

The Digital Transformation Obstacles in Implementing Emerging Technologies with in Higher-Education Institutions in Indonesia

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Article Info

Volume 82

Page Number: 4281 - 4286

Publication Issue:

January-February 2020

Abstract:

This study focuses on finding the obstacles of the implementation of emerging technologies in higher-education ecosystem. The barriers to adopt new technologies are the parts of transformation process of the university which is willing to change to the future environment – which is triggered by the industrial revolution 4.0. The research was conducted in two stages. The first qualitative research had an objective to define the types of emerging technologies that were suitable to Indonesia's university context. Another objective was to investigate the potential obstacles that might be faced by the university along the way. The second quantitative research was using survey approach to get more deep analysis on the obstacles. Firstly, it started by mapping how many percent of respondents who had implemented each defined emerging technology (adoption rate). Secondly, it followed by investigating the obstacles of every emerging technology stated – that could be seen from different perspectives. And thirdly, it measured the level of literacy of respondent's understanding on the concept of university 4.0 – a new future mode higher-education institution which inherits the characteristics of industrial revolution 4.0.

Keywords: *emerging technologies, higher-education, obstacles*

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 21 January 2020

1. THE INTRODUCTION

The advancements in technology are altering the global landscape of many industries. In the education sector, higher-learning institutions are facing challenges in preparing students for the fourth industrial revolution (Wallner&Gerold, 2016).The fourth industrial revolution is stated to be characterised by the integration between physical and digital technologies (Lapteva&Efimov, 2016).Knowledge society who equips themselves with digital gadgets as a learning tool has challenged the education institution in governing and managing campus (Readings, 1996). Without proper adjustment, new generation learners might avoid themselves to go to the university (Bingimlas, 2009).These circumstances have forced modern higher-education institutions to undergo a revolutionary change in its governance and management system if they are to stay relevant (Etzkowitz et al, 2000). Regardless the trend of

willingness to transform the insitution, Indonesian universities are facing many obstacles in the journey of transforamtion – especially in the context of implementing several emerging technologies. This obscales have caused serious impact as the adoption of Indonesian higher-learning institutions become extremely low. Failing to accelerate the process will bring a new risk to the organisation, especially in the era where other foreign universities can operate freely within the nation (Barth, 2012).

2. THE RESEARCH

2.1 Research Objectives

This study is to explore several obstacles of implementing emerging technologies within the higher-education ecosystem. There are seven objectives that should be fulfilled, which are:

- To identify the emerging technologies within the fourth industrial revolution framework that bring impact to the higher-education sector.
- To identify the obstacles faced by the higher-education institutions while implementing various emerging technologies within the organisation perimeter.
- To investigate the readiness level of adoption for every different type of emerging technology characterising the fourth industrial revolution.
- To map the obstacles encountered in the effort of implementing each type of emerging technology. Since each technology is different in nature, so does the obstacles associating with the entity.
- To identify the different obstacles portfolio faced by the universities in various region within the nation. Each geographical domain in Indonesia has unique situation and condition that cause different challenges in implementing the initiative.
- To investigate the different obstacles faced by various stakeholders group. There are three group that will be identified, which are based upon: generation cohort, job roles/position, and the year of university establishment.
- To measure the level of literacy of university's stakeholders in understanding the concept of university 4.0. This is the result of self/personal assessment regarding the issue being studied.

2.2 Data Gathering

There are twelve stakeholder's group that were interviewed during the first stage of the research:

1. Central Government Officers (10 people) – who are accountable for developing national policies within higher-education system in Indonesia;
2. Regional Government Officers (23 people) – who are responsible to monitor and to assist the development of Indonesian universities within the regional perimeter;
3. State University Rectors (13 people) – who are the top executives of state-owned campuses within the country;
4. Private University Rectors (37 people) – who are the owners and/or the top managers of private-owned campuses;
5. College Presidents (13 people) – who are the number-one persons in college type of institution;
6. Polytechnic Directors (7 people) – who are the leaders in vocational type of higher-education institution;
7. Higher-Education Consultants (7 people) – who have years of experience in advising

- Indonesian government and top universities within the nation;
8. Technology Vendors (11 people) – who have been working closely together as partners to a good number of Indonesian universities;
9. Education Management Consultants (4 people) – who have helped many Indonesian colleges to grow especially in the regional areas of Indonesia;
10. Education Experts (9 people) – who are the professionals and scholars in higher-education sector;
11. President of Education Associations (6 people) – who are the chairmans of the associations, forums, or federations of several education-based intitutions; and
12. Other stakeholders who have passion and experience in developing the higher-education sector within the nation (14 people).

