and sustainably deploy Internet services for cloud computing and improve sharing of research data for development. Cloud computing is the delivery of different services through the Internet. Infrastructures for cloud computing include tools and applications such as data storage, servers, databases, networking and software (Frankenfield, 2020). Cloud computing in modern academic libraries ensures possibilities for innovation, flexibility in resources mobilisation and economies of scale (Tella, 2020a). It helps in the integration of research data and information management in an easy manner and provision of users and stakeholders centred multi-level information and services. Digital libraries and social networking with research data and information users and stakeholders have made simple with cloud computing. On the same vein, Artificial Intelligence (AI) are machines such as robots or computer systems which are used to simulate human intelligence processes. It refers to a set of computational techniques inspired by the way humans use their nervous systems and bodies to feel, learn and act (Wheatley & Hervieux, 2019).

Despite its broad application in the fields of human life, AI is more prominent in education institutions and universities (Aldosari, 2020). With big data, modern libraries require intelligent performance machines or robots to overcome the consequences of the data produced (Bonami *et al.*, 2020). It is always expected that in sharing and disseminating research data, a library is considered as a pioneer in the quest for innovation and is viewed as an agent of change. It is however surprising that, for instance, in a study by Wheatley and Hervieux (2019) on environmental scan of AI, over 27 top research universities in the United States and Canada, it was observed that 5(18.5%) university libraries offered programming and collaborative services related to AI and 22(81.5%) libraries operated without AI programs and services. Despite the fact that robots save space, time and ease sharing of big data collection, they can automatically collect big data for research and development, transfer from collection or storage to the point of enquiry for use. In this regard, modern librarians have to be more technological literate to provide for human and robots mutual relationship and work together (Tella, 2020b).

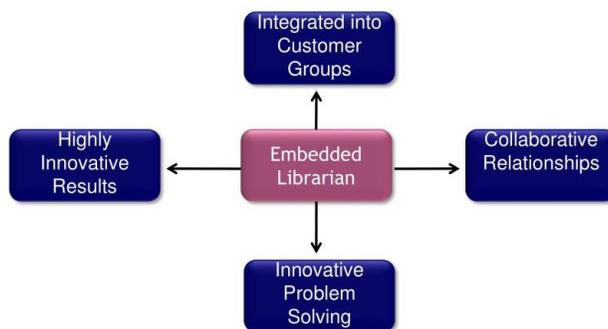
Cyberspace is a growing technology that has prominence in modern libraries. It has revolutionised libraries to cybrary or virtual library which has changed most of the libraries to cyberspace (Banker & Barot, 2017). Modern academic libraries have to struggle for the space and remain sustainable in meeting the needs of society and for economic development (Hongisto, 2019). Cybrarian describes the library staff in a cybrary or virtual library who works for information and data management through Internet and other online resources. Cybrarian use cyberspace and more of web content in order to reach the community. They are to perform data mining, using appropriate technologies such as big data, blockchain and cloud computing and easily disseminate to meet the user needs and for community development (Banker & Barot, 2017; Hongisto, 2019). Modern academic libraries have to use networks of potential stakeholders including industries, private and public economic development agencies and organisations to meet their enquiry in research and development (Kato *et al.*, 2021; Mwilongo, 2021).

Modern academic libraries have to adapt the embedded librarianship which entirely focuses at enhancing and maintaining close coordination and collaboration with stakeholders including the academic community, researchers, public and private organisations, industries and government agencies toward identifying information needs, sharing information services and products (Mushi, Mwantimwa & Wema, 2020). Embedded librarianship forms a new recommended

approach which is valuable to modern academic librarians and outside the academic library walls (Madu & Dawha, 2019). An embedded librarian refers to a library professional who focuses on the needs of one or more specific clients, establishing relationships with such specific clients, developing an understanding of their work, and providing information services that are highly customized and targeted to their greatest needs (Madu & Camble, 2020; Power & Munro, 2021). However, embedded librarianship is still in its infancy and perceived as an emerging model in most developing countries, and the strategy for how to succeed is not fully established. For instance, Mushi, Mwantimwa and Wema (2020:3) point that;

The question as to why academic libraries in Tanzania are not fully practicing embedded librarianship remains unanswered. Indeed, librarians’ perceptions and attitudes on practicing embedded librarianship in academic libraries in Tanzania seem to be unexplored.

