

# THE IMPACT OF INDUSTRIAL REVOLUTION 4.0 AND ITS MANIFESTATION IN ISLAMIC FINANCE INDUSTRY

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## Article history

**Received date** : 26-1-2019  
**Revised date** : 27-1-2020  
**Accepted date** : 19-3-2020  
**Published date** : 25-3-2020

## To cite this document:

Arif Foenna, Syukqran Kamal & Rashid Ating (2020).  
The Impact of Industrial Revolution 4.0 and Its  
Manifestation in Islamic Finance Industry.  
*International Journal of Accounting, Finance and  
Business (IJAFB)*, 5(26), 70 - 90.

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**Abstract:** *The advent of a new era, the Industrial Revolution (IR4.0) promotes the greater application of highly automated tools and innovation of cutting-edge technology which minimizes human intervention and it expedites normal processes in the current ecosystem in the banking industry. This paper attempts to explore the significance of IR4.0 in the Islamic finance and banking industry by analysing the nexus between IR4.0 and Islamic banking notably on financial technology (Fintech) adoption. The findings reveal that IR4.0 in the Islamic banking system is compatible with the current financial technology (Fintech) application such as blockchain, Robo-advisory, P2P financing, crowdfunding, and payment gateway. Nevertheless, it is not being fully utilized by most Islamic countries due to the financial and regulatory constraints and the lack of human capital in software development. The study also found that IR4.0 is highly developed and accepted in the European countries compared to the Islamic countries. Moving forward, more extensive studies and researches are needed on this subject to raise awareness to the industry players on the benefits and importance of IR4.0. This paper contributes to the dearth of literature on IR4.0 as the existing literature do not connect these two themes; Islamic banking and IR4.0*

**Keywords:** IR4.0, Islamic Finance, Fintech

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## Introduction to Islamic Banking

Islamic banking is banking systems that operate under the Islamic law principles which prohibit usury (*riba*) based transactions and uncertainty (*gharar*) elements. There are three types of Islamic banking modality in the current context namely: Islamic bank's windows, Islamic bank's subsidiaries, and full-fledged Islamic banks. Islamic banking windows are departments within the conventional bank setups which are operating and maintaining Islamic banking operations as profit and loss sharing entities from the conventional banking operation (Lone & Rehman, 2017). These

banks can operate in both ‘conventional plus system (a conventional system with a few Islamic banking institutions operating on the fringe of the banking system) or within the dual banking system whereby Islamic banks and conventional banks operate correspondingly within the banking system. Islamic subsidiaries which are the frontier of Islamic windows are the subsidiaries of conventional banks. Islamic subsidiaries have different governance structure, employees, buildings, products and services, but they are governed under similar infrastructure, operations and system similar to conventional banks. Islamic bank subsidiaries are either newly established or converted from existing Islamic windows, and they operate in both the dual banking system and full Islamic banking system. There are also standalone full-fledged Islamic banks which run on an independent system from the conventional peers be it in infrastructure, operations, corporate governance and so forth (Samat, 2013). Countries that structure all the above-mentioned banking ecosystem are like Iran and Sudan.

Viewing on the global statistics, the number of Islamic banks around the world has reached 396 across 53 countries managing a total fund of \$442 billion. Besides the non-mainstream banks around the world, Islamic banking windows stands around 320 banks managing a fund of \$200 billion (Abdullah Saif Al Nasser, Datin & Muhammed, 2013). In 2017, the number had risen to 505 Islamic banks globally, including 207 Islamic Banking windows. The biggest contributor to this number is Malaysia and the United Arab Emirates followed by Islamic finance's second-largest market, Saudi Arabia who has 16 Islamic banks, including windows (Report Buyer, 2019). Meanwhile, few European countries such as the UK, US and Australia have started to show interest in establishing Islamic banks. This is attributed to the upsurge of the number of Islamic population in Europe which had grown from 1.97 (1950), 2.22 (1960), 3.04 (1970), 3.57 (1980), 4.43 (1990), 5.14 (2000), 5.74 (2010) and it is projected to increase to 5.76% in 2020 (Kettani, 2010).

#### **Breakdown of Global Islamic Finance Service Industry (IFSI) by Sector and Region In (USD Billion)**

| Sector        | Islamic banking assets |        |        |        |        | Islamic Funds Assets |      |      |      |      |
|---------------|------------------------|--------|--------|--------|--------|----------------------|------|------|------|------|
|               | 14                     | 15     | 16     | 17     | 18     | 14                   | 15   | 16   | 17   | 18   |
| <b>Region</b> |                        |        |        |        |        |                      |      |      |      |      |
| <b>Asia</b>   | 192.3                  | 203.8  | 209.3  | 218.6  | 232.0  | 24.2                 | 23.2 | 23.2 | 19.8 | 24.8 |
| <b>GCC</b>    | 490.3                  | 564.2  | 598.8  | 650.8  | 683.0  | 30.6                 | 33.5 | 31.2 | 23.4 | 26.8 |
| <b>MENA</b>   | 518.3                  | 633.7  | 607.5  | 540.5  | 569.0  | 0.4                  | 0.3  | 0.3  | 0.2  | 0.1  |
| <b>Africa</b> | 20.6                   | 20.1   | 24.0   | 26.6   | 27.1   | 1.6                  | 1.8  | 1.4  | 1.5  | 1.6  |
| <b>Others</b> | 62.2                   | 54.4   | 56.9   | 56.9   | 46.4   | 12.1                 | 17.0 | 15.2 | 11.2 | 13.3 |
| <b>Total</b>  | 1283.7                 | 1476.2 | 1496.5 | 1493.4 | 1557.5 | 68.9                 | 75.8 | 71.3 | 56.1 | 66.7 |

Sources: Islamic Financial Stability Board, various years

A recent report by (IFSB, 2018) revealed that the Islamic banking industry assets have surpassed the \$2 trillion mark with the estimated worth of three main sectors (banking, capital markets and *takaful*) at approximately \$2.05 trillion in 2017; and 8.3% asset growth in US Dollar. The increase in key assets was experienced across all major regions, including the GCC (Gulf Cooperation Council), MENA, (the Middle East and North America) (ex. GCC) and Asia. GCC countries demonstrate a significant rise in Islamic banking assets over five-year period from \$490.3 billion in 2014 to \$683 billion in 2018. This was largely driven by huge retail demand for Shariah-compliant financial services in Muslim countries, which strengthened the financing growth at 5% rate; 3% higher than the conventional bank financing in the first months of 2017 (Gulf News,

2018). Likewise, the Islamic banking assets in Asia ascended gradually from \$192.3 billion in 2014 to \$209.3 billion in 2016 and extend to \$232 billion in year-end 2018. The assets of MENA, on the other hand, dropped initially for four years in a row before jump back to \$569 billion the following year. Both GCC and Asia regions exhibit upward flows in terms of their Islamic funds' assets albeit some changes at the beginning. GCC at the beginning rose to \$33.5 billion in 2015 but fell to \$23.4 billion for three years before rising to \$26.8 billion in 2018. Asia funds' assets descended within the first two years and worsen for the next two years before recovering a year later. Meanwhile, MENA shows a downward trend in its assets for five consecutive years. (IFSB, 2018).

