

THE THRESHOLD OF HIGH TECHNOLOGY IN GLOBAL COMMERCE: LEVERAGING THE ROLE OF HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

Global commerce is a transborder movement that is giving rise to varied alternative providers and services that cut through traditional structures to the international context in the era of technological disruption. As the legitimate providers of commerce-allied disciplines, Higher education institutions assume a compelling role to survive and move into the loop of intensive technology adaption to bring across transnational transactions for which cross-border commerce, global regulation, and legitimization of activities are the emerging points of multi-national convergence. This paper seeks to reflect about the purpose and the point of convergence between traditional commerce and global commerce and the emergent strategies in response to the relentless shockwaves of globalization and technological advancement, making the role of higher education sector more dynamically compelling and responsive. The growth is translated into two (2) unique features of global or e-commerce. First, it is global reach where it allows commercial transactions to happen in various organizational levels and geographical boundaries with convenience and efficiency through the exploitation of technological mechanisms; and second, due to this broad-based transaction, the potential market size of e-commerce stakeholders is global-driven, too.

Keywords: *high technology, global commerce, higher education institutions*

BACKGROUND

Prediction that automation will make humans redundant have been made before; however, going back to the Industrial Revolution when textile workers protested that machines and steam engines would destroy their livelihoods (Randall, 1997; Horn, 2005; Grint & Woolgar, 2013). ‘Never until now did human invention device such expedients for dispensing the labour of the poor’, said in the pamphlet at that time. Subsequent outbreaks occurred in the 1920’s, (March of the machine make idle hands, declared in New York Times headlines in 1928) and 1930’s when John Maynard Keynes coined the term “technological unemployment” and 1940’s when the New York Times referred to the revival of such worries as the renewal of an ‘old argument’.

As computers began to appear in offices and robots in factory floors (Sundstrom & Sundstrom, 1986); President John F. Kennedy

declared that he major domestic challenge of the 1960’s was to maintain full employment of a time when automation is replacing men. In 1964, a group of Nobel Prize winners known as the Ad Hoc Committee on the Triple Revolution sent President Lyndon Johnson a memo alerting him to the dangers of a revolution triggered by the combination of the computer and the automated self-regulating machine. This, they said was leading to a new era of production which required progressively less human labor and threatened to divide society into a skilled elite and a unskilled underclass (Massey & Denton, 1993; Urry, 2013). The advent of personal computer in the 1980’s provoked further handwriting over job losers (Frey & Osborne, 2017).

The First Industrial Revolution was catalyzed by Newton when he formulated slow of motion (Kauffman, 2013). Because from the onward motion was better understood and

quantified, it was possible to design steam engines that mechanized much of the work that was traditionally done by humans. The Second Industrial Revolution was catalyzed by Faraday and Maxwell who unified magnetic and electric forces and this led to electricity generation and electric motor which were instrumental in the assembly lines that have come to dominate many industries (Xing & Marwala, 2017). The Third Industrial Revolution was catalyzed by the discovery of a transistor which ushered the electronic age that gave us computers and internet (Coltman, Devinney, Latukefu & Midgley, 2001). The Fourth Industrial Revolution will revolutionize industries so substantial that much of the work that exists today will not exist in 50 years (Marwala, 2017). The Fourth Industrial Revolution digitizes and vertically integrates processes in the entire organization. It also integrates horizontally all the internal process from supplier to customers (Wagener, 2014)

LITERATURE REVIEW

HIGH- TECHNOLOGY AND GLOBAL COMMERCE

1. High-technology and Industry

Science and technology is the foremost force in enhancing economy and social development. With globalization trend of economy, science and technology, the demands for talents, physical resources, technology transfer and capital investments are becoming even more intensive in the world (Mowery, & Oxley, 1995; Morgan, 2007). Not only has high-tech industry become the engine of world's economy but also it is the crucial advantage edge for a country to survive in today's highly competitive global market. Consequently, the level of hi-tech industry is the determinant factor of what level of social and economic development a country could make, as well as what type of role the country could play in the global economy (Bell & Pavitt, 1997).