### **EMBEDDED LIBRARIANSHIP** WORKING DEFINITION



**Figure 3: Embedded Librarianship**  
**Source: Madu and Camble (2020)**

Embedded Librarianship Model is more prominent in the United States of America (USA) and European academic libraries (Shin, 2020). Effective engagement of embedded librarianship model impacts the modern academic libraries through promoting professional development programs, protecting professional prestige, enhancing the value of modern librarians, increasing the use of library services and resources to meet the society needs in research and development, new product development and promote academic libraries and social development (Madu & Camble, 2020; Shin, 2020; Power & Munro, 2021).

#### **Roles of Modern Librarians in R&D Enquiry**

Modern librarians are crucial now for not only their high level of expertise but because the libraries are changing from the storehouse of information resources to dynamic service centers (Pal, 2015; Shin, 2020). In the 21<sup>st</sup> Century, librarians have to be modern following the advanced changes in information management systems and the models of sharing resources based on the modern user information needs (Marwala, 2019). Modern librarians are currently facing pressure to equip themselves with multiple new skills and knowledge. The changing technological

environment and information management system forces them to merge new technical as well as professional competencies to remain valid. Modern librarians have to operate as data scientists, digital content developers, digital user advisors, community engagement and outreach experts (Marwala, 2019; Shin, 2020). Concerning this, De Mauro et al. (2018:8) opine that;

Data scientist has the ability to identify patterns, apply context and intelligence, extract relevant information hidden in the large volumes of data, design and implement data models and statistical methods, integrate research and best practices into problem avoidance and continuous improvement.

In the presence of information technology overload, modern librarians must be proactive and relevant in the way they deliver information products and services to the esteemed stakeholders (Lubanga & Mumba, 2021). Research and development enquiry and new technological changes with regard to information management system, web technologies, smart libraries and ways of sharing information resources and particularly research data outputs placed academic libraries under siege and challenged whether librarians and information professionals would continue to exist or should perish (Hashim & Mokhtar, 2012; Marwala, 2019; Shin, 2020; Lubanga & Mumba, 2021).

Based on the needs for information on research and development for economic and community growth, modern librarians have to ensure that contractual, legal and ethical obligations regarding sharing of research data and products for development are met (Hashim & Mokhtar, 2012). In light of this, modern librarians require to be professionally and personally competent while characterised by transferable skills which enable them to manage the changing work environment. Professional competencies relate to the specific knowledge in the areas of information resources, information access, technology, management and research and the ability to use these areas of knowledge as a basis for providing access to specific information and services (Hashim & Mokhtar, 2012; Pal, 2015; Banker Barot, 2017; Marwala, 2019). On the same vein, modern librarians should be able to manage the digital information system as this encompasses the overall competencies on knowledge, know-how, skills and attitudes (Hashim & Mokhtar, 2012; Pal, 2015). The latter competencies are necessary in research data and other digital information development, storage, analysis, organization, retrieve and dissemination of digital information in the form of text, image, sound or any format of information by using appropriate information management systems, networks and any web based technology. They have a role of assessing research and development information needs and designs and markets value-added information services and products to meet identified needs (Marwala, 2019).

Modern libraries require staff with personal competencies which represent a set of skills such as soft and technical skills (Hanchinal, 2014 as cited by Joseph & Devi, 2020) but also attitudes and values that enable modern librarians to work efficiently; be good in communication, focus on continuing learning throughout their careers, demonstrate the value-added nature of their contributions, and survive in the new world of work (Hashim & Mokhtar, 2012). In addition, modern librarians have to be excellently committed to services, seek out challenges and see new opportunities, both inside and outside the library, see the big picture of the library information

resources and services, create an environment of mutual respect and trust, work well with others in a team, networks cyberspace and the collaborating stakeholders, plan, prioritize and focus on what is critical (Madu & Dawha, 2019; Shin, 2020). Also, they have to show commitment to lifelong learning and personal career planning, have personal business skills and create new opportunities for proliferation, recognize the value of professional networking and solidarity and be flexible and positive in a time of continuing change and in R&D collaborative network (Pal, 2015; Banker Barot, 2017; Marwala, 2019).

