Future of Libraries in the Cyber-Physical Society

Tünde Lengyel Molnár

Eszterházy Károly University, Eger, Hungary

The Fourth Industrial Revolution leads to cyber-physical systems facilitating communication not only between machines and people, but between machines themselves (Straub, 2015). Such radical changes give rise to the cyber-physical society including not only the physical and virtual spaces, but the human social and cultural sphere as well (Monostori, 2019). Several professions and trades disappear and new ones emerge on the labour market while the skills required of employees have changed too (World Economy Forum, 2018). Hence the need for institutions capable of preparing people to meet such challenges becomes pressing. In the United States libraries are expected to train the population for the use of technological devices brought about by the Fourth Industrial Revolution along with improving the respective digital competence levels (Horrigan, 2016). Furthermore, various international strategies and the changing learning environment assign new tasks for libraries. Thus in the 21st century, in addition to their traditional function libraries have to become (1) digital education centres, (2) learning environments, (3) on-line educational spaces. Based upon data obtained via computerized qualitative content analysis of international strategies, my presentation focuses on the changing tasks and future perspectives of libraries.

Keywords: library strategies, ICT in library, cyber-physical society, Fourth Industrial Revolution

> If we are not becoming aware of the consequences of technological development and do not adapt to them […] their impact will be simultaneous and synergic. (Ford, 2015, p. 18)

The Fourth Industrial Revolution radically impacts society and one of its consequences is the changing labour market demands resulting in the elimination of most current professions and trades and the emergence of new heretofore unprecedented positions or forms of employment. The findings of a 2013 research project of Oxford University (Osborne & Frey, 2013) indicate that due to the technological development almost half, that is 47% of jobs performed by humans are expected to disappear by 2033. Furthermore, according to the latest reports issued in the fall of 2018, 52% of heretofore human work will be done by robots in 2025.

Today generator webpages provide information on the future perspectives of various jobs (https://willrobotstakemyjob.com/). The librarian profession will be primarily impacted in the area of routine tasks. At the same time information research efforts are expected to gain higher priority as a significant demand appears for experts capable of identifying, analysing, and using information. Consequently, libraries should monitor these trends and demands along with actively participating in meeting information-related needs.

Tünde Lengyel Molnár, Ph.D., vice dean, associate professor, Digital Technology Institute, Eszterházy Károly University, Eger, Hungary.
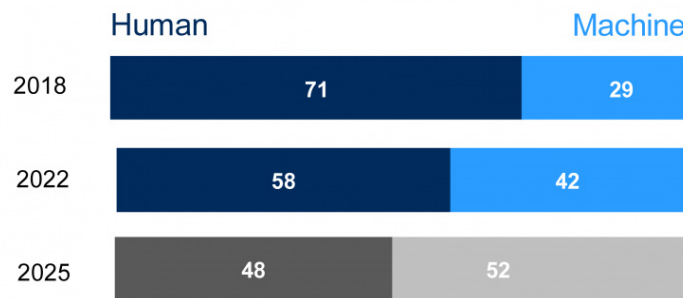
Figure 1. Rate of automation. Division of labour as share of hours spent (%) ("Future of Jobs 2018 Insight Report", 2018).

One feature of industrial revolutions is that it is difficult to prepare for their impact as they result in previously non-existent technological solutions. In case of the Fourth Industrial Revolution, the relatively short time available means an additional problem. Industrial revolutions are characterised by fast changes within an accelerated time framework.

• The main feature of the First Industrial Revolution lasting from 1780 to 1850 was the harnessing of steam for the operation of machines. ("List of inventions from the First, Second, and Third Industrial Revolution")

• The Second Industrial Revolution (1871-1914) (Harmat, 2015) brought fundamental social changes via mass production, the emergence of the assembly line, and the invention of electricity.

• The Third Industrial Revolution was launched in 1918 and it was dominated by electronics, automation, and the appearance of computers.

• The Fourth Industrial Revolution is currently taking place. Its main feature is the blurring between the hardware and software and the increasing role of cyber-physical systems in various economic sectors. The other dominant aspect is digitalization leading to the paperless world based on cloud-based technology.

