Library in the Context of the Industrial Revolution 4.0: Trends, Opportunities and Challenges

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ABSTRACT

The Industrial Revolution 4.0 was formed on the basis of the digital revolution, especially the popularity of the Internet. The core of the revolution is the development of a system linking the real and virtual world basing on the Internet of Things (IoT) and Internet of Systems (IOS). What have libraries been doing and will do on encountering these opportunities and challenges? The article discusses the development trends of libraries in the context of the Industrial Revolution 4.0 and its opportunities and challenges in the digital era.

Keywords: *The Industrial Revolution 4.0, Library 4.0, Intelligent Digital Library, Internet of Things, Big Data, Library service.*

1. INTRODUCTION

Since the 90s, libraries in Vietnam have gradually transformed from traditional models to modern ones such as building bibliographic databases and supporting searching information. In the early twenty-first century, Vietnamese libraries applied more modern tools such as the application of library management software. Nowadays, digital libraries have become quite popular. Apart from integrated library management software, libraries have used a number of specialized software such as digital resource management, centralized search software with cloud computing technology, thereby helping the library achieve higher operational efficiency.

Along with other professions, the information and library industry has also entered the era of the fourth industrial revolution (Industrial Revolution 4.0) with the development based on 3 main pillars of digital, biological technology and physics. In particular, digital development is based on the core elements like Artificial Intelligence (AI), Internet of Things, (IoT) and Big Data (Big Data) that are directly related to the information and library section. This is believed to bring a huge change in the provision of information to users (Cao M.K., 2019).

2. DEVELOPMENT TRENDS OF LIBRARY 4.0

As mentioned above, Industrial Revolution 4.0 is developed based on three main factors as Artificial Intelligence (AI), Internet of things (IoT) and Big Data (Big Data), of which the foundation is the application of Information and Communication Technology (ICT). Any sections or fields pursuing the development in the context of the Industrial Revolution 4.0 will be affected by these factors and the information and library industry cannot be exclusive of this trend. The core of library 4.0 is the result of the application of ICT, connecting various sources from many parts of the world to serve the users at any time and anywhere. In addition to this, it is the combination of user data, lookup data and other resources to create a big and complete data set (Big Data) to meet the needs of users of any fields (Cao M.K., 2019).

In his research, Nguyen, H.S., (2011) stated "digital library is an ideal space for digital knowledge exchange, constructing an unprecedented reading culture in the world history and sparking creativity for decisive inventions in the development of human intelligence". Therefore, the digital library is not only regarded as one of the determining foundations for the policy of the knowledge economy development and a country's competitive position in the international arena but also a constitutional factor of the national knowledge system. According to Cao M.K., (2019), the core part of the digital library is "an online collection of organized and guaranteed digital resources that which is collected, selected and managed by librarians based on international principles of collection development and preserved for a long time so that users can conveniently and sustainably access, retrieve and exploit resources on necessary services".

In a number of studies, of the various models and functions proposed for the digital library, the 7A model suggested by Brangier E., Dinet J., Eilrich L., (2009) and the 5S model by Shen, R., Goncalves, M.A., Fox, E.A. (2013), are the two most outstanding (Vu, D.H., 2018).

2.1 7-A Model

This model reflects the main functions of the digital library made up of the initials of English words such as *Archive, Accredit, Actualise, Analyse, Affirm, Associate* and *Animate*.

(1) Archive (resources): It is the function of storing information sources for the efficient provision of the appropriate data, which is in full accordance with the core nature of all libraries - the place to store, or more fully, the place to provide access, exploitation, use of the collections of information resources. This function is defined to streamline information sources so that they are easily accessed and become useful to the users according to their specific rights and obligations.

(2) Accredit (the information): It is the function of providing authentication of the information to improve the level of authenticity (in terms of the value of the content) of digital libraries. The authentication function is defined to officially recognize a digital library as an organization with the capacity of offering reliable specialized information that helps to trace the sources of knowledge. This is also determined through the information resource development policy of the library.

(3) Actualise (knowledge): It is the function of actualizing knowledge so as to update knowledge that aims to keep libraries up-to-date and supply the latest knowledge to meet any kind of users' needs. This is also very familiar because the current information dissemination services and information products such as new book directory, current directory have been all deployed in almost all libraries, especially science libraries and university libraries.

(4) Analyse (data): It is the function of data analysis that helps users to get a full understanding of the information archives. The data analysis function helps users to comprehensively analyze the data content of the archives. Digital library supports understanding of events, comparing resources, making references, comparing, searching information. Although not all libraries have implemented, it can be seen that the connection and sharing of information resources among libraries have been effectively implemented by a lot of major libraries around the world, which sets the premise for users to access and exploit a huge source of information, covering all intellectual achievements of mankind.