High technology has a very positive influence over the traditional industries, pouring new ideas and providing them with new tools (Veryzer & Borja de Mozota, 2005; Hakansson, 2015). In the field of agriculture, industry and service sector, its investment biological and information technology augments very quickly, reflecting that the technological level and competitive ability of these fields are acquiring sustainable improvement (Anton, Silbergliitt &

Schneider, 2001; Bende-Nabende, 2017). At the same time, during the penetration and improvement process entailed by high-tech industry to the traditional industry, it gave birth to many other advanced technologies and relevant products such as automatic control system, digital control system which in turn could bring new insights for the development of high-tech industry at a higher level. E-commerce is an extraordinary high-tech in the field of information industry (de La Torre & Moxon, 2001; Zhou & Xin, 2003). As a highly penetrating information tool, it owns immense potential to enhance modern productivity.

Various types of intermediary agencies such as productivity promotion center, innovation, service center, information consultancy service center, should be encouraged and supported. Here, the development of intermediary agencies could provide e-commerce related enterprises with comprehensive technology, human resources, and law affairs services (Den Hertog & Bilderbeek, 1999; Hertog, 2000).

The Fourth Industrial Revolution is characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres (Klaus Schwab, 2016). The fourth industrial revolution is powered by artificial intelligence and it will transform the workplace from tasks based characteristics to the human centre characteristics. Because of the convergence of man and machine, it will reduce the subject distance between humanities and social science and technology

2. Global Commerce.

Commerce as a system whereby goods or services are exchanged has existed since pre-historic times (Renfrew, 1969; Beniger, 2009). Indeed, the barter system introduced to civilization million of years ago was in fact the genesis of where traditional commerce stemmed from. Since the introduction of currency, the more sophisticated process is transaction. Also, available products and services were of a vastly different nature than what people have today, but the principles have largely permeated the same.

Commerce is the selling and buying of goods and services on a large scale (Gunasekaran, Marri, McGaughey & Nebhwani, 2002; Laudon & Traver, 2013). The history of commerce dates back to the mid-16th century

when trade started in Europe. Trade fairs were held and luxury goods were sold and bought by merchants. Soon wealth became capital, banking systems were developed, and money was transacted on bank accounts across and throughout national boundaries. In commerce today, businesses practice traditional and electronic commerce where peoples and companies try to make much profit (Kalakota & Whinston, 1997; Reichheld, Markey & Hopton, 2000).

3. Traditional Commerce

Traditional commerce is a kind of commerce which concentrated on the exchange of goods and services (Tsalgatidou & Pitoura, 2001; Delfmann, Albers & Gehring, 2002; Ratnasingam, 2005). It is comprised of all the activities that in one way or the other encourage the exchange of goods and services to take place. Moreover, there are many advantages of traditional commerce. One of them is that the customers can personally inspect goods before buying them. This is very crucial behavior for businesses. Visiting a physical store to verify goods can help one to tell about the goods and the environment; the owner of the business cannot lose money through scams and hacks; fraud merchants can be caught easily as well.

4. Electronic commerce

E-commerce is the selling and buying of goods and services or transmitting of funds and data over an electronic method primarily the internet (Fraser, 1997; Williams III, 2006). *U.S. Patent No. 7,099,835*. Washington, DC: U.S. Patent and Trademark Office. Their business transactions occur either business-to-business, business-to-customer, customer-to-customer, or customer-to-business. The term and e-tail is more often used in reference to the transaction process for on-line shopping.

The beginning of e-commerce can be traced to the 1960's when businesses started using Electronic Data Interchange (EDI) to share business documents with other companies (Hart & Saunders, 1997; Moore, 2002). After a number of individual users sharing electronic documents with each other grew in the 1980's, in the 1990's the rise of the e-Bay and Amazon revolutionized the e-commerce industry. Customers can now purchase endless amounts of items online, both from typical bricks to mortar stores from e-commerce operating

industries. Consumers can purchase amounts of items online with e-commerce capabilities.

The emergence of innovative softwares and apps is transforming the way payments are made in the global commerce ecosystem (Hu, Li & Hu, 2008; Basole & Karla, 2012; Liu, Kauffman & Ma, 2015). This is practically evident when it comes to mobile and electronic purposes, which are expected to grow at an annual rate of 59% and 18%, respectively through 2014. And with global commerce transaction expected to increase from 29 billion in 2013 and 34 billion in 2014 (Pizon, 2016). The World Economy Forum Annual Meeting in Davos typifies these features of the fourth industrial revolution, a term coined by Klaus Schwab, to describe the new generation of technological advances – sensors, robotics, artificial intelligence., 3D Printing, precision medicine – coming together to define the next wave of progress. These technologies have the potential to transform our lives.