The development takes place at an accelerated pace. While the First Industrial Revolution required 70 years, the Fourth is expected to bring radical changes in 20 years. According to the futurist Gerd Leonhard, the current industrial revolution known as digital transformation due to its fast pace can bring more changes in the next 20 years than humanity has experienced until now. A fundamental issue is how will individuals or countries react to challenges posed by the evolution of software and machines, the prevalence of real time information, and the continuous demand for the availability of data (Racsko, 2017, p. 8).

The first step of this technological development is the automation of production as more and more factories announce layoffs of thousands of people previously performing routine tasks. While the magnitude of the redundancies in Central Europe is around 10,000, millions of people lost their jobs worldwide.

Another consequence of the technological revolution is the availability of the means of production at an increasingly lower price. Thus not only large manufacturing companies, primarily in the automobile industry, find automation profitable as machines tend to substitute human power in all fields of life. While in the past several firms transferred production to Asia and South America (at first to China and Mexico, then later to India) for the low price labour force, by now this process has reversed itself and production takes place in the original company by the help of robots and automated assembly lines (Racsko, 2017, pp. 26-38). This phenomenon has become a trend as the price of producing robots reached the critical level of becoming a mass product thereby threatening with the elimination of workplaces. Thus society has to face new problems and challenges in this cyber-physical world including smart cities, manufacturing, transport, energy, and logistical

systems potentially making a higher quality of life available. Thus appears the Cyber-Physical Society including not only physical and cybernetic spaces, but said versions of the human, social, and cultural sphere (Monostori, 2016).

Libraries are also significantly impacted by this challenge. In the 21st century data represent the fourth economic sector and the utilization of big data, the results of the processing of high quantity of data can change the current geo-political relations and significantly alter the position of the leading countries. At the same time such a *paradigm shift* is taking place rather slowly both in the education sphere and in case of libraries as we seem to have arrived at a standstill in this case.

We must face the fact that the *technological development* fundamentally changed the functioning of society. The previous *information-based society* emphasized the accessibility of information via equipping schools with computers and Internet access facilitating the uploading of content and the construction of knowledge bases which led to the *knowledge based society* entailing the cooperation or linking of science and technology.

The demand for change comes from a variety of sources. The *economic crisis* of 2008 called for the reconsideration of factors influencing the operation of society. The European Union considers the improvement and increasing of *human capital* as one of the most important means of coping with the crisis. Consequently, the upcoming generation should be equipped with knowledge enabling them to productively use the modern technologies and the necessary instruction and informal contexts have to be established as well.

What Is Considered Knowledge in the 21st Century?

According to Marshall McLuhan, the *typographic man* represented the previous model of human existence. The definitive feature of the *typographic man* was the access to printed books and acquisition of knowledge from such sources. Today the typographic man emphasizing the possession of knowledge via information gained from various written sources gives way to the *electronic man* for whom "knowledge does not mean the possession of information but the ability to orient oneself in the limitless amount of electronically available information" (McLuhan, 2011, p. 233).

Who could prepare users more effectively to orient themselves in the daily deluge of information than librarians? In order to realize this goal, *libraries have to possess the respective technology*, along with an access to data bases which could satisfy the specific demands. Furthermore, such institutions have *important social roles* as they are scenes of encounter, learning, and cooperation. Since libraries are culture and value transmitting institutions, they have an important function in promoting the conscious and critical use of digital technology.

In order to meet these challenges, libraries have to improve in the following areas:
- human resources,
- technology and methodological arsenal,
- the physical aspects of the library space.

Expectations Related to Human Resources

There are several expectations related to human resources.

Digital literacy is one of the crucial components of the Digital Agenda of the European Union to be realized by 2020. A related issue is the improvement of the digital skills and literacy of the general public as

well. The annual reports of the International Federation of Library Associations and Institutions (IFLA) list this task as a crucial component of library strategy. Furthermore, the continent-based analysis of the IFLA reiterates this function of the library and considers it as the most urgent responsibility (*IFLA Report Update 2016*, 2016).