Despite its exponential growth, the Islamic banking industry must be concerned with the competitive threats from two sets of technology-driven companies that had risen from the new span; IR4.0. The first set comprises of blue-chip technology companies such as Alibaba, Apple Inc, and Facebook, and the second set consists of start-up financial technology (Fintech) companies. The former has reputable and marketable product offerings such as smartphone, laptops, gadgets and social media platforms, that could disrupt traditional banking products offered by the Islamic banking institutions. The latter concentrates on structuring products that have lower operating costs, faster processes and less regulatory burden to overcome the current lagging financial system (Schwab, 2016). According to EY Global Financial Index (2019), global implementation of Fintech has exceeded 64% across 27 markets and a majority of the countries are concentrated on the European regions which include Netherlands, Ireland, UK, Germany, Sweden, Switzerland, Spain, Italy, Belgium and Luxemburg and France. The highest adoption rate of Fintech comes from China and India (87%) while the lowest adoption rate comes from France (35%) and Japan (34%). If categorizing companies based on Fintech, the top ten ranking goes to *Ant Financial* (China), *Adyen* (Netherlands), *Qudian* (China), *Xero* (New Zealand), *Oscar* (US), *Lufax* (China), *Avant* (US), *Zhong An* (China), *JD Finance* (China) and *Smava* (Germany) (Cambridge Judge Business School, 2018). This indicates that Fintech technologies have rampantly evolved across different continents in the world. Therefore, it is important for any industry (including Islamic banking and finance) to assimilate with the emerging trend of technologies, in order to survive in the current era of digitalisation.

This paper aims to explore the exposition of IR4.0 in the Islamic finance industry. In doing so, it initially analyses the global development of Islamic banking sector. It then examines the conceptual idea of IR4.0 and its evolution in the human civilization . Subsequently, it explores the connection between IR4.0 and Islamic banking sector. Finally, it will address the weaknesses of IR4.0 within the current Islamic banking and financial system. This paper contributes to the literature on IR4.0 in Islamic banking as the existing literature focuses more on the application of IR4.0 in the conventional banking sector.

This paper is structured as follows: Section 1 discusses the growth of Islamic banking sector globally. Section 2 concentrates on literature review on IR4.0 and its adaptation by Islamic and non-Islamic countries. Section 3 demonstrates the linkage between Islamic banking and IR4.0. Section 4 scrutinizes the current loopholes among Islamic banking institutions in accommodating IR4.0 within their current practices. Section 5 concludes with recommendation.

## Literature Review

### Evolution of IR4.0

With time the world is getting more advanced and the transition is taking place from old to new. When a chapter is disclosed, another epoch approaches, signalling the new era IR4.0. Extensive studies on the concept and theories of IR4.0 show that IR4.0 is hotly debated and has gained numerous attentions by worldwide community and academia (Liu & Xu, 2017; Wyrwicka & Mrugalska, 2017; Oesterreich & Teutberg, 2016; Roblek, Meško, & Krapež, 2016; Sanders, Elangeswaran, & Wulfsberg, 2016; Strange & Zucchella, 2017; Wang, Wan, Li, & Zhang, 2016a; Wang, Wan, Zhang, Li, & Zhang, 2016b; Witkowski, 2017; Yuan, Qin, & Zhao, 2017).

IR4.0 is heavily discussed in the world sphere and it is known by different names in different countries such as; *Produktion der Zukunft* (Austria), *Made Different* (Belgium/Holland), *the Nouvelle France Industrielle* (France), *Industrie 4.0* (Germany), *Fabbrica Intelligente* (Italy), *Industria Conertada* (Spain), and *Produktion 2030* (Sweden). Hence, from the various names, it can be concluded that IR4.0 could bring positive or negative repercussion to human activities. In most incidence, IR4.0 is related to Artificial Intelligence (AI) which is integrated to perform the job similar to human capabilities or beyond with minimal supervision.

Before IR4.0, human civilization underwent three different transitions processes. Initially, it was known as IR1.0, a transition process from hand-based production towards machine-based production that started at the end of the 18<sup>th</sup> Century. It is also linked with the Industrial Revolution in Britain from 1750 until 1850 (More, 2002). During this period concentration was towards mechanical production with the assistance of natural resources (steam and waterpower). The outcome of IR1.0 in the textile industry which was the most developed. Next, known as IR2.0 at this epoch, mass production using mechanical machine was taking place with the usage of electricity to run factories particularly at the beginning of the 20<sup>th</sup> Century. Within this era, most of the countries opt to shift from agricultural-based towards industrial-based. With the advancement of technology in the 1970s, the amelioration of 3<sup>rd</sup> IR occurred with emphasis on the application of IT and electronic appliances (Ślusarczyk, 2018). Television and the internet were used, and which slowly grew to what it is today. Without realizing it, the degree of the system got more complex and shifted to the more advanced technology IR4.0.

### Emergence of IR4.0

IR4.0 is a phenomenon that came into the picture when Germany became a pioneer in this industry IR4.0 in 2012. This plan was partially carried out by the Germany Government High Tech Strategy Action Plan 2020, through the two ministries namely; Ministry of Economic Affairs and Energy (BMWI), and Ministry of Education and Research (BMBF) as key drivers for the project. The primary goal for this initiative is to support the current high-tech Industry, incorporating German as technological leadership, promoting digitalisation and connectivity of goods, upholding research industry and acting as a benchmark for standardisation in that country (Androniceanu, 2017; de Sousa Jabbour, Jabbour, Foropon & Godinho Filho, 2018; GTAI, 2019; Pereira & Romero, 2017; Zhou, Liu, & Zhou, 2015). IR4.0 was initiated in 2001 until 2011, a long-term plan that was pursued within the duration of 10 to 15 years tenure (Klitou, Conrads, & Ramussen, 2017). With this area gained a lot of attention from academia, we try to segregate IR4.0 can be into a few subthemes as follow:

### **Utilization of new and advance application**

IR4.0 more inclined towards the application of high-tech technology in human life. It refers to the utilization of the interaction between human and machine, (Alexandre, Salguero, Peralta-Alvarez, Aguayo-Gonzalez, & Ares, 2017; Bahrin, Othman, Azli, & Talib, 2016; Pfeiffer 2016; Sackey, Bester, & Adams, 2017; Shamim, Cang, Yu, Ouyang, Li, & Peng, 2017; Thramboulidis & Christoulakis, 2016; Qian, Zhong, & Du, 2017; Quintas, Menezes, & Dias, 2016).