With more intelligent, automated technology people could generate renewable energy, address climate change, connect billions of people to the internet, develop affordable housing solution and cure chronic diseases (Vermesan & Friess, 2013; Khatoun & Zeadally, 2016). Inversely, there are three concerns raised in Davos Meeting. Firstly, the fearful theme was the potential for job losses as automation continues to replace manufacturing or blue collar job in banking, law and medicine. Secondly, it was inequality in the world between 'digital haves and have not' reflected both as a challenge among nations developed and developing, but also an issue for specific socio-economic groups within individual nation, some of which arguably are still not pass the second or the third industrial revolution. Thirdly, it goes with the common concern particularly driven by robotics and artificial intelligence, which was claimed a dehumanization of people's lives. Another issue centered on the ethical and moral challenges of many advances.

To date, the technological innovation that has driven the Fourth Industrial Revolution is shaped by the commercial prospects small or large firms in the market. After all, one definition of "innovation" is the commercial application of invention. For example, investment in alternative energy, R&D fluctuates depending on the oil price just as

demands for hybrids or electric vehicles become more or less attractive depending on gasoline price.

What if, instead being driven solely by commercial returns, we could focus the fourth Industrial Revolution more directly on the big problems our world faces? What if we could prioritize policies? How do we draft policies and create economic incentives to encourage the right types of technology advances? What should governments and the private sectors do differently to focus technology on addressing these goals? How do we direct the energy and creativity of millions of entrepreneurs towards improving the state of the world? These and many other queries demand critical answers as societies approach the Industrial Revolution.

The world's innovation system is powerful and has generally worked well (Cooke, 2001; Chesbrough, 2006). However, it could be used as a guiding hand to nudge it in a direction that will benefit the planet beyond the incentives of commercial returns. Expanding our criteria for importance in solving areas of global need is not an inherently anti-capitalist idea, but it is one that would channel capitalism in the best direction for humanity as a whole.

LEVERAGING THE ROLE OF HIGHER EDUCATION

Technology disruption era is at its peak. Everything gets going through the combination of physical, digital and biological domains (Schwab, 2017). More perceptive in the academic environment is the continuing impact of Industrial Revolution 4.0 has triggered. Practically all work spaces are constantly challenged to shift and adopt a series of digitization practices using one or a blend of these modalities: e-learning, internet storage of data, artificial intelligence, big data mining, robotics, augmented reality, cloud computing, nano-technology and Bio-technology, and genetic editing, among others. This 4th revolution is characterized by the fusion of technologies that is blurring the lines between the physical, digital and biological spheres (Schwab, 2017), the same environment that paved the digitization of the higher education sector.

The fourth industrial revolution is powered by artificial intelligence and it is constantly transforming the workplace from task-based characteristics to the human-centred characteristics. Because of the convergence of

man and machine, it has reduced the subject distance between humanities and social sciences as well as science and technology. As predicted, digital revolution in Scan 2025 bears the following features/phenomena:

- Daily life goes digital; a caseless society exists and a global leader thrives in a smart office
- Local champion competes with silicon valleys; a borderless digital service is accessible
- Embracing industry 4.0, all of world firms are digitized and the global leaders in smart manufacturing are providers and consumers at the same time.
- Fast and efficient public service with digital ID and seamless cross-border public services for all citizens
- Rise of digital natives with 100% financial inclusion and 100% digital literacy

The rapid expansion of digital structures and their influence in the development and growth of contemporary higher institutions is an inevitable strategic response to the 4th societal revolution. Although little has been said about how globalization is transforming the forms and processes of global governance and their implications to the role of higher education; its impact, nevertheless comes in perceptible waves.

There are two sides of higher technology impact. Firstly, high technology needs the HE practitioners who continuously improve their professional readiness and competitiveness. It is thus expected that the local talents are driven to shift professionally into global employees, who by virtue of the forces arising from a highly digitized society, the quality of workforce skills is displayed through digital technology and innovative tasks (Park & Soc, 2017). Secondly, if higher education institutions still produce graduates only for competency and professionalism, their response capabilities to succeed in a globalized market remains futile. From the view of high-tech, bridging possible threats and making these threats as opportunities particularly fortifying entrepreneurial education may pave new and innovative platforms in the discipline. In global commerce for instance, knowing that there are two extreme schemes in the real world, namely: traditional commerce and global commerce, neutralizing the weakness of

one is getting its benefits for the other. As mentioned earlier, to acquire the positive impact of high-tech practices, state-of-the-art equipment and techno savvy workforce to bring in fast and seamless services is a systemic requisite. The transformation of traditional commerce into e-commerce, requires both workers' knowledge development and a digital intensified literacy program.