Digital literacy includes more than the ability to use computers, mobile phones, digital cameras, and other devices, as it is a complex, multifaceted concept. While digital literacy implies the theoretical and practical ability to use digital devices, it also means the capability to produce digital content via New Media including photos, videos and communicating and reflecting on such content, thus becoming a productive part of digital communication.

Development efforts should not be restricted to device use only! Consequently, a methodology has to be elaborated for the unwitting or indirect development of the digital literacy and skills of the participants in the reading and instruction process. Libraries should join in this effort as these activities not only promote digital literacy, but create a need for reading and nurture the new generation of readers.

Thus libraries should have a staff capable of the propagation of ICT literacy.

In order to achieve this goal, such *macro and micro-level strategic methods* are needed, which promote the *digital transformation* and contribute to the *stabilization* of the future role of libraries. Consequently, libraries have to find *new solutions* which were not part of their methodological arsenals earlier. While familiarity with technology and its areas of use is necessary, such factors are not sufficient alone. Any change has to be achieved via a system-oriented thinking and must be implemented in the whole organizational structure of the given institution with an eye to the expected benefits. *Human performance technology* is a strategy facilitating the achievement of the optimal result along with presenting a practical procedure system. It is an approach, which takes into consideration the potential of the employees of the given organization, the technological options provided by the developing world, and impacts the computer system via systematic procedures including continuous measurement and analysis (Lengyel Molnár, 2017).

While in the *business sphere* human performance technology elements have been used for years, such approach has yet to be implemented in the human sector.

Technological and Methodological Arsenal

More and more libraries recognize that in the future they have been in the vanguard of the application of modern technology. In addition to the improvement of the respective technological infrastructure, several types of solutions are available.

• The magnificence of the Library of Alexandria can be illustrated by a virtual tour.

• The state library of Bavaria with a population of almost 1.5 million people had nearly 70,000 subscribers or registered members in 2016. The library can be used in the virtual space of second life.

• In 2013 in Texas a bookless library was opened offering 10,000 e-books and 800 e-book readers for borrowing ("The First Bookless Library: BiblioTech Offers Only E-Books", 2013). Naturally, the success of such initiatives requires the changing of societal demands as in 2002 Arizona had a similar library, and that innovative enterprise failed due to lack of receptivity and interest.

