

**Поддержка исследовательской деятельности
в условиях 4-й промышленной революции: ответственность
академических библиотек Южной Африки.
Предварительное исследование**

**Responsiveness of Academic Libraries in South Africa
to Research Support in the 4th Industrial Revolution:
A Preliminary study**

*Деннис Н. Очолла и Людмила Очолла
Университет Зулуленда,
Южно-Африканская Республика*

*Dennis N. Ocholla and Lyudmila Ocholla
University of Zululand,
South Africa*

В 2016 году на Всемирном экономическом форуме в Давосе, Швейцария, Клаус Шваб, основатель и исполнительный председатель Всемирного экономического форума, ввел понятие 4-й индустриальной революции 4ИР, которая строится на фундаменте Третьей и характеризуется «смешением технологий, размывающим границы между физическим, цифровым и биологическим мирами». «Умные» технологии положили начало этому процессу. Действительно, 4ИР влияет на буквально все стороны жизни, в том числе, на исследовательскую деятельность и библиотеки. В данном докладе представлена концепция 4ИР и проведено сравнение между существующими формами и тенденциями в библиотечно-информационной деятельности академических/университетских библиотек Южной Африки и требованиями, выдвигаемыми 4ИР. С этой целью проведен анализ 26 веб-сайтов общедоступных университетских библиотек. Результаты анализа показывают, что библиотеки эффективно реагируют на требования времени, демонстрируя инновационность и креативность своей библиотечно-информационной работы. Можно ожидать, что библиотечное обслуживание и дальше будет соответствовать этим требованиям, будет опираться на ресурсы и будет доступным всегда и везде. На его основе будет строиться научно-исследовательская деятельность в регионе, а возможно, и за его пределами

Ключевые слова: Четвертая промышленная революция, академические библиотеки, Южная Африка, Южно-Африканская Республика.

At the World Economic Forum in Davos, Switzerland, in 2016, the concept of the 4th Industrial revolution (4IR) was coined by Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, with the reference that it would be building on “the Third, the digital revolution” and would be “characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological”. Thus, the ‘smart’ technologies will spearhead the revolution. We acknowledge that the 4IR will impact on everything, everywhere, including research and libraries. In this paper we conceptualize 4IR, and compare current academic/university library services/trends in South Africa with 4IR requirements through the analysis of 26 public university library websites. The findings show that the libraries are responding well to the revolution through their services, with remarkable of innovation and creativity on display. The study expects library services to be responsive, resourced and accessible anytime and anywhere, and provides a framework for further research and exploration in the region and perhaps elsewhere.

Keywords: 4th industrial revolution, academic libraries, South Africa.

1. Introduction and Background of the Fourth Industrial Revolution

Darwinists, largely informed by Charles Darwin’s seminal work, “The origin of species”, written in 1859, widely hold the view that human society has transformed from hunter/gatherers to the agrarian/agricultural society, to the industrial and post-industrial or information and knowledge societies or third industry (or ‘Third Wave’ as Alvin Toffler defined it in 1991). Daniel Bell’s conception of the Post-Industrial Society, also strongly referred to the Information Society and knowledge society, and Manuel Castells ‘Network Society’ and Frederick Lancaster’s paperless society also contributed significantly to debates around the third industrial revolution. Each of the stages of societal transformation has been characterized or defined by economic growth in terms of production of raw materials or agricultural products, industrial products, information products and knowledge products led by innovation, networks and technology. At the World Economic Forum in Davos, Switzerland, Klaus Schwab, Founder &

Executive Chairman of the World Economic Forum, recognized the societal and economic transformations and coined the concept ‘fourth industrial revolution’ which he succinctly explained thus: “The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres” (Schwab, 2016).

Some writers such as Kamble, Gawankar & Gunasekaran (2018) remind us that the term ‘industrie 4.0’ /Industry 4.0 is among the Germany’s ten ‘target items of high–tech strategy action plan of 2012 project’, which envisaged the amalgamated manufacturing with IT and led to the development of factories that are “smart,” and efficient and adaptable to new technological changes /demands. In their ‘sustainable industry 4.0’ concept, Kamble, Gawankar & Gunasekaran (2018:419) include in Industry 4.0 technologies such as IoT, Big data analytics, cloud computing, augmented reality & robotic systems, simulation prototypes and 3D printing.