In general, the role of modern librarians with regard to R&D enquiry, brings attention to the fact that they should have vision towards information and knowledge rich society by considering that, research data and products are potential drivers in boosting the economy (knowledge-based economy). They should consider research data and products management as an important discipline and commodity for economic development and recognize it as power, strength and weapon (Banker & Barot, 2017). On the other hand, research data and products have to be linked to policy and decision-makers, strategic management, competitive advantage and innovation. Similarly, research data and their outputs have to be globalized through integrated mushrooming information systems, cyberspaces, smart or virtual libraries and web technologies for reference and development (Pal, 2015). They have also to develop expertise in the use of innovative emerging technologies to design and develop web-based applications, programmes and services for sharing research data and products. Moreover, modern librarians have to assess, understand, think and adopt changes fit to the requirements in research and development rather than being blind followers of versatile technological developments (Marwala, 2019). These roles answer frequently asked questions that: are libraries inefficient, limited or obsolete? Is there a need for academic libraries and librarians in the modern library environment? (Halder, 2009; Lubanga & Mumba, 2021).

### **Challenges of Modern Academic Libraries in Sharing Information Resources for R&D**

The advanced technological development in information management has resulted to big data which on the other hand has challenged academic libraries in managing and disseminating information (Garoufallou & Gaitanou, 2021). The industrial revolution has been successful because of big data and other technologies that have contributed to research and development to this endeavor. Modern academic libraries, research institutions, agencies and organisations have contributed towards this industrial paradigm shift. Developed countries including USA, UK, Japan and South Korea have shown the contribution of academic libraries in their economic and community development (Khan, 2015; Penprase, 2018; UNESCO, 2019). However, in developing countries and Tanzania academic libraries being inclusive, their role in contributing to economic and community development through research data and products has not adequately been visualized (Bandura *et al.*, 2019; Mushi, Mwantimwa & Wema, 2020). The following are the main challenges of modern librarians in sharing research data and products for sustainable and innovative R&D (Kappi& Chidanandappa, 2018; Manda & Dhaou, 2019; Wheatley & Hervieux, 2019; Garoufallou & Gaitanou, 2021; Popova, 2021):

- i. Ability to find ways to extract value from the research data and products and provide better services to researchers and other stakeholders in need of the information for R&D;

- ii. An experienced historical background on reluctance to adapt technological changes; often one waits for a particular technology to reach market saturation before reacting to a new trend;
- iii. Ability to establish and engage into R&D networks, collaborations, cooperation and stakeholders involvement;
- iv. Availability and reliable policy, legal issues and information management systems for handling research data and products such as preservation of digital research data and products;
- v. Ability to meet the growing and diverse spectrum of R&D enquirers;
- vi. Availability of subject matter expertise, commitment and advocacy;
- vii. Insufficient resources and particularly funds for establishing research data and products management, professional development programmes, networking and training;
- viii. Lack of innovative human capital, technological and infrastructural challenges are remarkable in fostering sharing research data and products in developing countries;
- ix. Poor broadband penetration or low speed Internet access in developing countries is not convincing for the modern academic libraries and research institutions which are drivers of knowledge, innovation and sharing; and
- x. With big research data products and fused technology for information systems in sharing information to a diverse spectrum of customers may bring challenges on issues of data security, privacy, and authentication for efficiency and flexibility in collaborative value network and smart chain of production and sharing systems.

### **Suggested Ways to Overcome the Challenges**

Librarians' roles have naturally changed and evolved through time. Technology and knowledge have transformed the way academic libraries interact with users of all kinds and with varying information needs. Web technologies have advanced to virtual, smart or digital library services and thus drastically affected the mode of services and professionalism. Given the importance of research data and products in R&D, modern academic libraries with smart services and collaborative networks have to remain sustainable while striving towards addressing the challenges by providing the best ways so as to remain professionally and technologically abreast (Banker & Barot, 2017; Kappi & Chidanandappa, 2018; Nitecki & Davis, 2019; Chingath & Babu, 2020; Mushi, Mwantimwa & Wema, 2020; Mwilongo, 2021). In light of this, the following recommend the best ways to overcome the prevailing challenges:

- i. Modern academic libraries and librarians have to fully embrace the digital innovations by being curious, less bureaucratic, more flexible in adapting changes while carrying out more and better advocacy at all levels. Modernising most of the traditional functions, realizing and understanding better the needs of the potential stakeholders with regard to R&D. Developing effective services and maintain ethics and morality in behavior, high professionalism and collegiality, loyalty to the university, stakeholders and teamwork, vision for the future and perspectives, as well as the ability to achieve them.
- ii. Promote linkages and collaboration between modern academic libraries, R&D institutions or centres on the one hand and potential stakeholders or industries at local and international levels on the other hand. It is also important to invest in modern academic libraries in order to foster adoption of emerging technologies, decrease knowledge gaps,

enhance embedded librarianship, and improve visibility, sustainability and improve linkage on innovation R&D for economic growth.