(5) Affirm (an identity): It is the function defining an entity (a document, an information source, etc) to reflect the core values of each library. The core value refers to all the constitutional factors that convey the library's value and effectiveness to the community, including the information resources (the reserves and properties of the collections), the system of products and services, facilities, techniques, experts and partners, outstanding achievements, historical traditions. The defining function helps to indicate and confirm the value and identity of a library.

(6) Associate: The associate function helps users make links, connect to specialized social networks in accordance with their interests. This function is manifested through the participation of different forums (individually or collectively) in the development of general knowledge. For science libraries and university libraries, this is an increasingly important function because it promotes the scientific exchanges to be carried out effectively.

(7) Animate: This is the function that activates the user's interests to attract users through the development of digital events. This function is defined to stimulate the users in creating and exchanging knowledge through the uses of information resources and services provided by digital libraries.

2.2 5-S Model

The five Ss in the 5-S model are the abbreviations of the words *Society, Scenarios, Spaces, Structure, Streams* accordingly. Shen, R., Goncalves, M.A., Fox, E.A. (2013) and several researchers viewed a digital library as a

complex information system that performs functions explained in the sense of the five S as follows (Vu, D.H., 2018):
(1) Society: Digital library has the function of meeting the needs of users in general, that is, meeting the information searching needs of users.
(2) Scenorios: Digital library has the function of providing services to meet the needs of users, including specific activities that are designed in a defined sequence to achieve the end goal of satisfying a request. In the past, a variety of studies have found that the information searching strategies are represented in the form of a designed scenario under which the search takes place. It can also be seen as one of the underlying causes that authors view digital libraries when providing news services are implementing scenarios.
(3) Spaces: This is the function of presenting and providing information in ways suitable to the needs of the users; describing information according to the functional spaces of the library.
(4) Structure: This function is to organize and pack information in a way that suits the needs of the users, including the use of metadata to create appropriate structures for information in order to meet the needs of searching and exploiting information through data connection.
(5) Streams: This is the function of establishing information streams to link, exchange and share information among individuals and communities.

2.3 Development trends of the data source in the Industrial Revolution 4.0

A library has always been referred to as a place that stores all mankind's knowledge, which means it must have everything that the user wants. In order to meet the needs of the users, a library needs to have a sufficient, complete and ready-to-use data source. As a result, data source, as the major influencing factor, can be considered the essential foundation for implementing any library activities. Thus, the source as the main target of impact is the essential foundation for the implementation of the library's activities. The distinctive feature of the current sources is that they form a large data block as a unified information space covering all scientific documents in a thorough linkage. In that large data block, there exist no documents formed completely separate from the others but shows a date link that reflects the quotation relationship to each other.
Big data can be understood as the way to connect data so that the databases always provide the users with the impact factor, citation index as well as many other types of indexes on scientific journals, scientific papers and other scientific subjects. Big Data has been widely studied in the field of library information and regarded as one of the library's epochal features. It stimulates libraries in cooperation with researchers, publishers, data centers and journals to share huge data sources and reuse scientific data sources. Nowadays, libraries are developing data sources in order to provide users with services that are easily accessed and exploited on mobile devices.

Development platform of Library 4.0
Library 4.0 is considered as a generation of libraries developed to meet the needs of users in the context of the ongoing industrial revolution 4.0. It is constructed on the basis of the communication and information technology system, of which the web 4.0 technology plays a crucial role. Web 4.0 is the 4th generation of the web, which inherits the achievements of the previous 3 web generations and is being widely applied. Web 4.0 is considered the web of connecting things or the web of intelligence connections. Web 4.0 implements the symbiotic interaction between humans and computers. Thanks to web 4.0, the boundary between "physical library" and "digital space" is blurred because it appears a continuously connected world providing better and better facilities and services.
In web 4.0, self-learning systems are learning to understand users through the use of artificial intelligence. Web 4.0 communicates with the users in the same way people communicate with each other. It would be a linked, open, and intelligent website with unprecedented speed and reliability. In addition, the server system, internet transmission line, data storage system, software system and other supporting equipment must be capable to develop library 4.0 (Huynh, M.D., 2018),