### **Application of Mechanical System**

Refer to implementation of robotic system, (Mueller, Chen, & Riedel, 2017; Fengque, Yifei, Fei, & Dongbo, 2017; Wang, Wan, Zhang, Li, & Zhang, 2016b, Wang, Jiang & Ding, 2017).

### **3D and AR (Augmented Reality)**

Related to 3D-Printing and AR, (Chen, & Lin, 2017; Oesterreich, & Teuteberg, 2016; Strange, & Zucchella, 2017; Zawadzki & Zywicki, 2016).

### **Cloud system and Cyber Physical Centre (CPS)**

IR4.0 heavily associated with cloud systems for integrating the cyber physical centre (CPS), as postulated by (Harrison, Vera, & Ahmad, 2016; He, Jia, Han, Wang, & Yang, 2017; Ivanov, Dolgui, Sokolov, Werner, & Ivanova, 2016a; Ivanov, Sokolov, & Ivanova, 2016b; Kobara, 2016; Lee, Bagheri, & Kao, 2015; Liu, & Xu, 2017; Lu, & Cecil, 2016; Mosterman, & Zander, 2016; Qu, Lei, Wang, Nie, Chen, & Huang, 2016; Wang, Wan, Li, & Zhang, 2016a; Wang, Wan, Zhang, Li, & Zhang, 2016b, Wang, Jiang & Ding, 2017).

### **Fintech**

Not only that, Fintech is also one of the subtopics that included in IR4.0 with multiple sub-topics such as; Artificial Intelligent (AI), Big Data, Quantum Computing, Mobility, Open Banking, P2P Finance, Blockchain, Cloud Adaption and Cyber-Security (Dubai Islamic Economy Development Centre, 2018).

### **Internet of Technology (IoT)**

Numerous studies concur that the advent of this era brings benefits such as; the emergence of internet of technology (IoT), (Kamigaki, 2017; Lin, Deng, Chen, & Chen, 2016; Lu, & Cecil, 2016; Qu, Lei, Wang, Nie, Chen, & Huang, 2016; Thramboulidis, & Christoulakis, 2016; Wong & Kim, 2017; Yang, Lan, Shen, Huang, Wang, & Lin, 2017).

### **Projection and creation of early design of model**

Development of technology allowed simulation and prototype can be performed (Bahrin, Othman, Azli, & Talib, 2016; Lin, Deng, Chen, & Chen, 2016; Moreno, Velez, Ardanza, Barandiaran, de Infante, & Chopitea, 2017; Ramadan, Al-Maimani, & Noche, 2017; Thramboulidis, & Christoulakis, 2016; Wang, Wan, Zhang, Li, & Zhang, 2016b; 2017; Yu, Ouyang, Li, & Peng, 2017).

### Promoting Smart Factoring

IR4.0 propelling factory into a new height, and this proven by (Georgakopoulos, Jayaraman, Fazia, Villari, & Ranjan, 2016; Oses, Legarretaetxebarria, Quartulli, García, & Serrano, 2016; Wang, Wan, Li, & Zhang, (2016a); Shafiq, Sanin, Szczerbicki, & Toro, 2016; Thames, & Schaefer., 2016).

### Use for other purpose

IR4.0 act as an opportunity for better enhancement in competitiveness of the business model among entrepreneurs (Ślusarczyk, 2018); serving as the link between IR4.0 with manufacturing skills (Pinzone, Fantini, Perini, Garavaglia, Taisch, & Miragliotta, 2017); and influencing IR4.0 in internet connected technology (Roblek, Mesko & Krapez, 2016).

### Competitiveness of IR4.0 between Islamic and Non-Islamic Countries

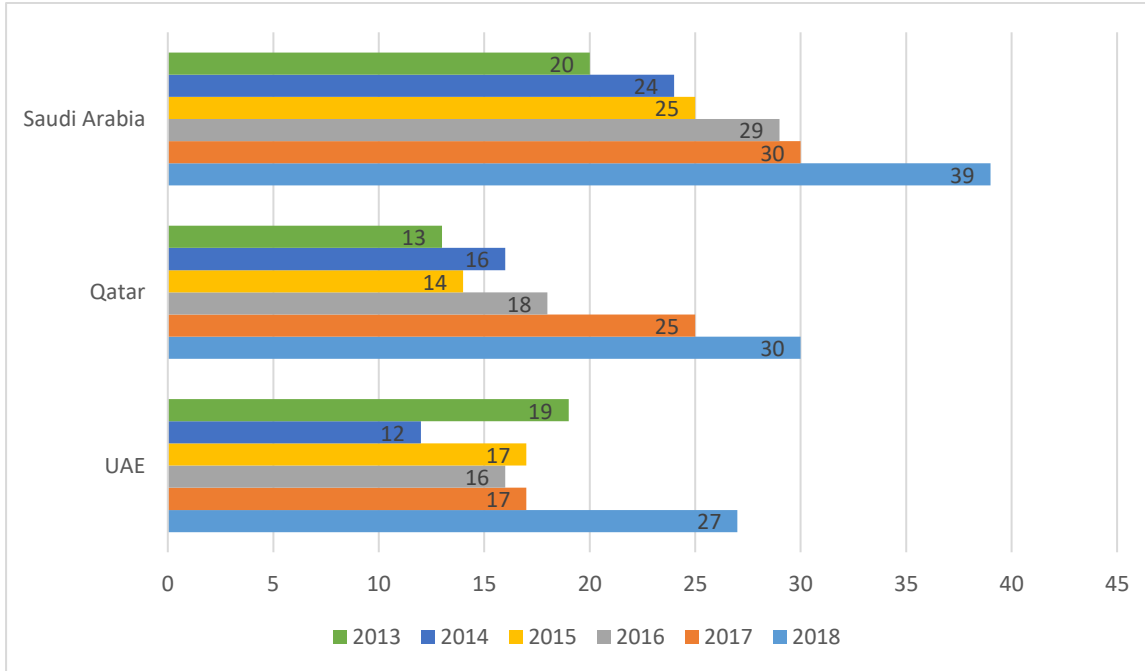
To catch up with the current trend of IR4.0, the World Economic Forum came out with the term Global Competitiveness Report or known as GCR 4.0. This index inception is aimed to integrate the notion of IR4.0 into the competitiveness of every country in the world and subsequently contributing to policymaking and global thinking (Global Competitive Report, 2018). The main purpose of the introduction of GCR 4.0. is to facilitate the related parties in the country to coordinate their economic policy to be aligned with Industry 4.0. This index constitutes of 12 pillars as follows: Innovation capacity, business dynamism, market size, financial system, labour market, product market, skills, health, macroeconomics stability, ICT adaption, infrastructure and institutions. The index also measures another factor such as defining features of economic success that contribute towards IR4.0 (World Economic Forum, 2018).