- iii. Integration of various innovative policies including ICT policy, industrial policy, R&D policy, National broadband policy, modern academic library policy and cyber-security policy. Additionally, an intellectual diaspora policy can be established to ensure that such a network connects modern academic libraries to the global knowledge community, provide opportunities for partnership and development particularly on innovation, technology and research.
- iv. Universities should revise their core functions and may establish innovative R&D centre for stakeholders such as industrial practitioners and investors' access. The centres should develop information management system, operational policies, procedures and incentives for academics and researchers in various disciplines to address problems related to economic and industrial development. The centre may however help to develop competencies in solving problems through technology.

## **Conclusion**

Modern academic libraries have to sustainably remain relevant despite the challenges of knowledge and technological development in sharing research data and products. Economic development and community well-being are partly the results of the initiatives of the academic libraries' contribution in innovative R&D. Academic libraries have to fully exploit technology which is giving opportunities for them to grow and make best utilization of the opportunities to provide better services and face the challenges to prepare them for the future. Modern librarians have to adapt new environment of collaboration with the community in R&D and strive to enhance the stakeholders' experience. Much of the traditional functions on research data and product collection management are rapidly losing their status as primary responsibility of librarians, while new functions related to research support, research data management, digital initiatives, use of emerging technologies, embedded librarianship, cybrarian, sharing research data and products for R&D and stakeholders' experience are increasing and becoming part of the modern academic librarians' responsibilities. Modern academic libraries have to strategically maintain this endeavour and address the possible challenges to their capacity while planning for the complex problems. In the end, academic libraries can deliberately achieve tangible and measurable efforts which promote and create conducive information management system for innovative R&D.

## **References**

- Aldosari, S.A.M. (2020). The future of higher education in the light of artificial intelligence transformations, *International Journal of Higher Education*, 9(3):145–151. <https://doi.org/10.5430/ijhe.v9n3p145>.
- Atkinson, R.D. (2018). Emerging technologies and preparing for the future labor market. *Information Technology & Innovation Foundation*, March, 1<sup>st</sup>–26<sup>th</sup>. <http://www2.itif.org/2018-emerging-technology-future-labor.pdf>.
- Bandura, R., Campbell-Zausner, C., Carter, W., Hammond, M., Jorge, S., Klynge, C., Milner, A.,

- Nakagaki, M., Raymond, P., Rubin, N., Runde, D. F., & Zausner, S. (2019). *Beyond technology: The Fourth Industrial Revolution in the Developing World, A Report of the CSIS Project on Prosperity and Development* (Issued in May). <https://doi.org/10.1145/944596.944597>
- Banker, A.U. & Barot, V.P. (2017). Transforming libraries into digital era: A journey from librarian to cybrarian, *2nd National Conference On Transforming Libraries into Digital Era A Journey from Librarian to Cybrarian 23<sup>rd</sup> April 2017 at the C.U. Shah University, Wadhwan City, April.*
- Bonami, B., Piazzentini, L., & Dala-Possa, A. (2020). Educación, big data and artificial intelligence, *Media Education Research Journal*, 5(65): 43–52.
- Chingath, V., & Babu, R.H. (2020). Advantage of blockchain technology for the libraries. *International Conference On Digital Transformation: A Cognitive Learning towards Artificial Intelligence*, May, 127–134. [https://www.researchgate.net/publication/341725555\\_Advantage\\_Blockchain\\_Technology\\_for\\_the\\_Libraries](https://www.researchgate.net/publication/341725555_Advantage_Blockchain_Technology_for_the_Libraries).
- De Mauro, A., Greco, M., Grimaldi, M., & Ritala, P. (2018). Human resources for big data professions: A systematic classification of job roles and required skill sets. *Information Processing and Management*, 54(5): 807–817. <https://doi.org/10.1016/j.ipm.2017.05.004>.
- East Africa Community (EAC). (2016). Development strategy 2016/17-2020/21: Accelerating a people-centered and market-driven integration, *EAC Development Strategy I* (2016).
- Emezie, N. (2018). Stepping up the ladder to meet user needs : Innovative library services and practices in a Nigerian University of Technology, *Library Philosophy and Practice (e-Journal)* 1767, 1–20. <https://digitalcommons.unl.edu/libphilprac/1767>
- Frankenfield, J. (2020). Cloud computing, Available at <https://www.investopedia.com/terms/c/cloud-computing.asp>, (Accessed; 26<sup>th</sup> September 2021).
- Garoufallou, E., & Gaitanou, P. (2021). Big data: Opportunities and challenges in libraries, a systematic literature review. *College and Research Libraries*, 82(3): 410–435. <https://doi.org/10.5860/crl.82.3.410>.
- Halder, S.N. (2009). Multimodal roles of library and information science professionals in present era, *Journal of Library and Information Science*, 1(6): 92–99. [www.academicjournals.org/ijlis/pdf/pdf2009/nov/halder.pdf](http://www.academicjournals.org/ijlis/pdf/pdf2009/nov/halder.pdf).
- Hashim, L., & Mokhtar, W.N.H. (2012). Preparing new era librarians and information professionals : Trends and issues, *International Journal of Humanities and Social Science*, 2(7): 151–156.
- Hongisto, S.L. (2019). Cybrarian - the new digital librarianship: Cybrarian serving digital natives in hybrid libraries, *Thesis report*, Finland: Oulu University of applied science.
- Huang, Y., Cox, A.M., & Scaffi, L. (2021). Research data management policy and practice in Chinese University libraries, *Journal of the Association for Information Science and*

