



READINESS IN MEETING THE FOURTH INDUSTRIAL REVOLUTION: THE ROLE OF HIGHER EDUCATION LEADERS

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Abstract: This paper discusses some strategies taken by several universities in response to the Fourth Industrial Revolution (4IR). The discussion starts with the use of metaphor to describe the appearance of university in the era of 4IR followed by the need to re-look at the role of the university from different perspective. The discussion then focuses on small but innovative strategies initiated by some university leaders abroad and in Malaysia. The presentation eventually ends with the initiatives taken by Universiti Teknologi Malaysia (UTM).

INTRODUCTION

Many have been discussed regarding the Fourth Industrial Revolution (4IR) and its impact to our industries. Probably, almost all seminars or academic talks that you have attended already indicated that the 4IR will transform the way we live, the way we work and may be the way we are governed. Many speakers and presenters in the seminars may also have agreed that the nature of this 4IR is differed from the previous three industrial revolutions for both, in term of speed, and in term of magnitude of change that confronting us. They may have also highlighted that the new technologies of 4IR that come from various fields possess huge challenges to human being. Despite those scary things to happen, to this date none can inform us clearly the actual impact of 4IR. What we all know is that the actual impacts of 4IR is still uncertain. Despite of this uncertainty, higher education must be ready to react to that exponential change. This readiness can ensure that higher education institutions can move away from the label of one of the most difficult institutions to change (Ramaley 2014).

to better understand what will happen to higher education institutions in the wake of some scholars suggested that we employ metaphors that close to our daily life. One of the many metaphors proposed by scholars is higher education 4.0 or university 4.0. This metaphor is used to describe what may happen to the university in this era of exponential change. Prior to using number as metaphor to the word 'university', many other metaphors have been used to describe how universities were perceived by others.

One classic example of metaphor that frequently used to describe the nature of higher education is the Convenience Store at gasoline station. Applying the convenience store metaphor to describe the university, thus university is considered located along the highway of life. As many of us know, this convenience store until today is not a

place the students as customers necessarily want to stop at. However, looking at the opportunity, the customers may have decided to stop for a while to fill up on knowledge to continue the journey. Using this metaphor to describe the nature of higher education, everything that the university offers can be compared with an item offered at the convenience store. The knowledge a student is buying can be compared to the different grades of gasoline available to the customer of a convenience store. For example, RON87, RON95, and RON97. The type of performance the gasoline (knowledge) provides to the customer (student) is depended on the commitment the customer (student) has. Car owners (customers) who want to get the most from their gasoline may go for the expensive type of gasoline, that is, high grade gasoline. In this case, RON97. For the meanwhile, the customers who do not care what kind of performance the gasoline may give them may opt for the cheapest gasoline. In this case, RON87. Similarly, the students who want to get the most out of their tertiary education may sacrifice their interests by paying the higher price and spending more time with their studies and taking more challenging courses. In contrast, students who do not care much on what type of education they get may choose to minimize the amount of work necessary to get a degree by taking less challenging and demanding courses. Looking into this metaphor, the customers' goal is to reduce expenditure by purchasing cheaper gasoline while the students' goal is to maximize the amount of free time to allow them to pursue their personal interests.

This presentation, however, will not use convenience store as the metaphor for higher education. This presentation instead will use number at the end of the word university or higher education to describe the number of industrial revolutions that the world has gone through. Thus, we write university 1.0, university 2.0, university 3.0, and university 4.0 for each industrial revolution. Each of this number brings gigantic change to the university and country higher education system.

Metaphor for University

Using number as a metaphor, we can classify university into four phases. First is the University 1.0, which is known as the metaphysical university, that is, in service of the church. This university emerged in medieval times (Maria, Shahbodin, & Che Pee, 2018). Of course, all of us sure are not from this era. The university at this era focused to resolve special communities' issues and this eventually advanced into liberal arts education that we know today.

Second is the University 2.0. This is a research university which emerged in the post-industrial societies. At this era, universities became the focal point for research-driven technological advancement (Maria, Shahbodin, & Che Pee, 2018). This great post-war expansion of universities has a clear research focus in service of economic development. Many of this type of university is still in existence and become strong higher education institutions in producing scholarly journals.

Third is the University 3.0. This type of university is often known as entrepreneurial university. At this era, this type of university served many diverse functions and



communities including enhancing its own self-interest (Maria, Shahbodin, & Che Pee, 2018). This type of university has been a buzzword for many years to produce graduates who are job creators and game changers rather than job seekers. However, only a handful of university managed to secure this status. A vast majority of graduates still searching for the jobs rather than creating new jobs. This type of university is still strong and often receive world recognitions for its contributions.