### Top 10 countries in Global Competitive Report

| Rank | 2013           | 2014           | 2015           | 2016           | 2017           | 2018           |
|------|----------------|----------------|----------------|----------------|----------------|----------------|
| 1st  | Switzerland    | Switzerland    | Switzerland    | Switzerland    | Switzerland    | United States  |
| 2nd  | Singapore      | Singapore      | Singapore      | Singapore      | United States  | Singapore      |
| 3rd  | Finland        | United States  | United States  | United States  | Singapore      | Germany        |
| 4th  | Germany        | Finland        | Germany        | Netherlands    | Netherlands    | Switzerland    |
| 5th  | United States  | Germany        | Netherlands    | Germany        | Germany        | Japan          |
| 6th  | Sweden         | Japan          | Japan          | Sweden         | Hong Kong      | Netherlands    |
| 7th  | Hong Kong      | Hong Kong      | Hong Kong      | United Kingdom | Sweden         | Hong Kong      |
| 8th  | Netherlands    | Netherlands    | Finland        | Japan          | United Kingdom | United Kingdom |
| 9th  | Japan          | United Kingdom | Sweden         | Hong Kong      | Japan          | Sweden         |
| 10th | United Kingdom | Sweden         | United Kingdom | Finland        | Finland        | Denmark        |

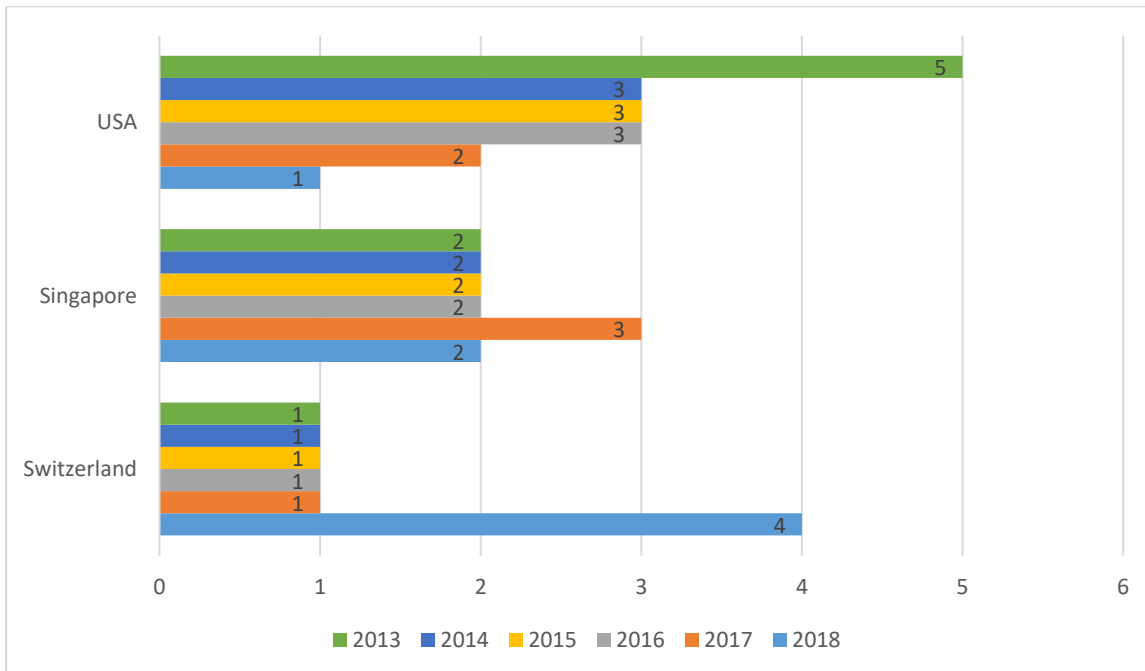
Sources: World Economic Forum, various year

### Rank for Islamic Countries Top Performer in CGI 4.0 Index



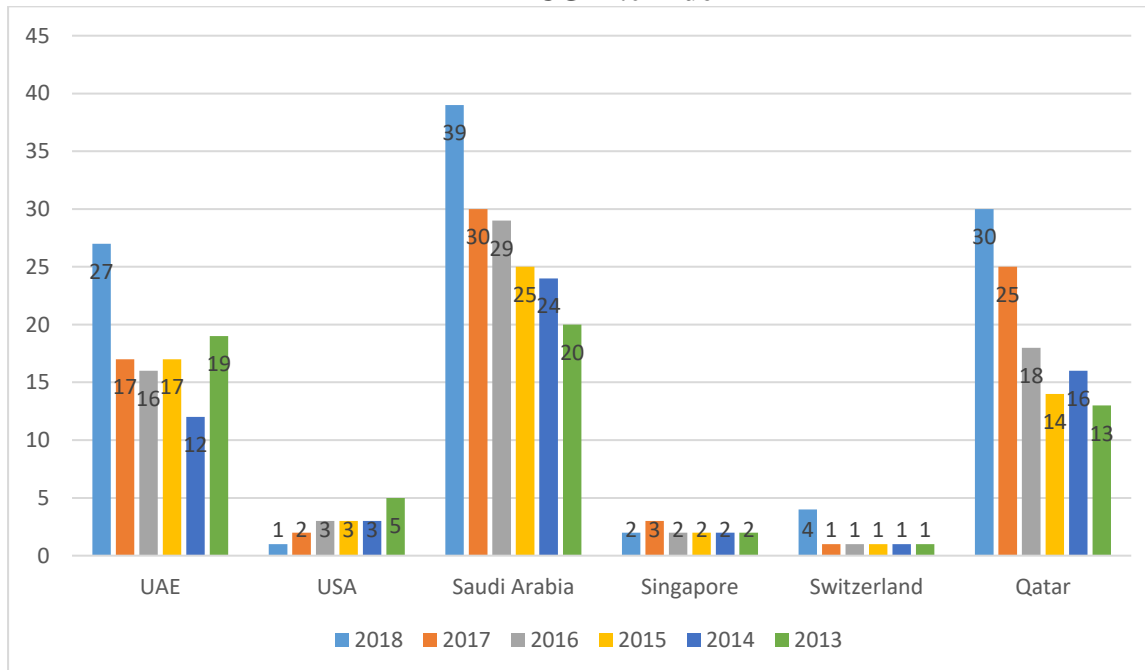
Source: World Economic Forum, various years

### Rank for Non-Islamic Countries Top Performer in CGI 4.0 Index



Source: World Economic Forum, various years

### Comparative Rank between Islamic and Non-Islamic Countries Top Performer in CGI 4.0 Index



Source: World Economic Forum, various years; Organization of Islamic Countries (OIC)