We have attempted to determine what characterizes the 4th industrial revolution further through keyword analysis by making advanced searches on SCOPUS (2014-2019), which is known for more inclusivity of scholarly peer refereed publications (Onyancha & Ocholla, 2009) than WoS. This was achieved using a Boolean search (OR) by linking “fourth industrial revolution” OR “Industry 4.0” OR 4IR or “4th Industrial revolution” resulting in 5380 records. Using VOSviewer for the display of terms, it was possible to visualize 4IR as reflected in Figure 1 (based on 100 top terms/keywords) with relevant links. Essentially, most of the technologies are known to us from the third industrial revolution or digital revolution, and therefore may not be necessarily new. This suggests that there is still a strong presence of the third industrial revolution in the fourth industrial revolution, something that we should not ignore.

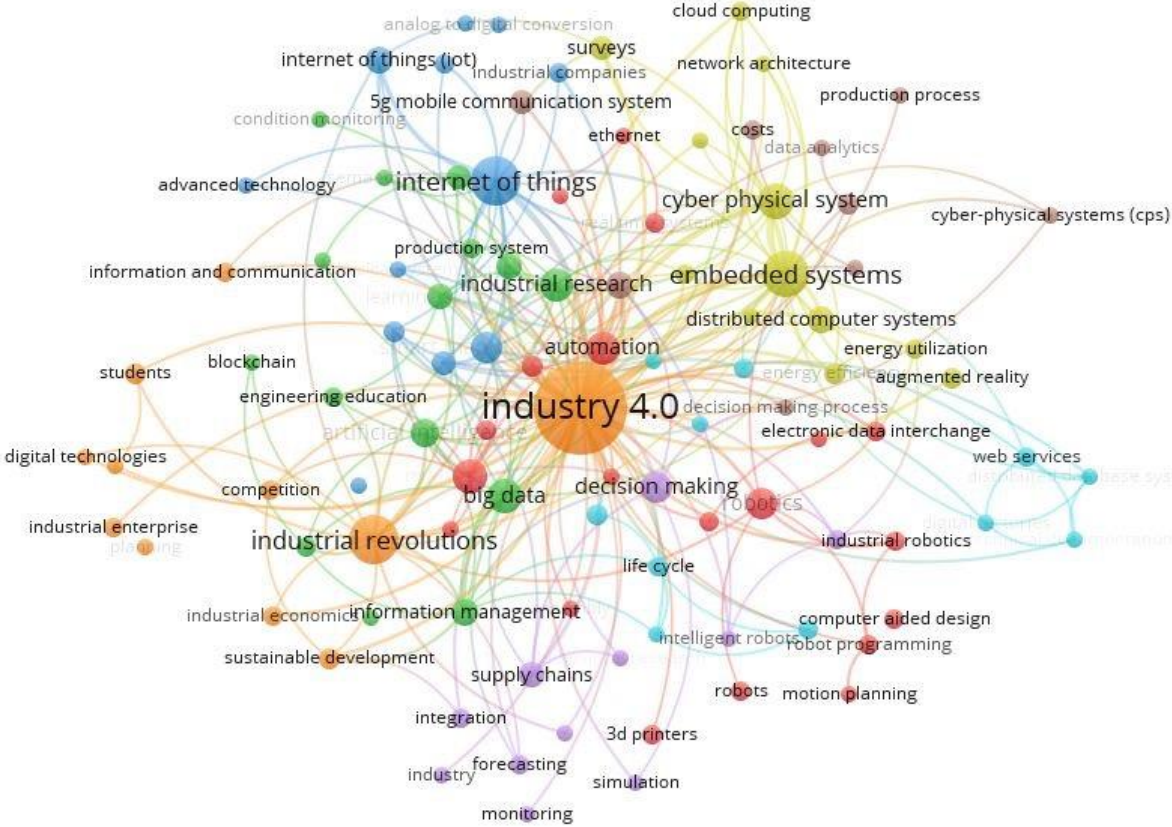


Figure 1. A link analysis of keywords/terms to Industry 4.0 in SCOPUS from 2014 – 2019

2. Frameworks

The response to 4IR cannot occur without sufficient conceptualization and contextualization. Kamble, Gawankar & Gunasekaran (2018) report several studies that have occurred in the domain and cluster the methodologies to be largely conceptual, followed by case studies that include simulations, experiments and surveys, while Moon & Seol (2017) focus on the response of Korea to Industry 4.0 and, among others, highlight fourth industrial revolution theories quite intriguingly. We think that the two studies provide a good starting point for the theoretical and conceptual understanding of the fourth industrial revolution by unpacking both theories and recent studies in the domain.