At the present time is the University 4.0. This is an ecological university or also commonly known as university for others. This type of university focuses on outward looking which deeply connected to industry and the communities. This type of university committed to serve the needs of its students (Maria, Shahbodin, & Che Pee, 2018). Thus, the metaphor 'University 4.0' is a metaphor to describe the ways that universities need to respond to the new economy and associated trends such as digital disruption and radical changes in the labour markets. At this point, many existing universities are working seriously to achieve university 4.0 status to ensure that they are up-to-date and produce graduates that sought after by the industries. For that, many universities must undergo revolutionary change to ensure that they are still relevant. Any university that failed to react to the demand of change will be obsolete. As stated earlier, if no is taken and as happened in the past, university is still one of the 100 institutions that is considered the most difficulty to change. This slow way of reaction to IR may render universities obsolete.

University 4.0 and the Thinking Patterns

The emergence of university 4.0 requires faculty members and administrators to rethink and visualize the role of university in a broader perspective. This change reflects that university can no longer enjoy working and functioning in a silo. University must collaborate with many other entities to progress further and faster. For this purpose, many universities around the world currently developing collaborative strategic plans to move towards a university 4.0 model to flourish in this fluid times. There are many reasons tied to this need, but due to space limitation, only four reasons will be discussed below.

First, the work environment for which we are preparing our students for future is changing dramatically. Many reports and seminars related to higher education 4.0 or university 4.0 indicated that future job landscape will not be the same anymore. As has been reported in many seminars, books, journals and other types of publications that automation will make many existing jobs either disappear or no longer relevant. From the many seminars and publications, we were informed that many ways of working are changing rapidly. Many of our traditional ladders into the workforce which were working very well previously, are either can no longer hold water or no longer available. From those seminars and publications, we also know that the current life-span of knowledge and skills that we shared and delivered to our students and the qualifications that they are acquired through formal education in the classes at our campus is reducing very quickly. This means that the fast change resulting





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from the emergence of digital technologies making the current knowledge, skills, and qualifications have short life-span (D'Souza, & Mudin, 2018).

Second reason for us to re-look at our universities is related to the expectations towards universities for economic development and growth. For many years, research conducted by faculty members at universities has been an important source of innovation for the country. If we look back to history, it was since university 2.0 that faculty members became the main and sole source of innovation for the community, industry, and country. However, currently we cannot simply assume that our research or product that we produced through research will reach our customers and users. At this time, we must do more to ensure that our products reach the appropriate customers and users. Beside research and products, universities are demanded to demonstrate that it gives back to the community more directly than through the production of graduates. Looking at this aspect closely, we must notice that the community trusts toward university is depended on the ability of the university to provide high impact to the community.

Third reason for us to re-think our university role is due to the increase in demands toward university ability to do more with less. Less in almost every aspect of working life. Less resources and budget, less leisure time, less staff, and less rewards. These demands require universities to be more active in pursuit of applied research through deep industry partnerships, accelerator programs, incubators, and others. This demand is reinforced by the fact that technological innovation now happens much faster and at diverse scales. In the past, very long time was needed to translate university research into commercial outcomes or products. At present, innovation occurs on daily basis. This dramatic change creates a need, and a space, for the rapid stimulation of ideas and their translation to commercial outcomes. We all know that university is the best institution to play this role and will continue to play this role. This is because university is about people and is surrounded with smart people, sophisticated research infrastructure, and extensive real estate. For this, university must position itself and act as a centre of innovation or innovation hub. With this goal in mind, universities must strategize its resources to play this role handsomely.

Finally, the fourth reason to re-look at our university is the digital technology itself. Many publications highlighted that the digital technology is a significant driver in the developments of all aspects of life. For example, the presence of digital technologies increases the expectations about the availability and flexibility of the learning experience, not only on campus, but anywhere and anytime (Chao, 2017). In short, the presence of digital technology creates many opportunities to respond to challenges in many ways. For this reason, once again university must react positively and rapidly to be relevant to the community and students. University may have to change its organizational structure to suit the needs of the demands for fast reaction. This reaction may include merging several faculties or departments or develop totally new faculties and departments to ensure effective and efficient use of resources including its human capital.