From Table 1.1, we can see that most of the spot is dominated by European countries. Singapore and Japan are the only Asian representative among this elite group. Hence, it shows that the European countries are more exposed to IR4.0 compared to South East Asia countries. Surprisingly, there are no Islamic countries within the top 10 list countries (Table 1.2), and most of the Muslim countries lies at the bottom of the index (Table 1.3). Non-Islamic countries also performed better in CGI 4.0 Index, hitting consistently the top five within six years (Figure 1.2; 1.3), while Islamic countries on the other side, performed badly in this index (Figure 1.1; 1.3). Most of the Islamic top performers are also not consistent with the position. For instance, Qatar was in the 13<sup>th</sup> place in 2013 but drop tremendously to 30<sup>th</sup> position in 2018. When looking in the wider scope, the disparity between the Islamic and non-Islamic countries in term of readiness for the implementation show a shocking outcome, where the gap and disparity being wide (Figure 1.3). There are a few possibilities that could be derived from this result and that most of the Islamic countries might be not exposed to IR4.0, or they are still adapting to it and it is still in its infant stage for implementation, and they do not have the capabilities in terms of financing to follow this trend.



**Rank for Muslim Countries in CGI 4.0 Index**

| <b>2018</b>  |       | <b>2017</b>  |       | <b>2016</b>   |       | <b>2015</b>   |       | <b>2014</b>  |       | <b>2013</b>  |       |
|--------------|-------|--------------|-------|---------------|-------|---------------|-------|--------------|-------|--------------|-------|
| Malaysia     | 25th  | UAE          | 17th  | UAE           | 16th  | Qatar         | 14th  | UAE          | 12th  | Qatar        | 13th  |
| UAE          | 27th  | Malaysia     | 23th  | Qatar         | 18th  | UAE           | 17th  | Qatar        | 16th  | UAE          | 19th  |
| Qatar        | 30th  | Qatar        | 25th  | Malaysia      | 25th  | Malaysia      | 18th  | Malaysia     | 20th  | Saudi Arabia | 20th  |
| Saudi Arabia | 39th  | Saudi Arabia | 30th  | Saudi Arabia  | 29th  | Saudi Arabia  | 25th  | Saudi Arabia | 24th  | Malaysia     | 24th  |
| Indonesia    | 45th  | Azerbaijan   | 35th  | Azerbaijan    | 37th  | Kuwait        | 34th  | Indonesia    | 34th  | Brunei       | 26th  |
| Oman         | 47th  | Indonesia    | 36th  | Kuwait        | 38th  | Indonesia     | 37th  | Azerbaijan   | 38th  | Oman         | 33th  |
| Bahrain      | 50th  | Brunei       | 46th  | Indonesia     | 41th  | Bahrain       | 39th  | Kuwait       | 40th  | Kuwait       | 36th  |
| Kuwait       | 54th  | Kuwait       | 52th  | Bahrain       | 48th  | Azerbaijan    | 40th  | Bahrain      | 44th  | Indonesia    | 38th  |
| Kazakhstan   | 59th  | Turkey       | 53th  | Kazakhstan    | 53th  | Kazakhstan    | 42th  | Turkey       | 45th  | Azerbaijan   | 39th  |
| Turkey       | 61th  | Kazakhstan   | 57th  | Turkey        | 55th  | Turkey        | 51th  | Oman         | 46th  | Bahrain      | 43th  |
| Brunei       | 62nd  | Oman         | 62th  | Brunei        | 58th  | Oman          | 62th  | Kazakhstan   | 50th  | Turkey       | 44th  |
| Azerbaijan   | 69th  | Jordan       | 65th  | Jordan        | 63th  | Jordan        | 64th  | Jordan       | 64th  | Kazakhstan   | 50th  |
| Armenia      | 70th  | Iran         | 69th  | Oman          | 66th  | Morocco       | 72th  | Morocco      | 72th  | Jordan       | 68th  |
| Jordan       | 73th  | Morocco      | 71th  | Morocco       | 70th  | Iran          | 74th  | Algeria      | 79th  | Morocco      | 77th  |
| Morocco      | 75th  | Albania      | 75th  | Iran          | 76th  | Tajikistan    | 80th  | Iran         | 83th  | Armenia      | 79th  |
| Albania      | 76th  | Tajikistan   | 79th  | Tajikistan    | 77th  | Armenia       | 82th  | Tunisia      | 87th  | Iran         | 82th  |
| Lebanon      | 80th  | Algeria      | 86th  | Albania       | 80th  | Algeria       | 87th  | Tajikistan   | 91th  | Tunisia      | 83th  |
| Tunisia      | 87th  | Tunisia      | 95th  | Algeria       | 87th  | Cote d'Ivoire | 91th  | Albania      | 97th  | Albania      | 95th  |
| Iran         | 89th  | Bangladesh   | 99th  | Tunisia       | 95th  | Tunisia       | 92th  | Gabon        | 106th | Algeria      | 100th |
| Algeria      | 92th  | Egypt        | 100th | Lebanon       | 101th | Albania       | 93th  | Kyrgyz Rep   | 108th | Guyana       | 102th |
| Egypt        | 94th  | Kyrgyz Rep   | 102th | Cote d'Ivoire | 99th  | Lebanon       | 101th | Bangladesh   | 109th | Lebanon      | 103th |
| Kyrgyz Rep   | 97th  | Lebanon      | 105th | Lebanon       | 101th | Kyrgyz Rep    | 102th | Suriname     | 110th | Suriname     | 106th |
| Tajikistan   | 102th | Senegal      | 106th | Bangladesh    | 106th | Gabon         | 103th | Senegal      | 112th | Libya        | 108th |