- Technology*, 72(4): 493–506, <https://doi.org/10.1002/asi.24413>.
- International Federation of Library Association (IFLA). (2020). Library map of the world, Available at: <https://librarymap.ifla.org/stories>, (Accessed on 26<sup>th</sup> September, 2021).
- Jantz, R.C. (2017). Creating the innovative library culture: Escaping the iron cage through management innovation, *New Review of Academic Librarianship*, 23(4): 323–328. <https://doi.org/10.1080/13614533.2017.1388055>.
- Joseph, S.A., & Devi, B.M. (2020). Soft skills for library professionals. *ILIS Journal of Librarianship and Informatics*, 3(1): 95–98.
- Kappi, M. & Chidanandappa, S.C. (2018). Managing modern libraries: Challenges for academic libraries in the 21<sup>st</sup> Century, *Journal of Emerging Technologies and Innovative Research*, 5(11): 648–651.
- Kato, A., Kisangiri, M. & Kaijage, S. (2021). A review development of digital library resources at university level, *Hindawi Education Research International*, 2021(1): 1–13.
- Khan, J. (2015). The role of research and development in economic growth: A review, *Journal of Economics Bibliography*, 2(3): 128–133, <https://doi.org/10.1453/jeb.v2i3.480>.
- Kumar, S. (2016). Application of Internet of Things (IoT) technology in library management and service, *International Journal of Scientific & Innovative Research Studies (IJSIRS)*, 4(2): 1–8.
- Lubanga, S., & Mumba, J. (2021). Research and Development (R&D), creativity and innovation in academic libraries in Malawi: A way to rethink library development in the 21<sup>st</sup> Century, Available at: SSRN, <https://doi.org/10.2139/ssrn.3867430>, (Accessed on 26<sup>th</sup> September, 2021).
- Lynch, R., Young, J.C., Jowaisas, C., Boakye-Achampong, S., & Sam, J. (2020). African libraries in development: Perceptions and possibilities, *International Information and Library Review*, 0(0): 1–14, <https://doi.org/10.1080/10572317.2020.1840002>.
- Madu, A.U., & Camble, E. (2020). Indicators of embedded librarianship and the effects on practice by librarians in Northeast University Libraries, *Asian Journal of Information Science and Technology*, 10(1): 6–15, <https://doi.org/10.51983/ajist-2020.10.1.302>
- Madu, A.U., & Dawha, E.M.K. (2019). Analyses of awareness, perception and attitude towards embedded librarianship among librarians in North-Eastern Universities, Nigeria, *Asian Journal of Information Science and Technology*, 9(3): 37–43, <https://doi.org/10.51983/ajist-2019.9.3.290>.
- Marwala, T. (2019). Preparing for the fourth industrial revolution, *World Intellectual Property Organization*, 11 (November), 1–46.
- Masinde, J., Chen, J., Wambiri, D., & Mumo, A. (2021). Research librarians' experience of research data management activities at an academic library in a developing country, *Data and Information Management*, 5(4): 1–13, <https://doi.org/10.2478/dim-2021-0002>.
- Mohammadi, M., & Yegane, M.E. (2021). How can we equip academic libraries with IoT