Contextualization is important in the framework because it reflects on international, national, institutional and individual responses to and direction of 4IR. It is difficult to draw a concrete line between the beginning and end of the industrial revolution because of the uneven or unequal economic growth of societies. The international response to the fourth industrial revolution could have started in the third industrial revolution with, for example, the WSIS discussion on the information and knowledge society over the last two decades and MDG (substituted by Sustainable Development Goals (SDG), 2015 – 2030) where some of the industry 4.0 concerns have been raised. However, a major and probably focused international response to 4IR started with the World Economic Forum (WEF) in Davos, 2016 (Prisecaru, 2016).

Government response would normally be defined by declarations, discussions/debates statements, notices, policy and legislations¹. For example, a recent analysis of 4IR on the South African government website (above) revealed two documents both originating from the Department of Telecommunication and Postal Services (in the Government Gazette Notice No 764 of 2018), one of which was an open ‘invitation to nominate candidates for the Presidential Commission on the Fourth Industrial Revolution’. The same Department echoed ‘Government response to the Fourth Industrial Revolution’ at the Consumer Goods Council South Africa (CGCSA) Annual Summit in 2018.

Institutional response would be defined by conversation and policy forums such as meetings, lectures, seminars, workshops, conferences, guidelines and policy. In Davos, Ian Blinder from Princeton University considered in his paper, ‘Education for The Third Industrial Revolution’, that for “adapting to the era of information, students need to acquire an education which is not quantitative but specialized and qualitative, focusing on the demands of the moment. Therefore it is necessary a personalized education since we talk of much higher and more complex requisites, requiring innovation, inter Disciplinarily, networking” (cited in Prisecaru, 2016). While his view resonated 4IR, it does seem to us that the paper did not envisage that 4IR would be proclaimed by Klaus Schwab at the conference. Thus, although some of our activities and technologies bear Industry 4.0 characteristics, conversations on 4IR in our institutions are still quite limited while, in essence, focusing on the revolution should enable institutions to plan and strategize for the future. A recent short article by Butler-Adam (2018), while putting more emphasis on artificial intelligence (IR) in 4IR, recognises that the education sector should be prepared to respond to the changes in the nature of work and the job market, such as possible job loss or more jobs; better education and training, particularly striving for critical skills; changes in curricula and teaching and learning content and approaches; achievement of 17 SDGs; and recognition of the fundamental role of the human factor in the revolution. Thus, the institutional/university response should be strongly ingrained in the agenda of HEIs. But institutional responses can also be reflected in research and innovation. For example, it was recently reported that at the University of Pretoria, Faculty of Health Sciences, Department of Otorhinolaryngology in South Africa, the Professor and Head of Department, Mashudu Tshifularo, conducted ground breaking ear surgery by using 3D technology, and commenting on the successful operation, said: “3D technology is allowing us to do things we never thought we could.”²

The professional/discipline response is also essential. Globally in LIS, IFLA would play a major role. Regional professional associations, such as the Standing Conference of Eastern, Central and Southern African Library and Information Association (SCECSAL) and national professional associations such as the Library and Information Association of South Africa (LIASA), The American Library Association (ALA), and Association of College and Research Libraries (ACRL), are likely to be key players in the

¹ <http://www.polity.org.za/>

² <https://www.up.ac.za/media/shared/1/ed-3d-printed-ear-bones-11.zp170070.jpg>

revolution. Recent and planned conferences in Africa and South Africa in particular, such as the UNILISA conference organized by the University of South Africa in March 2019, University of Pretoria Capstone Carnegie Conference organized by the University of Pretoria in March, the forthcoming 20th IS Annual conference organized by the University of Zululand in September, and University of Johannesburg's 4th Industrial Revolution and Library Practices Conference in October 2019, directly or indirectly create a forum for discussing and strategizing for the 4IR which we believe will feed research, teaching and learning in the future.