3. OPPORTUNITIES OF LIBRARY IN THE INDUSTRIAL REVOLUTION 4.0

Along with the development of web generations, library generations have bloomed from 1,0, 2.0, 3.0 to the current 4.0 with the ability to bring the virtual world and the real world together (Phan, X. D., 2018).
Library 1.0 refers to the traditional library generation with Online Public Access Catalog (OPAC) and a single bibliographic database.
Library 2.0 refers to the application of web 2.0 into library services, which means applying technology that enables interaction, collaboration, and web-based multimedia tools into library services. Library 2.0 provides a variety of

services aimed at meeting the needs and expectations of the users, ensuring the availability of information resources and services everywhere at any time without any obstacles. Library 2.0 makes everything easy and encourages collaboration, participation, and involvement from the web management department, technical partners, and the broader community. The principles of library 2.0 are to be user-centered and to support the seamless interaction between libraries and the users by such tools as wikis, blogs, RSS, etc.

Library 3.0 refers to the library system of emerging technological applications such as the semantic web, cloud computing, mobile devices, and the system of tools such as affiliate search systems that support the development, organization and sharing of user-generated content through seamless collaboration among users, professionals, and libraries.

Library 4.0 possesses similarities with Web 4.0 and incorporates many similar concepts and technologies. Library 4.0 with the base of web 4.0 is an intelligent library that consists of not only available inference and studies but also the automatic analyzing system of the current findings. It can be imagined that is a merged environment of various platforms, services and contents that allows the librarians, users and machines to symbiotic, read, write, execute and unify. This is also the library of thinking, making decisions, and providing library services using reasoning.

Web 4.0 owns a lot of advantages that greatly benefit library 4.0 in adopting information technology. In library 4.0, there is almost no limit on resources in each library, users, even the disabled, not only use information from their library as members but also be allowable to access the world's huge library. More importantly, when libraries are connected to share resources, there will be no investment in duplicating documents. This greatly contributes to reduce investment costs for libraries and helps to solve financial difficulties (Duong, D.T., 2018).

4. CHALLENGES OF LIBRARY IN THE INDUSTRIAL REVOLUTION 4.0

In addition to the opportunities, library 4.0 encountered many challenges due to the requirements of the Industrial Revolution 4.0.

Although the library exists in a long tradition, its role seems to be diminished. Besides, the concept of "information service" is vaguely understood by the majority. It can not be denied that the Industrial Revolution 4.0 has made enormous changes in all aspects of life, which means the speed of technological development will be even higher. The fact urges libraries to renovate the operation and the way of service provision; otherwise, they will be lagged behind, that is, they will no longer be able to fulfill their mission of providing information and knowledge effectively (Duong, D.T., 2018).

Data is essentially the lifeblood of the era of the Industry Revolution 4.0 because of its importance and utilization. Without any data, a library cannot be upgraded to a library 4.0. Therefore, a library needs to enrich information resources, especially to build databases with metadata capable of meeting the diversified needs of the users.

The Industrial Revolution 4.0 has posed more challenges in information safety and security while data is assessable everywhere. This is a big concern for all the libraries in finding a solution to guarantee the information exchanges among the systems. Besides, ensuring data quality and transparency is also an obstacle (Vu, D.T.N., 2018).

A modern library requires librarians to have sufficient and eligible qualities, qualifications and skills beyond the usual library skills.

It is commonly known that the Industry Revolution 4.0 has made it hard to identify the boundary among libraries as they share the same data source and the library linkage system is becoming more and more popular. Therefore, library and information industry needs to build an appropriate and equal mechanism for linking and sharing resources among libraries. The current inconsistent data structure has influences the data exchanges among libraries around the world, even some software does not recognize the records as the focused cataloging software to process data posted to Worldcat Discovery. This requires the libraries to update and follow international standards in storing and preserving the data for long time use of digital data.

5. CONCLUSIONS

The Industry Revolution 4.0 with the development trend based on breakthrough technologies such as Artificial Intelligence, Internet of Things and Big Data has greatly redefined the operations in different dimensions library information industry.

With the powerful application of communication and information technology, intelligent libraries in the Industry Revolution 4.0 era create a flat world - a world that treats users equally with opportunities and conditions and connects them in exploiting knowledge and information serving their training, scientific research and professional development. The development of digital libraries should be an important mission needed to be paid attention to by libraries and information agencies.

The Industry Revolution 4.0 is bringing about both opportunities and challenges to library 4.0. To develop a library 4.0 contributing to the development of Vietnamese personality, morality, intelligence, creative capacity, it is necessary to implement synchronous solutions and take the advantages of the Industry Revolution 4.0. This may bring more opportunities to access the world's information and knowledge, making it possible to improve people's understanding, socio-economic and cultural development and gradually overcome the challenges.

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