Presently, there are more than 4,500 colleges and universities in Indonesia within the higher-education system. Among these organisations, 5% of the population is state university while the rest 95% is private university. Most of the universities are located in Java Island Corridor, while the others are spread over five different corridors, which are: Sumatera Corridor, Kalimantan Corridor, Sulawesi Corridor, Bali-NTT Corridor, and Papua-Maluku Corridor. Every corridor is representing a group of islands that are close to each others geographically. In this research, 250 universities (5% of the population) were selected as respondents by using stratified sampling.

2.3 Data Analysis

There were several instruments utilised to analyse the result of the results. In the qualitative research, a simple text analysis tool was being used as an instrument to conduct a cluster analysis. For the quantitative research, an SPSS software and Tableau application are being utilised to process the data by using descriptive and comparative statistics.

3. THE RESULTS

3.1 The Emerging Technologies in Campus

Industrial revolution 4.0 is characterised by the introduction of emerging technologies. During the results, the researcher were interviewing more than fifty education stakeholders to discuss about these technologies. Since the respondents were the people who work within education industry, the discussions were focused on finding the emerging technologies that can add value to the universities. Several emerging technologies such as internet-of-things, artificial intelligence, block chain, big data, machine learning, robotics, cloud computing,

biometrics, and 3D printer were being discussed intensively. Many examples on how those technologies can bring new values to the modern universities were being discussed. The objective of the conversation was to find twenty applications of emerging technologies that were suitable for Indonesia context and condition. In order to come out with such cases, all suggestions from the respondents were being tabulated and analysed. The twenty implementation of emerging technologies identified during the study were:

1. Biometrics for face recognition, which can be applied to manage attendance of students, lecturers, and employees;
2. Mobile individuals tracking system, which can be used to locate campus human resources to increase services in conducting learning and research;
3. E-learning for virtual campus, which can increase the number of student's enrollment significantly since the learning process can be done from anywhere and anytime;
4. Massive Open Online Course (MOOC), which can enhance the quality of learning delivery by working together with top world-class universities;
5. Virtual reality devices in laboratories, which can help the researchers in conducting high-risk experiments and simulating many technical scenarios;
6. Integrated digital library network, which can leverage the collection of publications across the lecturers and students within the universities (and public at the same time);
7. Flexible personalised curriculum system, which can give direct values to students who want to tailor-made their curriculum based on unique personal needs;
8. Internet-of-Things (IoT) for energy saving, which can save a lot of university's money from making the energy consumption and management worked in an extremely more efficient;
9. Disruptive business models for campus, which can bring more income and revenue to the universities by leveraging many assets and resources of the institution;
10. Global resource sharing in distance education, which can bring more valuable resources to the universities such as professors, journals, books/publications, laboratories, classrooms, and modules;
11. 3-D printer as research and development tool, which can help the innovators in producing their physical product's prototypes;
12. Integrated mobile hybrid value chain, which can automate the complex operational and

administration process to make the activities cheaper, better, and faster;

13. Artificial intelligence for learning and campus administration, which can assist many campus stakeholders in conducting their everyday activities;
14. Big data analysis and machine learning, which can help the management to make strategic and tactical decisions;
15. Robotics in laboratories and campus operational system, which can operate as technologies or devices to take care of repeatable or danger operations;
16. Cloud computing architecture topology, which can add campus capabilities and services without having to have big investment;
17. Radio Frequency Identification (RFID) technology for asset management, which can help the management to track and to control university's assets and resources;
18. Financial Technology (Fintech) and crypto currency system, which can enable university's stakeholders in managing their money and financial transaction around campus perimeter;
19. Global higher-education services development, which can increase university's capabilities in providing more education products and services; and
20. Industrial partnerships business proposition, which can generate more income to the university – while at the same time increasing the value of campus brand.