Furthermore, there is the research, teaching and learning response. It has been reiterated by Butler-Adam (2018), Blinder in Priscearu (2016) that teaching and learning would be affected. New competencies will be required (Raju, 2017) with ten requisite skills: complex problem solving, critical thinking, creativity/innovation, people management, coordinating with others, emotional intelligence, judgment and decision making, service orientation, negotiation and cognitive flexibility leading.³

The employment and job market will also be affected (Butler-Adam, 2018). Already, there is already unfounded concern on job loss similar to what happened at the beginning of the third industrial revolution with computers, electronics and digitization leading the pack. For example, Carl Benedict Frey and Michael Osborne estimated that "47% of jobs in the US will be in massive distress because of the introduction of computers, and other developed countries and emerging ones are in a similar situation" (cited in Priscearu, 2016:59). The two authors probably meant 'smart' technologies or AI or super computers, as computers has been with us since the mid-20th century. An important study conducted in this decade (Ocholla & Shongwe, 2013) demonstrates a diversification in the employment of LIS graduates with emerging disciplines/fields such as information and knowledge management becoming increasingly attractive while ICT influence on LIS jobs boogieing (Shongwe, 2014).

The individual response would be to focus on competency requirements for the revolution. Essentially, complex problem solving skills, critical thinking, and creativity/innovation will be critical. But life-long learning /self-learning and Continuing Professional Development (CPD) is fundamental.

Lastly, a response to indexing that is more inclusive than exclusive will be required. While relying on OCLC-supplied controlled vocabulary for indexing and cataloguing, providing author indexes to our publications through natural and free indexing languages and thesaurus is essential. The same applies to having an author ID (Ocholla & Ocholla, 2017a) and dealing with related indexing challenges.

3. Case Study – Academic Library Response

3.1. Conceptualization and contextualization

The transformed roles, innovative services and future of academic libraries have been the focus of attention by many researchers around the world (Catalano et al., 2018; Cox, Pinfield & Rutter, 2019; Dempsey & Malpas, 2018; Feret, 2018; Schulte et al., 2018; Sewell & Kingsley, 2017) and in South Africa (Chiwane & Becker, 2018; Hodonu-Wusu & Lazarus, 2018; Kwanya & Stilwell, 2018; Ocholla, 2016; Ocholla & Ocholla, 2017b; Onyancha, 2018; Raju et al., 2018; Wilson et al., 2019). The result has been the creation of new library spaces and services, which are suitable for the needs and orientation of individual institutions (Dempsey & Malpas, 2018; Ocholla, 2016) in response to the rapidly changing landscape of higher education influenced by a strong research, teaching and learning agenda; ICTs; university ranking; community engagement (for contextualizing research and teaching); and the fourth industrial revolution demanding that library services be accessible anytime, and anywhere. South Africa has 26 public universities (DHET, 2018), 12 of which are traditional universities (with a strong orientation on research); 6 comprehensive (both research and vocational education), and 8 that are universities of technology (technology orientation). LIS programmes are offered by nine universities (UCT, UKZN, UNIZULU, UWC, DUT, UNISA, UFH, UP, UJ – some count eight without UJ) with different focus points that are largely diversified but also none traditional, normally with stronger ICT-IS (UP) and KM (UJ) in the qualification programmes.

Although the term, 'industrial revolution' (especially 4th industrial revolution), is rarely used in LIS research (still not indexed at such by OCLC), academic libraries are in the process of embracing the

³ World Economic Forum, 016 – <https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/>

concept. According to Dempsey & Malpas (2018) “libraries are transitioning from a collection-based model to a more broadly services-based model”. They further note that the library’s role “is to support their users’ creative activity in more diffuse ways – as a partner and an advocate”. In this section we answer three research questions: What services are provided by the academic libraries in readiness to the revolution? How do the academic libraries respond to the changing environment?

3.2. Methodology

In the multiple case study of university libraries in South Africa, 26 South African public universities were identified from the Department of Higher Education and Training’s (DHET) website. We note a similar approach used in a related study (Catalano et al., 2018) examining websites of the Association of Research Libraries (ARL) and non-ARL academic libraries in the US. The university websites were visited to obtain the necessary information about their libraries. It was observed that the two newly opened universities (Sol Plaatje University (SPU) and Sefako Makgatho University (SMU)) do not have detailed information on their websites about their libraries.

Twenty one areas were identified as the current trends in academic libraries, especially in terms of providing research support. These include free Wi-Fi in the libraries; access to library resources on and off-campus; 24/7 study areas; research commons; group study areas; makerspace; borrowing ICTs (e.g. laptops); e-Resources (e.g. eBooks, databases, etc.); e-Catalogues; digital scholarship (including institutional repositories); research data services (RDS; RDM); open scholarship; information literacy; research information services (e.g. library workshops, consultations, etc.); reference/bibliographic tools (e.g. Refworks, Endnote, etc.); Libguides (SpringShare); video tutorials; Ask-a-librarian chat; services to differently abled social media; and UX (e.g. evaluations). Catalano et al. (2018) study focused on eight trends, namely “research data services (RDS), digital scholarship (including institutional repository), makerspace, emerging staff positions, open educational resources, distance learner services, non-traditional reference services and use of social media”.