The international association of libraries, the IFLA, summarizes the main trends influencing the global library profession. An analytic look at the association's 2016 strategic document reveals that the respective main trends range from the crucial legal protection issues via the impact of the technological development to the support of the learning process.
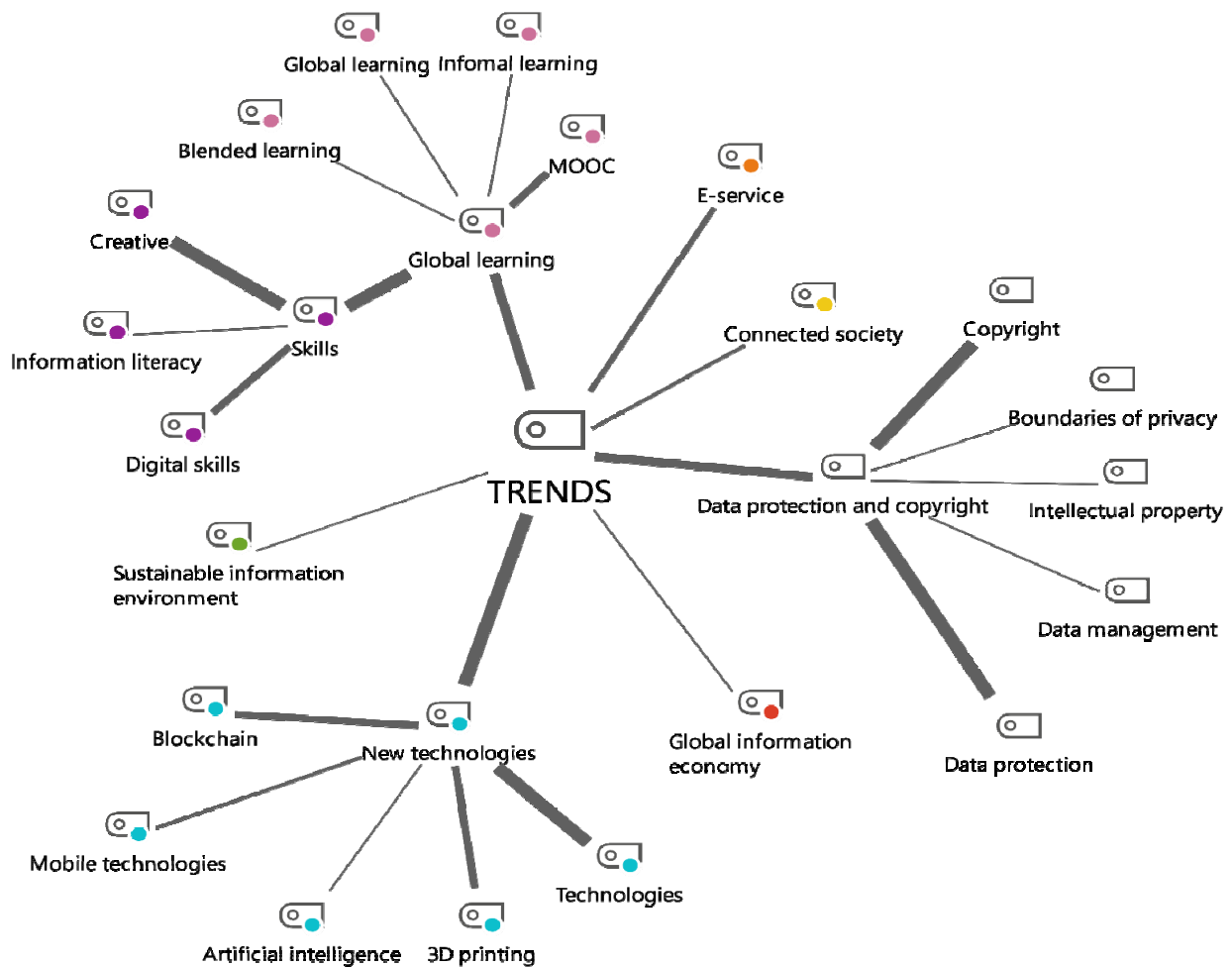
Figure 2. IFLA Trend Report 2016 Update code-map.

The code map prepared via a computerised content analysis software (MaxQDA) indicates the strength and intensity of the respective links with the thickness of the given lines. This shows that

• The protection of the security and integrity of the private sphere is more important than intellectual property or copyright issues.

• While the strategy emphasizes the application of 3D printers and other ICT devices in the library environment, the IFLA calls attention to a "block-chain revolution, yielding a paradigm shift in our global society and economy" (*IFLA Report Update 2016*, 2016). The above content analysis chart reflects this emphasis as well.

• Libraries contributing to on-line instruction and developing the digital competence of the general public have an important role in the future of education.

The Library and Its Physical Appearance

Libraries not only have to demonstrate an attitudinal change related to the modified learning habits, but the respective buildings have to be transformed in order "to meet the demands and needs of the community" as well. Libraries should be more than mere *isolated knowledge distribution centres*, as they have to become a *community space* attracting children and families, in fact functioning as a real community centre.

In Denmark the library meeting the demands of the 21st century was developed via the joint effort of librarians, architects, designers, and stakeholders including firms and users involved. The project resulted in a library facility supporting the following four functions:

- creation,
- inspiration,
- learning,
- and meeting (Koreny, 2016).

Libraries have to provide a feeling of customization for the readers along with serving as locations for cooperative efforts. Thus in the United States such libraries have been developed, which function as a combined location for thinking, creativity, and comfort.

Figure 3. Learning space at the Hunt Library (North Carolina State University) ("iPearl Immersion Theater", 2020).

As shown above, in addition to the traditional reading areas, comfortable study halls were formed and they were equipped with whiteboards and projectors usable by readers. The furnishing can be adjusted or converted according to personal needs, along with supporting cooperative efforts or group work. The Hunt Library is a high technology equipped new generation learning area ("Hunt Library. Find Inspiration", n.d.).

Figure 4. Community space at the Hunt Library (North Carolina State University) ("The Library of the Future Is Here", n.d.).