Defining the Role of University

Based on the abovementioned scenario, university leaders must adapt or lead the change. What strategy may university leaders take to transform their universities into university 4.0? There are many ways university leaders may react to University 4.0. For this presentation, only four ways are discussed as follows:

1. University leaders may provide on-demand learning in multiple modes to students. Each mode can seamless handoff with other modes of learning. Students may choose any mode based on their inclination, interests, and convenient.
2. University leaders may plan to move away from degrees as the only form of credential offered to students. University may move towards a more mixed offering of degrees and shorter cycle qualifications and credentials. The mixed form of offering may welcome non-traditional students to enrol and continue their studies. This plan may enable university leaders to cater for different types of customers for quality education.
3. University leaders may put much stronger focus on career management for students. This can be done while students are at the university and when they become alumni of that university. This strategy must go beyond merely careers advice or career talks in its traditional forms as many universities have done in the past. This strategy may include things such as the ability to add value to standard university qualifications throughout a working life.
4. University leaders may transform university into physical sites for co-location and research collaboration with various industries. University leaders may expand their roles to brokers of relationships between young entrepreneurs, potential mentors, supporters and funders. This plan may ensure university stay relevant and maintain enrolment throughout their existence.

Strategies Employed by University Leaders

Several strategies have been developed across the academic world that are promising examples of the direction that higher education might take in the coming years. Some of those initiatives are discussed below.

Make university education more universal

To better serve the community and the industries, scholars proposed that university education to regain some breadth of knowledge disciplines that is previously either ignored or diminished. With knowledge disciplines being created and merged, the university leaders may have to reduce its focus on teaching within single discipline. This suggestion goes beyond merely technical skills. For this suggestion to be implemented, a broad understanding of humanistic issues is necessary to overcome the challenges that awaited ahead. As we all realize that prior to this 4IR, we have seen many things happened as a result of separation between humanities and technology.



As stated earlier in this paper, previously many departments tend to work in a silo. Due to this separation, many have the tendency of viewing technology as the ultimate solution to our today's problems rather than as a tool to improve our existence. Without a humanistic understanding of the nature of the relationship between technology, users and society at large, we are inclined to produce technology that does not actually match with human demands.

Many studies showed that at present only 23 percent of employers think that university education is producing graduates who are adequately prepared for working in industries (Ramakrishnan & Mohd Yasin, 2011). As a result, many employers argued that they have to re-train these graduates before the graduates can function fully in the jobs. Many reports or even complaints from employers stating that university graduates are lacking in softskills including interpersonal skills, problem-solving skills, and creative thinking skills. To those employers, these skills are not just crucial to be good employees for their organizations, but also important to be good citizens. This incident indicated that there are huge opportunities to educate students through non-traditional ways.

Almost everywhere in the world now that the demand of the job market has shifted towards a mixed of both social skills and technical skills. A few reports indicated that many technology companies now start recruiting liberal arts graduates (Anders, 2017). This indicates that the jobs that artificial intelligent (AI) may create in any organizations will most likely focusing on understanding human relationships with the technology more than understanding the technology itself. For this purpose, university must take precaution toward unpredictable future, that is, to gear towards the traditional foundations and mission of higher education. This suggestion indicated that students must be educated in fundamental principles of teaching. These may include skills on (a) how to think of becoming productive and responsible citizens; (b) how to question assumptions, to analyse facts, to reason and to formulate arguments; and (c) to express themselves clearly without hurting others while at the same time maintaining integrity.

Diversify departmental structure

Many universities currently diversify its department structures to ensure smooth adoption to 4IR. This strategy requires the university leaders to develop academic structures that span the traditional disciplinary boundary. A few universities, listed below, have successfully implemented this strategy.

Cambridge University through the Institute for Manufacturing offers a more fluid curriculum. One of them is by diversifying its curriculum offering across disciplines. By doing this, the university offers students a cross-disciplinary collection of expertise from the department of management, engineering, technology, and policy that relates to manufacturing. The offering provides more flexibility to students and faculty members regarding courses that can be accounted for a degree.



- ii. Cranfield University organized its departments across specialty-focused themes. Among the famous specialty-focused themes that frequently mentioned in the literature are transport systems, agri-food, and energy. This strategy intends to provide real world solutions to the vast challenges facing the society. This strategy allows various disciplines to collaborate and come together to offer views on systems design, human factors, technology, and trends in business and economics.

c. Life-long learning

Many other universities have highlighted the need to produce life-long learning graduates. This strategy requires university leaders to put more emphasis on life-long learning in their programmes. For example, many universities have discussed the contemporary requirement for a 4-year undergraduate degree. With the emergence of 4IR, this requirement may seem out-dated and may face with limited number of students enrolling in classes. With information freely available on the Internet, students may choose to learn at an individualized pace and direction. Supposedly at any time and anywhere. Thus, attending classes on regular basis and in traditional forms may no longer be the best option to move ahead. This strategy allows students to continue their tertiary education at their convenient time and location.