Universities emphasize their role in shaping future technology by being the test beds for innovation and educating future generations. Traditional education has contributed greatly to the current levels of industrial revolution and technological advancement. However, in order for Higher Education to deliver future generation with the right set of skill and knowledge: an imperative question has to be asked regarding how Higher Education Institution would be affected by the fourth Industrial Revolution and how the delivery of education will be transformed.

There are different opportunities available that will shape the role which can be undertaken by higher education in the fourth industrial revolution. Combining the strength of the traditional higher education with the increasing trends of Massive Open Online Courses (MOOCs) represents necessary steps to scale quality education. On the other hand "Global Identity" and "Educating for you" embody aspects, if globally embraced that would transform global Higher Education. At times where the boundaries between the internet, physical world and people are becoming more blurred by each passing day, the need for education in general and higher education in particular to be "place-based" is diminishing.

Currently, education is being connected to mobile devices through applications in the cloud and is no longer limited to knowledge but extended to skill acquisition. With the expansion in networking services nationally and globally, physical boundaries are no longer barriers to education. Actually MOOCs are potentially disruptive innovations. The number is increasing exponentially across the globe making learning more accessible to people. According to By the Number MOOCs, the number of participants has doubled in 2015 from 16-18 million students to 35 million students across all MOOCs providers. This is to say that universities are digitizing their courses.

However one cannot overlook the importance of direct and face-to-face interaction

between the learners and teachers as an influential part of quality education. Therefore, a mix between MOOCs, and traditional education which are gaining more and more popularity and traditional ways of delivering education is extremely vital for meeting the global job market's needs. One of the main issues facing MOOCs is related to accreditation and trust in the associated credential. On the other hand, higher education institutions are trusted especially those with long experiences in accreditation.

The future mix between MOOCs and traditional education can provide higher education institutions the opportunities to expand services and to offer credential using the experiences of the lecturers and teachers. One of the main services universities offer is the provision of certification for students whose education is disrupted whether because of war, conflicts, or lack of financial resources. The higher education community might address this great challenge by creating micro-certificates recognizing the level of knowledge or skills acquired by the sum of a person's education until the moment of its interruption.

GLOBAL IDENTITY

Having a digital identity that is trusted, portable and secured, which stores an individual information and can be used across countries, especially in case of conflict, eruption or natural disaster, would address this challenge. As individuals gain education from different universities, work at diverse and global organizations and participate actively with different initiatives, his/her identity is no longer tied to one organization.

Creating Identities based on every institution one learns from or organization one works at could be very confusing and overwhelming which raise the question of "What is our identity and where we can find it? The trust placed in higher education institution could be driver for higher education institution to be leading the creation of a global identity that is portable across universities and organization. These efforts could lead to the vision of "global identity" which can extend beyond the education sector and others and across the country.

EDUCATION FOR ALL

Data Analysis and automation help companies not only to survive but also to thrive in the future. Similarly, higher education

institutions are embracing data mining in order to gain better understanding of student performance and deliver "Education for you" that is tailored to meet the demand of the job markets while considering the student's need.

Data regarding student performance, behavior, development and interaction inside classrooms and on the platform of MOOCs as well as data from smart campus would create diverse and fast-changing data. The ability of HEI to integrate this information into smart data would result in intellectual decisions with regards to the delivery of customized education and personalized learning experiences of students.

THE CHALLENGE AHEAD

Altering HEI is more necessary than ever before. However the challenges ahead have to be considered in order to ensure effective in immediate transformation. With the reduced public financial support for HEI, universities need to think strategically regarding methods to utilize their experiences in credentials, trust and identity to offer new services.

Furthermore HE Leadership needs to be less risk averse especially in this world of disruptive change. It is no longer an option to keep doing things the old ways. Innovating and accepting change is now a prerequisite for survival. Risk, privacy and security are other challenges facing higher education. Collaboration, integration and aligning security process are thus the keywords for scaling HE efforts and bringing it to a sustainable level.