|               |       |              |       |              |       |              |       |               |       |               |       |
|---------------|-------|--------------|-------|--------------|-------|--------------|-------|---------------|-------|---------------|-------|
| Bangladesh    | 103th | Uganda       | 114th | Gabon        | 108th | Bangladesh   | 107th | Lebanon       | 113th | Bangladesh    | 110th |
| Pakistan      | 107th | Pakistan     | 115th | Kyrgyz Rep   | 111th | Senegal      | 110th | Cote d'Ivoire | 115th | Gabon         | 112th |
| Senegal       | 113th | Cameroon     | 116th | Senegal      | 112th | Cameroon     | 114th | Cameroon      | 116th | Senegal       | 113th |
| Cote D'Ivoire | 114th | Gambia       | 117th | Uganda       | 113th | Uganda       | 115th | Guyana        | 117th | Cameroon      | 115th |
| Nigeria       | 115th | Guinea       | 119th | Egypt        | 115th | Egypt        | 116th | Egypt         | 119th | Gambia        | 116th |
| Uganda        | 117th | Benin`       | 120th | Cameroon     | 119th | Guyana       | 121th | Uganda        | 122th | Egypt         | 118th |
| Gambia        | 119th | Mali         | 123th | Pakistan     | 122th | Benin        | 122th | Gambia        | 125th | Nigeria       | 120th |
| Cameroon      | 121th | Nigeria      | 125th | Gambia       | 123th | Gambia       | 123th | Libya         | 126th | Kyrgyz Rep    | 121th |
| Benin         | 123th | Sierra Leone | 130th | Benin        | 124th | Nigeria      | 124th | Nigeria       | 127th | Cote d'Ivoire | 126th |
| Burkina Faso  | 124th | Mauritania   | 133th | Mali         | 125th | Pakistan     | 126th | Mali          | 128th | Uganda        | 129th |
| Mali          | 125th | Chad         | 135th | Nigeria      | 127th | Mali         | 127th | Pakistan      | 129th | Benin         | 130th |
| Guinea        | 126th | Mozambique   | 136th | Sierra Leone | 132th | Mozambique   | 133th | Mozambique    | 133th | Pakistan      | 133th |
| Mauritania    | 131th | Yemen        | 137th | Mozambique   | 133th | Sierra Leone | 137th | Burkina Faso  | 135th | Mali          | 135th |
| Mozambique    | 133th |              |       | Chad         | 136th | Mauritania   | 138th | Sierra Leone  | 138th | Mozambique    | 137th |
| Sierra Leone  | 134th |              |       | Mauritania   | 137th | Chad         | 139th | Mauritania    | 141th | Burkina Faso  | 140th |
| Yemen         | 139th |              |       | Yemen        | 138th | Guinea       | 140th | Yemen         | 142th | Mauritania    | 141th |
| Chad          | 140th |              |       |              |       |              |       | Chad          | 143th | Sierra Leone  | 144th |
|               |       |              |       |              |       |              |       | Guinea        | 144th | Yemen         | 145th |
|               |       |              |       |              |       |              |       |               |       | Guinea        | 147th |
|               |       |              |       |              |       |              |       |               |       | Chad          | 148th |
| 40 countries  |       | 36 countries |       | 39 countries |       | 39 countries |       | 41 countries  |       | 42 countries  |       |

Source: World Economic Forum, various years

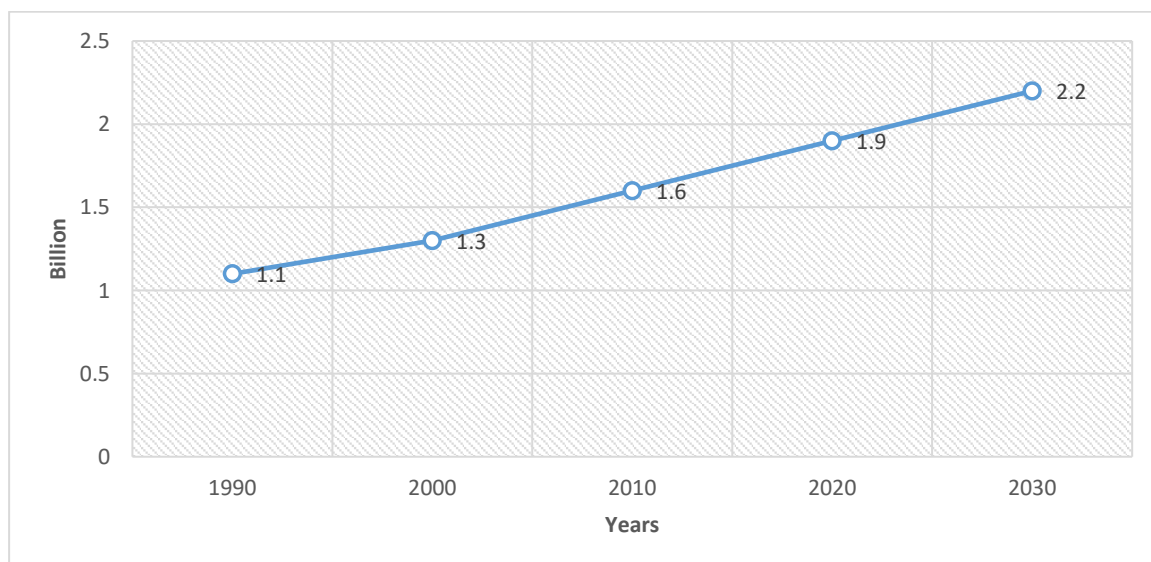
The transition from IR1.0 to 4.0 is blatantly happening and the world tries to adapt to this new system in all its activities. Changing is unavoidable for a better outcome in the future. Nevertheless, nothing such as a free lunch, where someone needs to be responsible for it, some country can begin implementing IR4.0 while other are unable to initiate it due to the developmental factors and most importantly the financial constraint. The upcoming section will explain the relationship and impact (pro and cons side) of Islamic banking and IR4.0.

### Nexus of IR4.0 and Islamic Banking

Islamic banks have embraced Fintech as part of the new medium to connect and attract customers. The Fintech integration, in banking product and services, ranges from deposits, customer and business financing, trade financing, treasury, wealth management and *takaful* has simplified bank's processes, strengthened security and increase customer's convenience (Riemer, 2017). The dawn of IR4.0 continues to enhance and disrupt 20<sup>th</sup> century banking and financial services, operations, business models, and customer engagements.

The growth of Fintech was driven by three key factors. Firstly, the projected rise of the global Muslim population from 1.7 billion in 2018 to 2.2 billion by 2030 (26.4%). The growth is double than the rate of the non-Muslim population over the two decades – with an average annual growth rate of 1.5% for Muslims, compared with 0.7% for non-Muslims. The demographic is dominated by young generations whose median age around 24 years old in contrast with the normal age of 32 years worldwide. If categorized by countries, 15 of the top 50 countries with smartphone penetration are found to be in OIC regions. This signifies that the demand for practical, digital Islamic finance solutions are emerging steadily (Pew Research Center, 2011).

**Total of Muslim Population from 1990-2030 (in billion)**



Source: Pew Research Centre, 2011

The second factor is the low accessibility of a banking application. The data reveals that there are 72% of the OIC population is unbanked in the core Islamic finance markets especially in North-Africa Muslim countries such as Morocco, Tunisia and Egypt, as compared to 49% of the unbanked population worldwide (Pew Research Centre, 2011). This eventually spurred the banking regulators and players to embark Fintech in their financial system. Lastly, the government initiatives (eg. Bahrain and Malaysia) to take steps of setting up 'regulatory

sandbox' to stimulate Fintech growth enables the local Fintech start-ups to expand and grow faster.

Fintech ecosystem focusses on three key areas: (i) Greater automation from insight to typical banking activity and operation (ii) Disintermediation leading to open access to services and (iii) Greater decentralization and enhancement security.