3.2 Obstacles in Implementing the Technologies

Based on the interview, the researchers had found several conditions with regards to the implementation of emerging technologies within Indonesia campus. These are the findings from the discussion:

- There are universities which have started to implement two or three applications related to the emerging technologies defined – but not in a full-suite mode;
- There are universities which are planning to adopt several emerging technologies in the near future – but they are still waiting for the right time to do the initiatives;
- There are universities which are willing to utilise the emerging technologies found in the market – but they are facing some barriers in the process;
- There are universities which are still thinking that the implementation of the emerging technologies will only take place in the future – so that they are not even thinking of doing the transformation; and

- There are universities which have high motivation to do the transformation – but they do not know how to handle technical and operational problems.



The Text Analysis Wordcloud of Interview Manuscript

In other words, the majority of Indonesian universities are actually willing to do the transformation as soon as possible, but the big obstacles they are facing make them to slow down the progress. After the first round of discussion being done, the next interviews were focusing on the perceived obstacles found by Indonesian universities in the process of transformation. Based on the tabulation of the interview transcripts, a simple text analysis by using words-cloud was generated. Hundreds of obstacles found from the research can be categorised into fifteen types, which are:

1. The adequacy of financial resources (money), which consists of the money for investment (capex = capital expenditure) and the money for operations (opex = operational expenditure);
2. The issues of people competencies and skills, which relates to the abilities to develop and to operate the emerging technologies defined;
3. The knowledge literacy of campus stakeholders, which involves the full understanding on the concept of industrial revolution 4.0 impacting higher-education sector;
4. The readiness of network and infrastructure, which relates to the performance and capabilities of the existing technology infrastructure within campus territory;
5. The absent of related software and applications, which relates to the ownerships of software, applications, or tools required to operate the emerging technologies;
6. The availability of resources and facilities, which consists of physical resources such as rooms, labs, devices, people, and other assets related to the emerging technologies;
7. The quality of process delivery, which relates to the ability to deliver the implementation of

emerging technologies which fulfill some standards associated;

8. The support from university stakeholders, which consists of the management, staffs, faculty members, head of divisions/units, full-time lecturers, part-time lecturers, and researchers;
9. The motivation from internal people, which relates to the level of willingness of campus stakeholders in transforming the institution;
10. The governance alignment of campus owner's rules, which relates to the principles and values established by the owners of the institution;
11. The additional value to the accreditation board, which relates to the alignment between the existence of emerging technologies and key performance indicators set-up by external accreditation board;
12. The lack of relevancy and context in education process, which relates to the applications of emerging technologies to the core processes of the institution (learning, research, and services);
13. The appropriate products and services offered, which relates to the university's programs for public;
14. The misalignment with government regulation, which relates to the context ; and
15. Other related obstacles with the technology implementation, which consist of other minor constraints found within the perimeter.

3.3 The National Rate of Adoption

The average score of the twenty questions shows that only 8.51% of the respondents state that they do not have any problem or obstacle in implementing the technologies. It means that the adoption rate of implementing the fourth industrial revolution's emerging technologies is relatively slow, since 91.49% of them face serious problem in adopting it.

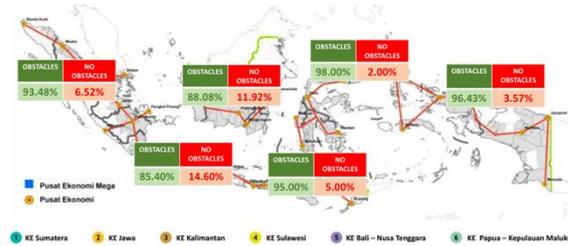


The Adoption Rate of the Emerging Technologies

3.4 The Economic Corridor's Rate of Adoption

As the biggest archipelago nation in the world, Indonesia has divided into six regional corridors. Every corridor has its own unique characteristics than the others. The history has shaped the

differences of every corridors with respect to its economic development, infrastructure readiness, political situation, cultural heritage, and social context.