d. Strengthening the STEM curriculum

Many literatures indicated the need for curriculum change for STEM (science, technology, engineering and mathematics). This strategy requires university leaders to look at curriculum for STEM from different perspectives and making STEM education a driver of change. For example, significant changes to the STEM curriculum would allow students to harness capacity in many emerging areas of knowledge disciplines such as genomics, data science, artificial intelligence, robotics and nanomaterials just to name a few. This strategy allows the academic leaders to reconsider the curriculum in the traditional “primary” sciences, that is, biology, chemistry and physics. This strategy may place a higher priority for training in computer science subjects as a form of 4IR literacy. Within biology or chemistry course for example, new approaches may take place, including within introductory courses to discuss emerging areas such as synthetic biology and molecular design. A few universities that have opted for this strategy are listed below. More focus is placed on Stanford University since this university becomes one of the world most innovative universities in facing 4IR.

Stanford University started with the strategy of reshaping its own existing life science curriculum. Using this strategy, a new problem solving is developed in the biology course. This course requires students not only to find cures by conducting interviews with real doctors but also to design cures to real-world pathogens using authentic data from the scientific literature and experiment design (Cyert, 2017). This strategy enables the students to mingle with professionals and people from the community.

Stanford University introduces a new course in engineering biology that allows students to design their own life forms on computers. They later can bio-print





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them to solve practical problems including curing the diseases and environmental mitigation. These courses received quick responses to the emerging bio-economy (Endy, 2016), which later become one of the fast-emerging businesses. These courses create huge opportunities for students to employ their creative thinking.

ii. Stanford University offers a new multidiscipline academic programme known as Bio-engineering. This program trains students at the interface of life sciences and engineering. This strategy allows Stanford University to merge their expertise and resources in the departments of Medicine, Biology and Engineering (Abate, 2015). This strategy enables experts from the three departments to work collaboratively for the common goal.

v. Stanford university, on a bigger and far ahead vision, set up what it called Stanford2025. The Stanford2025 is a 4-year education programme that takes over a span of 30 years rather than four consecutive years. This means that students have as long as 30 years to earn a degree after the first day of registration at this university.

Similar innovative strategy employed by the Stanford University leadership in respond to 4IR is to develop new chemistry programme with a new brand called green chemistry. This green chemistry programme blends three courses (chemistry, biology, and environmental science) to allow students to engage on real environmental problems. The students are also trained in techniques to reduce pollution. They are exposed to three real environmental problems frequently stated in the literature: synthetic fuels, bioplastics, and toxicology (Mammimo & Zunin, 2015).

i. MIT, the second most innovative university in the world, in collaboration with Udacity, developed a graduate school programme that does not require a formal undergraduate degree. Students can join MIT based on their experience in the related fields.

ii. Georgia Institute of Technology or commonly known as Georgia Tech, in collaboration with AT&T, developed 100% online Master's degree programme in computer science. This master's degree programme allows students to study while being employed full-time regardless of geographic location. The programme gives a taste of the academic-industry alliances that may become common in years to come.

iii. Singapore higher education has taken bold steps ahead of many nations by revamping the higher education policy. With the themes, higher education in Singapore joins hand to develop Smart Nation Singapore, and Skills Future Singapore (Gleason, 2018). Additionally, with the support from government Singapore higher education establishes new higher education institutions. These new education institutions are structured to deepen and diversify international connections with many top universities to develop new academic



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programmes. These new programmes allow students to acquire deep skills and at the same time develop strong digital capabilities.

e. **Intensify the use of MOOCs**

In facing 4IR, many other universities have employed MOOCs as the first step in the progress from campus-based university education toward more online education. In this regard, campus-based learning plays only a part in the education process.

Malaysia Perspective: Redesigning Malaysian Higher Education

On a bigger scale of change, Ministry of Education Malaysia through its Department of Higher Education introduces several strategies under the label of redesigning higher education or Malaysian higher education 4.0. With the commitment and support from various entities, the ministry established Malaysia Education Blueprint 2013-2025 and known as MEB (HE). This program is developed to ensure that the Malaysia's education system in tandem with global trends. The blueprint highlights the balance between both ethics and morality (*akhlak*) along with knowledge and skills. The balance graduates can be achieved through the 10 Shifts as shown in Figure 1. The 10 Shifts of MEB are holistic, entrepreneurial and balanced graduates; talent excellence; nation of lifelong learners; quality TVET graduates; financial sustainability; empowered governance; innovation eco-system; global prominence; globalize online learning; and transformed higher education delivery. All these Shifts address key performance issues in the system regarding quality and efficiency, as well as global trends that are disrupting the higher education landscape. The 10 Shifts can be categorized into two categories: shifts for outcomes and shifts for enablers. The first four Shifts focus on outcomes for key stakeholders in the higher education system. These key stakeholders include students in academic and TVET pathways, the academic community, as well as all Malaysians who participate in lifelong learning. The other six Shifts focus on enablers for the higher education ecosystem. These six Shifts covered critical components regarding higher education including funding, governance, innovation, internationalization, online learning, and delivery.