The activities and trends of South African academic libraries were captured in an Excel spreadsheet, analyzed and displayed as reflected in Figure 2 and 3.

3.3. Preliminary results

1. What services are provided by the academic libraries in readiness to the revolution?

In Figure 2, we illustrate the current trends in response to the fourth industrial revolution, while in Figure 2 we compare the responses of the 26 academic libraries. We note that some of the services or facilities (Figure 2), such as Information literacy (88%), e-Resources (92%), e-Catalogue (92%), Digital scholarship (88%), Social media (73%), and Research commons (73%), among others, are more developed and available in most of the 26 university libraries. It is recognized that some of the library websites are not informative enough to showcase their services (e.g. no information is provided on the availability of WiFi, or off-campus access) which may be a minor oversight, but only affects the trends to a limited extent. It is evident (Fig. 2) that some of the fairly new developments, particularly Makerspace (8%), Research Data Services (RDS – 27%), Borrowing ICTs (19%), User Experience (UX – 19%), and 24/7 study area (42%), are already taking place and developments in this area are likely to grow in the future.

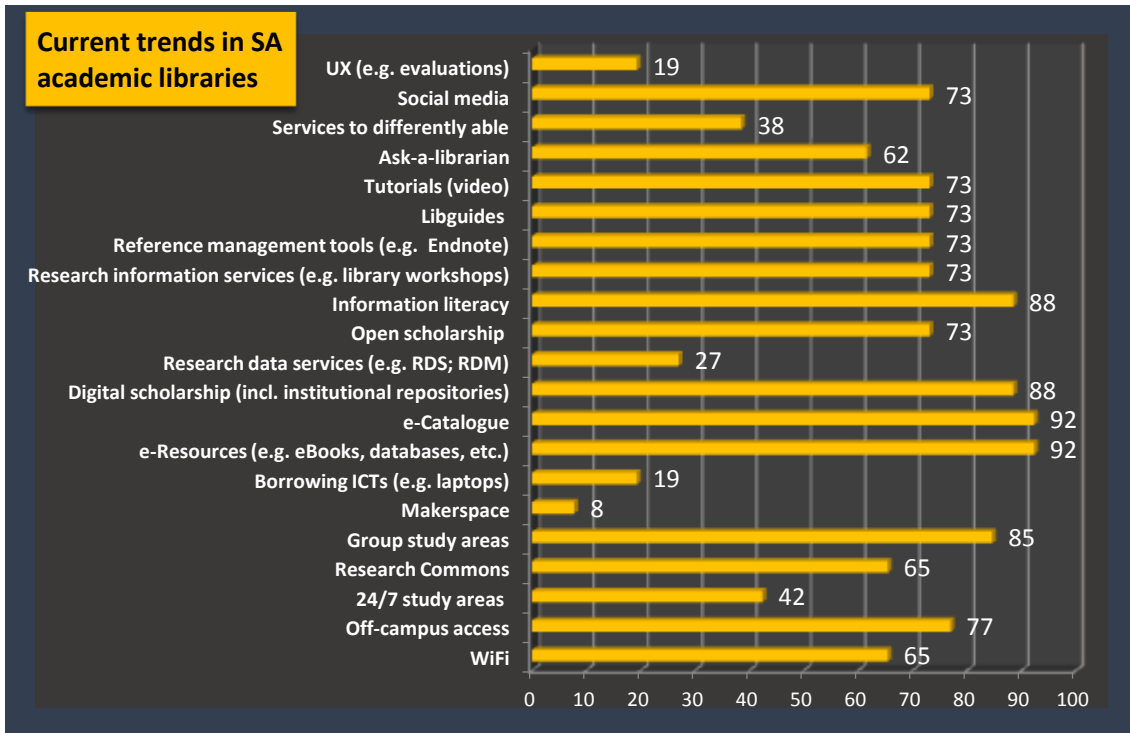


Figure 2. Current trends in SA academic libraries

2. How do the academic libraries respond to the changing environment?

Looking at the university libraries in South Africa and their response to the changing environment in the education sector, the average amounts to 64% (Figure 3), ranging between 100% (UCT) and 0% (UMP – a new university). Traditional universities (12), which are more research-oriented, take the lead (Figure 3) with an average of 76%, followed by comprehensive universities (7) with an average of 65%, and universities of technology (7) with 42%. The gaps shown in Figure 2 in terms of low performing areas (e.g. make space, borrowing devices, UX, RDM) provide useful information for strategic intervention.