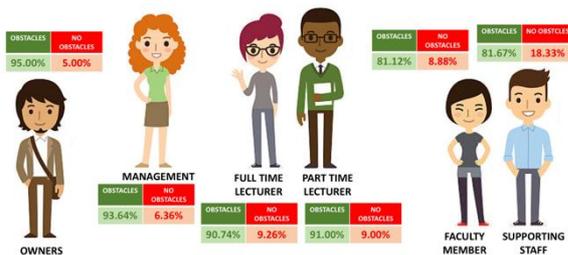


The Adoption Rate of the Regional Corridors

The research result came out with an interesting finding. It can be seen from the adoption rate that Jawa Corridor – a main island where the capital city of Indonesia is located – has the highest adoption rate (14.60%). It is followed by Kalimantan Corridor (11.92%), Sumatera Corridor (6.52%), Bali-NTT (5%), Papua-Maluku Corridor (3.57%), and Sulawesi Corridor (2%). Generally it can be concluded that the farther the corridor from the capital city, the lower the adoption rate is. This finding aligns with the real fact that the problem of disparity of economic development within the nation has brought significant impact to its readiness in embracing the future challenge.

3.5 The Generation Cohort's Rate of Adoption

More analysis of this research was being done to see the obstacles from the perspectives of the respondents who were representing different generation. The Baby Boomers Generation shows the lowest adoption rate (7.27%) while the Generation-Y or Millennials Generation shows the highest adoption rate (9.05%).



The Adoption Rate of the Generation Cohorts

This figure shows that the younger the university's stakeholders, the lower the adoption rate is. In other words, young generation is more ready for the transformation compare to the older ones.

3.6 The Campus Age's Rate of Adoption

A further analysis was then conducted to get more interesting finding to the research. This time the study was focusing based on the year of university's establishment. According to the

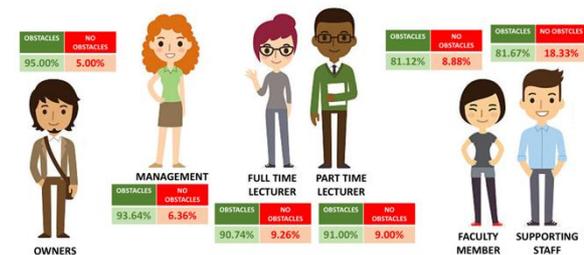
research result, the new established universities (under ten-years-old) have the highest adoption rate (11.56%) while the oldest universities have the lowest adoption rate (7.50%). It brought to the conclusion that the older the university, the higher the adoption rate of implementing emerging technologies.



The Adoption Rate of Campus Establishment

3.7 The Roles and Position's Rate of Adoption

The university is operated by different type of people with various roles and position. This research was also analysing respondent's answers based on their job position within the campus.



The Adoption Rate of the Stakeholder's Roles

The results showed that supporting staffs in the administration were the parties who had the highest adoption rate to the change (18,33%) while the owners of the higher-education institution were the ones with the lowest adoption rate (5%). More analysis on the rest of data gave the conclusion that the higher the position of stakeholders in the university, the lower the adoption rate of the emerging technologies.

4. RECOMMENDATION

The results of the research explicitly suggest that a series of breakthrough should be done within the Indonesian higher-education ecosystem to accelerate the growth. The slow level of adoption and the existence of many obstacles show the serious issues faced by Indonesian universities. Based on the thorough understanding on the issues, several things that can be done in the near future are as follows:

- Finding the mechanism to solve the financial problem (the highest obstacles) faced by the university, such as: public-private partnerships, foreign investment, joint ventures, or other

industrial relationships (Goktas&Yildirim, 2009);

- Conducting training on the understanding of emerging technologies that will transform higher-education institutions as the answer of the knowledge literacy issues (Keengwe&Onchwari, 2008); and
- Working closely with technology and infrastructure providers to take care of the hardware/software problems (the third highest obstacles) by implementing the technical approach such as: cloud computing, on demand technology, sharing resources, and virtualisation (Schneckenberg, 2009).

Without conducting any breakthrough effort, the adoption of emerging technologies will be very slow, and might disturbing university performance – especially in the context of tight competition.`

Developments, WIARS Publishing,
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