The greater automation from insight to typical banking activity and operation means that typical banking documents and process are being transformed into an automation process. The adoption of Artificial Intelligence (AI), big data and quantum computing have immensely improved its product offerings that fulfils the clients' desires, needs and behaviours. These technologies also lower the bank's cost and increased its efficiency of the back-office operation. AI enables computers to be self-smart tasks through advance natural algorithm processing and self-machine learning that analyses data to generate cognizance and make a suggestion of options and opinion (Aazhvaar, 2019). AI is automated and it reduces human initiative tasks and enhances customer decision by generating insights and decision making based on customer behaviour and mentality. Moreover, AI consumes less time with quantum computing and big data, as well as solves complex problems which lead to the reduction or zero-error from the traditional banking that often employs manual business intelligence methods.

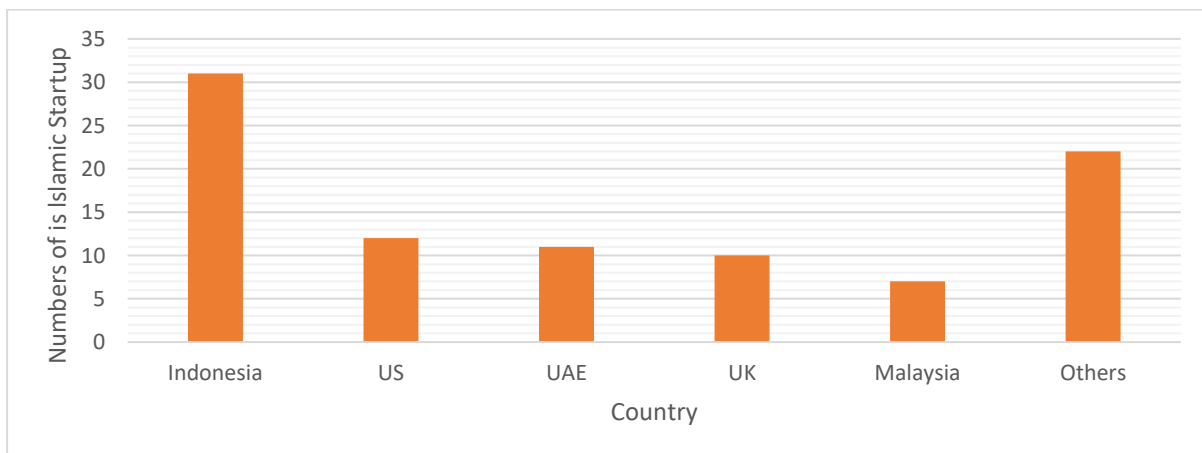
Fintech has allowed the disintermediation leading to open access to services by cutting down middleman or hassle documentation. Amidst fintech, the typical brick and mortar banking system have been redefined and with newcomers that have to redesign the banking and financing structure with better competitive return and open systems such as P2P finance and Open Banking. With advanced technology and internet, the banking system has become more mobile and not restricted to area and boundaries (Alinska & Czepirska, 2016). For example, peer to peer (P2P) financing in Malaysia has skyrocketed from RM 17 mil in 2017 to RM 159.56 mil in 2018. This is largely contributed by millennial users, as 59% of its investors are under 35 (Tariq, 2018). Open banking allows a software application to communicate with other software application's functions through Application Programming Interface (API), that currently use in any e-commerce application such as *Lazada* and *Shopee*. Thus, customers can enjoy more real-time personal financial information and regularly update transaction information.

As Fintech offer greater decentralization and security, it allows and expedites the rapid managerial response to local or product-specific problems. Together with blockchain and cloud adaptation, the customers especially retail customers could enjoy better security and transparency of the contract. For banks, Fintech improves cybersecurity and the banking operation system and reduces the risk of cyber-attack and malware (Casinoa, Dasaklis, & Patsakis, 2019). Also, it removes the extra and associated cost, of keeping transactions documents and contracts in a central repository database that comes with expensive fees. Hence, with cybersecurity, it improves accountability and improves security.

Concerning the development of Islamic bank financial technology, it has come a long way since 2010, mimicking and replicating the growth of the global Fintech ecosystem, with a focus on developing *Shariah-compliant* business and Islamic smart contracts as well as retail consumer financing and wealth management. Most Islamic Fintech is driven by the government initiative particularly in advanced Islamic economic and financial countries such as Malaysia, UAE, Bahrain and Indonesia.

Malaysia, for example, creates a Malaysia Digital Economy Corporation, MDEC (2019) that is responsible to develop Malaysia's digital business ecosystem. Besides, Malaysia actively supports halal economy businesses through providing *Shariah* certification and providing a network and link to venture capital investors such as *Gobi Partners*, *MAVCAP* and *Cradle* (MDEC, 2019). UAE, through its Dubai International Financial Centre (2019), the leading financial hub in the Middle East, Africa and South Asia (MEASA) region, has announced a \$100 million FinTech focus fund to invest in Fintech start-up from incubation to growth stage. Meanwhile, Bahrain focuses on different area segment by creating a co-working space called Bahrain FinTech Bay, which focuses on attracting and developing the human capital of Islamic FinTech (Dubai International Financing Centre, DIFC, 2019). Indonesia, via its Indonesia Financial Services Authority (OJK), takes a step forward by creating a P2P regulatory framework for P2P lending platforms ahead of Malaysia in 2015 (Otoritas Jasa Keuangan, 2017).

### Number of Islamic FinTech Start-up by Country



Source: Dubai Islamic Economy Development Centre, 2018

The constant government initiatives have resulted in successful case studies in the field of Islamic Fintech. Firstly, *Wahed Invest*, the world's first *Shariah-compliant* Robo-advisory platform, that was launched in 2015 with leveraging automated trading techniques. It has secured SEC registration but seeks to attain global coverage especially in GCC and South East Asia country and provide affordable investment opportunities to Muslims regardless of location and income (Wahed Invest, 2019). The *Wahed Invest* platform creates an opportunity to lower and middle income especially from Muslim countries to invest and increase their wealth as suggested by its religion.

Another good example is *Ethis Indonesia*, the world's first Islamic property crowdfunding platform which operated in Indonesia and has several branches located in Dubai and Kuala Lumpur. The platform bridges the gap between investors and developers by raising or crowdfunding the construction of affordable housings (mostly happens in Indonesia) through private and institutional investors, as well as Islamic banks. *Ethis* can attract both Muslim and non-Muslim investors to their platform through high Return of Investment (ROI) at the scale of 12 to 15% (Ethis Venture, 2019). Next, the *Waqfe*, a fintech digital community banking platform for deposit mobilization. It enables Islamic banks to acquire digital-ready customers

through an engagement model that is built around their lifestyle needs (Nazim, 2019). Its offerings include an integrated digital saving account and personal financial management tool.