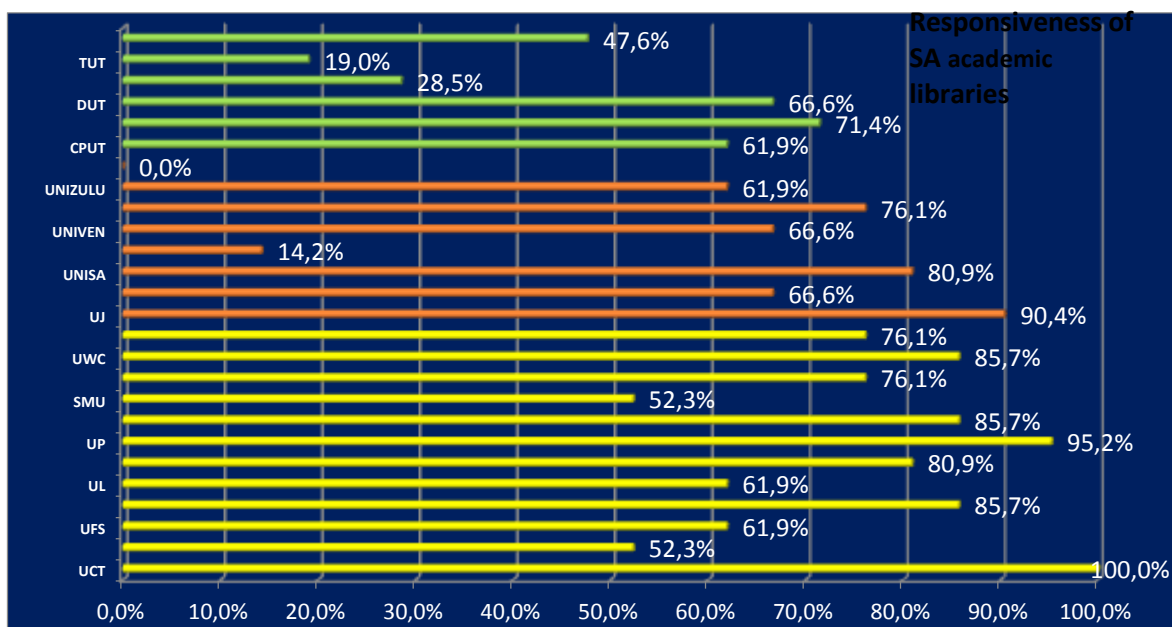


Figure 3. Responsiveness of academic libraries towards changing environments

Conclusions

The 4IR concept does not occur often in literature in relation to academic libraries since its conception in 2016 (Catalano et al., 2018; Chiware & Becker, 2018; Sewell & Kingsley, 2017). However its components (Fig. 1), such as internet of things (IoT), embedded systems, cyber physical systems, and big data, cloud computing, information management, data acquisition/handling, and network security, among others, are already accessed and variably applied in academic libraries. This also reflects on library activities/trends (Fig. 2) and levels of response to the revolution (Fig. 3). Based on the twenty one services/trends analyzed, the average response of 64% is fairly good. Emerging services/trends such as makespace (8%), RDS (27%), borrowing of ICTs/devices (19%) and User Experience (19%), project an encouraging growth at this stage. Interestingly, the borrowing of devices scored much higher (68% and 70% respectively) in ARL and non-ARL libraries in the USA (Catalano et al., 2018). Traditional university libraries presently exhibit the highest score with regard to the 21 trends, followed by comprehensive universities and universities of technology. Catalano et al. (2018) study found the sampled research university libraries in the US to lead in developing their eight trends more than other universities due to better resources and a better understanding of research needs. Overall, the UCT library (which belongs to the top research university in Africa by world university rankings) achieved the highest score with all the trends. In order to improve accordance with trends, academic libraries have to be better resourced, accessed and used. This could be achieved if library services could be accessed anytime and virtually everywhere. The university library website should be the virtual gateway to the library, and it therefore has to be well designed with valuable content and strong visibility and customer orientation. Essentially, 4IR propagates inclusivity, interlinkage/interconnection, the interdependence and blending of everything (such as smart technologies, knowledge, people, services and access) to the extent that their distinction is blurred in order to achieve the requirements of the time. Libraries have to develop resources, enable access, and eliminate inequality. This requires investment in people, technology, innovation/creativity, spaces, capacity building/empowerment of staff and users, and access and use of resources. This paper envisions academic libraries in 4IR as depicted in Figure 4, with smart jobs, (anytime, anywhere, everywhere, well paying, ethical and transformative) and smart policies (adaptable, responsive, sensitive, ethical/social justice). This is a preliminary study based on data collected from university library websites some of which are still underdeveloped which is a limitation. Future work require verification of the trends/services through contact with the responsible individual from the Libraries. Also a robust discussion on the proposed conceptual framework (fig.4) is essential. This paper adds to the on-going research and discussion/debate about the 4IR and the future of academic libraries that is likely to develop of the sector.