Economic challenge & digital technology stay on the opposite sides of digital economy. These are two sides that are seemingly abstract. A closer look into the changing landscape of global governance of higher education suggests that the implementation of successful digitization strategies is defined by a 'global governance broker or disruption' as an innovative, multi-sector, and voluntary approach

to organizing global governance among higher education institutions.

CONCLUSION

The concept of global commerce bears complex processes. Basic definition points that global commerce denotes the complete integration, synchronization and digitization of the entire global supply chain. It is poised as an explosive growth of commerce using the cyber highway. In higher education institutions, this growth is translated into two (2) unique features of global or e-commerce. First, it is global reach where it allows commercial transactions to happen in various organizational levels and geographical boundaries with convenience and efficiency through the exploitation of technological mechanisms; and second, due to this broad-based transaction, the potential market size of e-commerce stakeholders is global-driven, too.

Globalization allows people and the world to become increasingly interconnected as a result of massive increased trade and cultural exchange on an equally massive and varied technological platform. This suggests that new methods and policies must govern contemporary businesses and for higher education institutions, to move in accordance to the needs and trends of global business, their policies and programs must be governed with a technological perspective and disruption of their conventional practices and programs are considered. The roles of Higher Education Institution are very important, as Prof Sabina Jeschke from RWTH Aachen University, during the World Engineering Education Forum 2015 said, that the complexity of the system developed to meet the demands of the fourth industrial revolution necessitate interdisciplinary and collaboration as a precondition for innovation.

REFERENCES

- Anton, P. S., Silbergliitt, R., & Schneider, J. (2001). *The global technology revolution: bio/nano/materials trends and their synergies with information technology by 2015*. Rand Corporation.
- Basole, R. C., & Karla, J. (2012). Value transformation in the mobile service ecosystem: A study of app store emergence and growth. *Service Science*, 4(1), 24-41.
- Bell, M., & Pavitt, K. (1997). Technological accumulation and industrial growth: contrasts between developed and developing countries. *Technology, globalisation and economic performance*, 83137, 83-137.

- Bende-Nabende, A. (2017). *Globalisation, FDI, regional integration and sustainable development: theory, evidence and policy*. Routledge.
- Beniger, J. (2009). *The control revolution: Technological and economic origins of the information society*. Harvard university press.
- Chesbrough, H. W. (2006). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.
- cluster policies*. London: Springer Ltd. Retrieved at <https://doi.org/10.1007/s00146-017-0777-5>.
- Coltman, T., Devinney, T. M., Latukefu, A., & Midgley, D. F. (2001). E-business: revolution, evolution, or hype?. *California Management Review*, 44(1), 57-86.
- Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *Industrial and corporate change*, 10(4), 945-974.
- de La Torre, J., & Moxon, R. W. (2001). Introduction to the symposium e-commerce and global business: The impact of the information and communication technology revolution on the conduct of international business. *Journal of International Business Studies*, 32(4), 617-639.
- Delfmann, W., Albers, S., & Gehring, M. (2002). The impact of electronic commerce on logistics service providers. *International Journal of Physical Distribution & Logistics Management*, 32(3), 203-222.
- Den Hertog, P., & Bilderbeek, R. (1999). Conceptualising service innovation and service innovation patterns. *Research Programme on Innovation in Services (SIID) for the Ministry of Economic Affairs, Dialogic, Utrecht*.
- Fraser, R. (1997). *U.S. Patent No. 5,664,115*. Washington, DC: U.S. Patent and Trademark Office.
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: how susceptible are jobs to computerisation?. *Technological Forecasting and Social Change*, 114, 254-280.
- Grint, K., & Woolgar, S. (2013). *The machine at work: Technology, work and organization*. John Wiley & Sons.
- Gunasekaran, A., Marri, H. B., McGaughey, R. E., & Nebhwani, M. D. (2002). E-commerce and its impact on operations management. *International journal of production economics*, 75(1-2), 185-197.
- Hakansson, H. (Ed.). (2015). *Industrial Technological Development (Routledge Revivals): A Network Approach*. Routledge.
- Hart, P., & Saunders, C. (1997). Power and trust: Critical factors in the adoption and use of electronic data interchange. *Organization science*, 8(1), 23-42.
- Hertog, P. D. (2000). Knowledge-intensive business services as co-producers of innovation. *International journal of innovation management*, 4(04), 491-528.
- Horn, J. (2005). Machine-breaking in England and France during the Age of Revolution. *Labour/Le Travail*, 55, 143-166.
- Hu, X., Li, W., & Hu, Q. (2008). Are mobile payment and banking the killer apps for mobile commerce?. In *Hawaii International Conference on System Sciences, Proceedings of the 41st Annual* (pp. 84-84). IEEE.
- Kalakota, R., & Whinston, A. B. (1997). *Electronic commerce: a manager's guide*. Addison-Wesley Professional.
- Kauffman, S. (2013). Evolution beyond Newton, Darwin and entailing law. *Beyond mechanism: putting life back into biology. Plymouth, UK: Lexington Books*, 1-24.
- Keynes, J. M. (1933). Economic possibilities for our grandchildren (1930). *Essays in persuasion*, 358-73.
- Khatoun, R., & Zeadally, S. (2016). Smart cities: concepts, architectures, research opportunities. *Communications of the ACM*, 59(8), 46-57.
- Klaus, S. (2016). The fourth industrial revolution. In *World Economic Forum*.
- Laudon, K. C., & Traver, C. G. (2013). *E-commerce*. Pearson.
- Liu, J., Kauffman, R. J., & Ma, D. (2015). Competition, cooperation, and regulation: Understanding the evolution of the mobile payments technology ecosystem. *Electronic Commerce Research and Applications*, 14(5), 372-391.
- Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of management Review*, 21(1), 135-172.