- technologies: Practical guidelines, *International Journal of Digital Content Management* 1(2): 71-84.
- Mushi, C., Mwantimwa, K. & Wema, E. (2020). Perceptions of librarians towards the adoption of embedded librarianship in Tanzania, *University of Dar Es Salaam Library Journal*, 15(2): 21–38.
- Mushi, G.E., Pienaar, H., & Deventer, M.V. (2020). Identifying and implementing relevant research data management services for the library at the university of dodoma, Tanzania. *Data Science Journal*, 19(1): 1–9, <https://doi.org/10.5334/dsj-2020-001>.
- Mwilongo, K.J. (2021). Integration of Higher Learning Institution Research Outputs into Industrial and Economic Development in Tanzania. In Amutabi, M.N. (ed.), *New Realities in Africa*, Nairobi: Center for Democracy, Research and Development (CEDRED).
- Ndaruhutse, S. & Thompson, S. (2016). Literature review: Higher education and development, Commissioned by Norad for Norhed conference on Knowledge for Development Oslo , 6<sup>th</sup>-7<sup>th</sup> June 2016, pp. 1–30.
- Nhendodzashe, N., & Pasipamire, N. (2017). Research data management services: Are academic libraries in Zimbabwe ready? The case of University of Zimbabwe library. *IFLA Wlic 2017*, 1–12. <http://library.ifla.org/1728/1/S06-nhendodzashe-en.pdf>.
- Nitecki, D.A., & Davis, M.E.K. (2019). Expanding academic librarians' roles in the research life cycle, *Libri*, 69(2): 117–125, <https://doi.org/10.1515/libri-2018-0066>.
- Pal, S.K. (2015). Role of librarian (Cybrarian) in the modern library (Cybrary): With special reference to research library (Issue October 2012).
- Pavithra, A., Anandhakumar, C., & Meenashisundharam, V.N. (2019). Internet of things with big data analytics: A Survey, *International Journal of Scientific Research in Computer Science Applications and Management Studies*, 8(1): 1–4.
- Penprase, B.E. (2018). The Fourth Industrial Revolution and Higher Education. In Gleason, N. W. (ed.), *Higher Education in the Era of the Fourth Industrial Revolution* (pp. 207–229). USA: Soka University of America, Aliso Viejo, CA. <https://doi.org/10.1007/978-981-13-0194-0>.
- Popova, E. (2021). *Library and Society: Contemporary Challenges* (1st Edition), Bulgaria: St. Kliment Ohridski University Press.
- Power, H., & Munro, S. (2021). Move Out and Move in: An Embedded Approach to Liaison Roles. In Canuel, R. & Crichton, C. (Eds), *Approaches to Liaison Librarianship: Innovations in Organization and Engagement* (pp. 99–114). Association of College and Research Libraries.
- Rotolo, D., Hicks, D., & Martin, B.R. (2015). What is an emerging technology? *Research Policy*, 44(10): 1827–1843, <https://doi.org/10.1016/j.respol.2015.06.006>.
- Shin, E.J. (2020). Embedded librarians as research partners in South Korea, *Journal of Librarianship and Information Science*, 53(3): 466–474,

<https://doi.org/10.1177/0961000620962550>.

- Tella, A. (2020a). Repackaging LIS professionals and libraries for the fourth industrial revolution, *Library Hi Tech News*, 37(8): 1–6, <https://doi.org/10.1108/LHTN-02-2020-0016>.
- Tella, A. (2020b). Robots are coming to the libraries: are librarians ready to accommodate them? *Library Hi Tech News*, 37(8): 13–17, <https://doi.org/10.1108/LHTN-05-2020-0047>.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (2019). Global Investments in R&D. In *Sustainable Development Goals* (Vol. 54, Issue 54). <http://uis.unesco.org/sites/default/files/documents/fs54-global-investments-rd-2019-en.pdf>.
- University of Dar es Salaam Library (2021). East Africana Collection, Available at: <https://www.udsm.ac.tz/web/index.php/institutes/library/east-africana-collection>, (Accessed on 26<sup>th</sup> September, 2021).
- Wheatley, A. & Hervieux, S. (2019). Artificial intelligence in academic libraries: An environmental scan *Information Services & Use*, 39(4): 347–356. <https://doi.org/10.3233/isu-190065>.