The main aspects treated in this study are substantiated by an annual Pew Research Center survey on the general public's view of libraries. Accordingly, in 2016 1,601 residents were asked via telephone concerning their attitude to their library. While in 2016 77% of the respondents expressed their loyalty to their library, in 2015 53% reported on maintaining a certain type of interaction with a public library either via personal visit, a virtual visit on the webpage, or via a mobile application (Horrigan, 2016).

The 2016 survey inquired about the services readers expect from libraries. The answers included the following:

1. Libraries should offer programs which teach people including children and senior citizens for the use of digital devices such as computers, smart phones, and applications.

2. To provide more comfortable areas for work and relaxation.

3. Libraries should purchase 3D printers and other digital devices so that people would learn how to use them for the production of various objects.

4. Reduce the proportion of printed books in public spaces to provide more room for technological centres, reading rooms, conference rooms, and cultural evenings (Horrigan, 2016).

As a last word of encouragement, we can expect that librarians will be needed in the future. Nevertheless, the preservation of the name of the profession cannot be guaranteed, as in the 21st century the rate of information presented in the form of traditional books is expected to decrease. At any rate the library experts of the future have to be highly trained in the retrieval of information and the discipline of informatics. Additional responsibilities include the preservation of cultural heritage, the transmission of general culture and values along with actively participating in various digitalization projects. Universities have made the first steps towards the technological and content-based renewal in order to adjust to the changes brought by the Fourth Industrial Revolution. It is crucial, however, that not only the young graduates are prepared to meet these challenges as those in the library profession have to possess these competences since the knowledge of librarians will be needed for a long time to come!

References

Ford, M. (2015). *Robotok kora. Milyen lesz a világ munkahelyek nélkül* (What will the world be like without workplaces)? Budapest: HVG Kiadó.

Future of jobs 2018 insight report. (2018). Retrieved from http://reports.weforum.org/future-of-jobs-2018/shareable-infographics/

Harmat, Á. P. (2015). Az ipari forradalom története. Retrieved from http://tortenelemcikkek.hu/node/147

Horrigan, J. B. (2016). Libraries 2016. Retrieved from https://www.pewresearch.org/internet/2016/09/09/libraries-2016/

Hunt Library. Find inspiration. (n.d.). Retrieved from https://www.ncsu.edu/huntlibrary/find/

IFLA report update 2016. (2016). Retrieved from https://trends.ifla.org/update-2016

iPearl Immersion Theater. (2020). Retrieved from https://www.lib.ncsu.edu/spaces/ipearl-immersion-theater

Koreny, A. (2016). Könyvtár és közösség 3. rész: Funkciók és terek kapcsolata a közösségvezérelt könyvtárban (Books and community (Part 3) links between functions and spaces in a community directed library). Retrieved from http://librariandbd.blogspot.hu/2016/07/konyvtar-es-kozosseg-3-resz-funkciok-es.html

Lengyel Molnár, T. (2017). A humán teljesítménytechnológia (Human performance technology). *Könyv és Nevelés (Books and Education, a Periodical of the Hungarian Institute for Educational Research and Development), 19*(3), 97-109.

McLuhan, M. (2011). *The Gutenberg galaxy: The making of typographic man* ([New] ed.). Toronto: University of Toronto Press.

Monostori, L. (2016). A számítógépes szerszámgépvezérlésektől a kiberfizikai termelési rendszerekig. Retrieved from https://mta.hu/vi-osztaly/a-szamitogepes-szerszamgepvezerlesektol-a-kiber-fizikai-termelesi-rendszerekig-monostori-laszlo-rendes-tag-szekfoglalo-eloadasa-107244

Osborne, M. A., & Frey, C. B. (2013). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 26.

Racsko, R. (2017). *Digitális átállás az oktatásban* (Digital transformation in education). Budapest: Gondolat.

The first bookless library: BiblioTech offers only e-books. (2013). Retrieved from http://money.cnn.com/2013/10/08/technology/innovation/bibliotech-ebook-library/index.html?iid=SF_T_River

The library of the future is here. (n.d.). Retrieved from https://wearelibrarypeople.com/project-gallery/the-library-of-the-future-is-here/