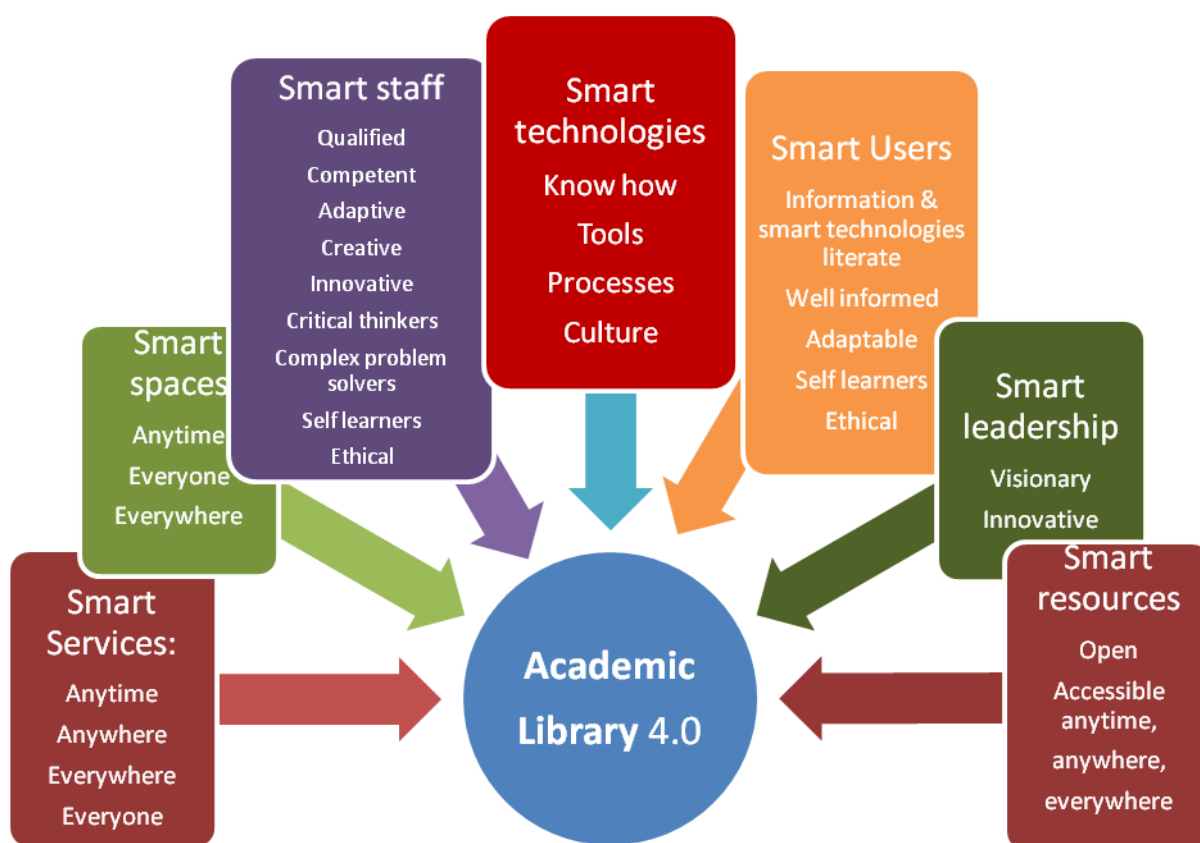


Fig. 4. Academic Library 4.0

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