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Figure 1: 10 Shifts in MEB

The Malaysian Ministry of Education together with universities also developed a few more initiatives in meeting 4IR. A few of those initiatives are listed below.

i. Universiti Teknologi Malaysia together with other public universities in Malaysia employed their own successful alumni and other prominent figures from various fields to give back to campus for various educational experiences. Under the program called Faculty@CEO, these alumni and prominent figures to coach young and motivated public university faculty members, aged between 30-40 years old, on the full scale of running the industry. Each CEO will spend about 40 hours a year coaching these young and motivated faculty members.

The Department of Higher Education from the Ministry of Education introduces an academic programme called 2CUCI. This initiative allows students to spend the first two years of their studies on campus following all the necessary courses and the other two remaining years at industries of their choice. Prior to their departure to the industries, the students must agree with the set of courses to be taken at the industry. Additionally, students may also opt for three years on campus and take necessary compulsory courses and one full year at industries of their choice to complete a degree programme. This initiative allows students to get exposure and practical experience early as possible.

The Department of Higher Education from the Ministry of Education take drastic action to redesign learning space by calling universities to have more adaptable classrooms where different kinds of pedagogies such as heutagogy (self-determined learning), paragogy (peer-oriented learning), and cybergogy (virtual-based learning) are employed for classroom teaching and learning. The produce future proof human capital for country development, the ministry introduces more learning without lecture concept and applies the latest learning and teaching technologies. All these initiatives require the ministry to introduce more evaluation without examinations.

UTM Synergy 4.0

UTM takes a bold initiative in meeting the 4IR by introducing UTM Synergy 4.0 starting from July 1, 2018. This synergy requires UTM to merge several faculties or schools of similar in nature. From the 18 faculties that previously each working in a silo, now each faculty is asked to work in a team and merge to become seven big faculties: Faculty of Engineering, Faculty of Science, Azman Hashim International Business School, Faculty of Built Environment and Surveying, Faculty of Social Sciences and Humanities, Malaysia-Japan International Institute of Technology, and Razak Faculty of Technology and Informatics. This synergy allows UTM management to rectify some duplications of topics and courses from the many program studies run by the respective faculties. In the early time when each faculty was working in a silo, many of these duplications were carried out unnoticed by other faculties. The merging allows us to be more efficient many aspects including human capital, asset and facilities utilisation. The merger allows UTM management to see the university from a bigger picture and starts developing new programmes that meet the needs of 4IR.

The merger also permits UTM to embrace data mining in order to gain better understanding of student performance and deliver through the concept of “education for you” that is tailored to meet the demand of the job markets while put into considering the students’ needs. In other words, UTM concerns on type of education the students receive rather than the quantity of education they receive. This initiative is targeted at ensuring that education for students becoming more like “just in time” education rather than “just in case” education. This means that it is more about what our students need to know for a certain time than compiling knowledge that they never be needed (Blinder, 2008). This merger would also allow UTM to collect data regarding student performance, behaviour, development, and interaction inside and outside classrooms could path the way for smart campus. In short, this merger allows UTM to focus on the delivery of customized education and personalized learning experience for students.

CONCLUSION

Principally we all agreed that higher education has the power to change lives and effect better future for the country and the world. However, at the advent of this 4IR, universities have to reconsider how to conduct fundamental research and how to translate the many applied researches into real-world solutions, how to deliver the core components of education, and how to provide education at the time when it is needed by the students. Each of these challenges poses a tantamount challenge to higher education and they must confront all the challenges simultaneously. At the same time, they must ensure that students grasp the fundamental principles of a knowledge discipline, along with the basic skills of reasoning and communicating.

In short, in this university 4.0, university leaders must find the best way to adjust to change to ensure that they can lead a great university in the modern era. To remain



competitive in the wake of the 4IR, university leaders have to develop a more holistic education system that suits diverse groups of students, embrace many more open policy of education for all, design future ready curriculum that is fluid and organic, develop more customize assessment system, place more flexible recruitment policy, develop more customer-oriented admission system, and produce more diversified reward system structure. Until university leaders ready to face challenges in the wake of the 4IR, they are prone to make a university a relic.

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