- Marwala, T. (2017). Implications of the fourth industrial age in higher education. Retrieved at <https://www.researchgate.net/publication> on April 2, 2017.
- Massey, D. S., & Denton, N. A. (1993). *American apartheid: Segregation and the making of the underclass*. Harvard University Press.
- Moore, G. A. (2002). Crossing the chasm.
- Morgan, K. (2007). The learning region: institutions, innovation and regional renewal. *Regional studies*, 41(S1), S147-S159.
- Mowery, D. C., & Oxley, J. E. (1995). Inward technology transfer and competitiveness: the role of national innovation systems. *Cambridge journal of economics*, 19(1), 67-93.
- Park, S., AI & Soc (2017). *The Fourth Industrial Revolution and implications for innovative*
- Randall, A. (1997). Reinterpreting 'Luddism': resistance to new technology in the British. *Resistance to new technology: Nuclear power, information technology and biotechnology*, 57.
- Ratnasingam, P. (2005). Trust in inter-organizational exchanges: a case study in business to business electronic commerce. *Decision support systems*, 39(3), 525-544.
- Reichheld, F. F., Markey Jr, R. G., & Hopton, C. (2000). The loyalty effect-the relationship between loyalty and profits. *European business journal*, 12(3), 134.
- Renfrew, C. (1969). Trade and culture process in European prehistory. *Current Anthropology*, 10(2/3), 151-169.
- Schwab, K. (2017). *The fourth industrial revolution*. Crown Business.
- Sundstrom, E., & Sundstrom, M. G. (1986). *Work places: The psychology of the physical environment in offices and factories*. CUP Archive.
- Tsalgatidou, A., & Pitoura, E. (2001). Business models and transactions in mobile electronic commerce: requirements and properties. *Computer Networks*, 37(2), 221-236.
- Urry, J. (2013). De-industrialisation, classes and politics. *Richard King*, 28-48.
- Vermesan, O., & Friess, P. (Eds.). (2013). *Internet of things: converging technologies for smart environments and integrated ecosystems*. River Publishers.
- Veryzer, R. W., & Borja de Mozota, B. (2005). The impact of user-oriented design on new product development: An examination of fundamental relationships. *Journal of product innovation management*, 22(2), 128-143.
- Wagener, D. 2014. Industry 4.0. Opportunities and Challenges of the Industrial Internet. German. Strategy and PWC.
- Williams III, L. E. (2006). *U.S. Patent No. 7,099,835*. Washington, DC: U.S. Patent and Trademark Office.
- Xing, B., & Marwala, T. (2017). Implications of the Fourth Industrial Age on Higher Education. *arXiv preprint arXiv:1703.09643*.
- Zhou, Y., & Xin, T. (2003). An innovative region in China: interaction between multinational corporations and local firms in a high-tech cluster in Beijing. *Economic Geography*, 79(2), 129-152.