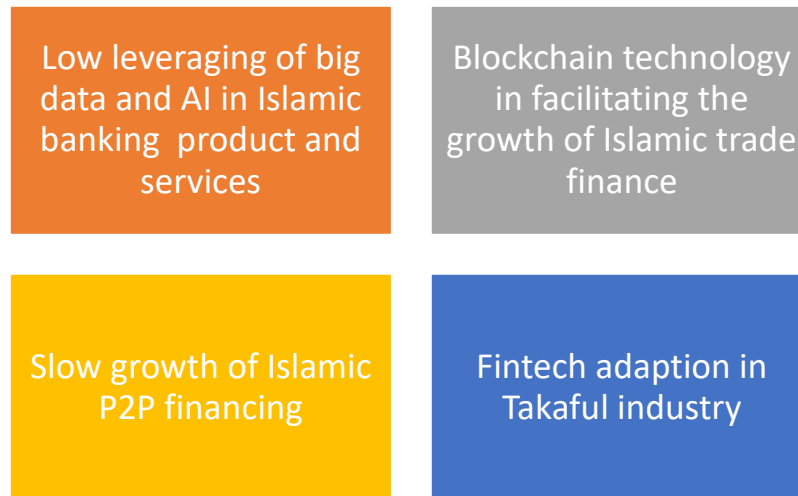
Last but not least, *PayHalal*, a *Shariah*-compliant payment gateway, that focuses on Muslims in South East Asia, GCC and MENA regions. It is attested and certified as end-to-end *Shariah* compliance by *Shariah* advisory firm, *Amanie* Advisors. PayHalal, (2019) plays a crucial role in the e-commerce segment. It acts as an agent (*wakeel*) or payment gatekeeper between the Halal Market Merchants that is responsible to ensure the adherence of online transactions by the customer according to the principles of *Shariah*. This is to meet and preserve the best interest of Muslim clients who demand for halal procedures and operations in the system.

### **Gaps in Islamic Fintech And IR4.0**

No doubt Islamic Fintech has essential space for growth, however, there are a lot of gaps and areas that need to be addressed. It can be divided into four key areas: (1) The low leveraging of big data and AI in Islamic banking product and services, (2) The opportunity of blockchain in facilitating the growth of Islamic trade finance, (3) Slow growth of Islamic P2P financing and (4) Fintech adaption in Takaful industry.

This can be partly solved through the development of human capital in Islamic finance such as the establishment of International Centre for Education in Islamic Finance (INCEIF) and other reputable institutions in Malaysia, Indonesia and GCC countries. The current human capital development is adequate to fill the gap to solve the common issues related to Islamic finance product, contract and structure of financing (Arshad, Noor, & Yahya, 2015). However, in terms of human capital development in advance technology, Islamic country still left behind as compared to the western country counterparts such the United States of America, United Kingdom and Germany (University of Cambridge, 2018). Thus, the Islamic countries sought to leverage more into human capital in technology development and create an advanced ecosystem that akin to Silicon Valley in California.

### Key gaps and areas in Islamic Fintech



Source: Dubai Islamic Economy Development Centre, 2018

Analytics and big data have played important roles in disrupting and changing the landscape of the global banking system. Islamic finance institutions have taken steps to incorporate AI and big data into their organization's operations. Maybank Islamic, for instance, employs analytics to enhance the HR system (Dubai Islamic Economy Development Centre, 2019). Likewise, Emirates Islamic uses HR Panda, an AI program that could automate 50% of the Bank's recruitment processes (Dubai Islamic Economy Development Centre, 2019; MENA Herald, 2016). Al-Rajhi Bank utilises AI to check any money laundering issues in their remittance transaction (Shen, 2017). Kuwait Finance House (KFH) employ AI to filter the loan or financing application from customers which led to a decline in their non-performing loan (NPL) in 2018 (Arabian Business Industries, 2019).

However, the application of AI and big data to retail and corporate customers still have lower adaptation due to low technology exposure, especially those customers and clients aged above 50 years as they not technology illiterate. Moreover, they prefer face to face transaction rather than online transaction (Yuspita, Kamala, & Pebruary, 2019). Therefore, Islamic financial institutions cannot fully embrace IR4.0 in their banking system due to low demand from customers. This makes Islamic bank less adaptable and low leverage on AI in their product and services especially to the unbanked population in MENA (Hardman, 2019).

As for the non-financial institutions in the ecosystem, the excellent example of successful AI application in Islamic finance *Wahed Invest*, aids to solve a fundamental problem of Muslim consumers around the world in Shariah-based investment products (Wahed Invest, 2019). This application makes Islamic investment products more accessible and affordable by the public. However, when compared to conventional financing products, Islamic finances seems less developed (Belanche, Casaló, & Flavián, 2019). This is since its operation system, human capital, product and services offered are still lagging than its counterparts. For instance, Mint, an innovative conventional finance application based in US, provide a comprehensive and automated self-services of user financial management based on customer behaviour. Unlike *Waheed Invest* that focuses on Shariah investment particularly ETF, Mint offered more diversified functions which include budget, credit score, loan application, wealth management and so forth. Each function is connected with a bank's customer account and this allowing them to monitor the performance of their investment portfolios on regular basis (Mint, 2019).

The global trade stood at \$19.48 trillion industry in 2018 (World Trade Organization, 2019). Specifically, the total intra-OIC trade reaches \$280 billion in 2018 (Islamic Center for Development of Trade, 2019) with \$1.8 trillion in imports across the OIC (World Trade Organization, 2019). Despite having a huge room for growth opportunities, the Islamic trade finance industry was estimated to rise at \$200 billion only in 2018 (Islamic Center for Development of Trade, 2019). To facilitating greater trade across the OIC, there is a need for more funding on the start-up's innovation, as well as investment in innovation among Islamic finance institutions, to fill a critical funding gap. The Blockchain utilization in trade finance through smart contract can simplify the typical review of substantial documentation and independent verification (Bogucharskov, Pokamestov, Adamova, & Tropina, 2018). This led to cost reduction borne by all relevant parties.

Environmental, Social and Governance (ESG) in the financial industry start to be important when the Global Financial Crisis (GFC) hit the America economy as a result of poor governance and minimal social focus (Steen, Moussawi, & Gjolberg, 2019). The components of ESG can be described as follows: Environmental focus on climate change, energy efficiency and waste management. Meanwhile, social focus on employee engagement, gender rights and labour standard. For governance, it focuses on shareholder right, bribery and corruption policy and audit committee structure (Sila & Ceka, 2017). Islamic finance come to complement ESG by ensuring their business and operation comply with Shariah requirements. The embodiment of ESG principles in the transaction system along with efforts to be more innovative and competitive will position Islamic finance at the front line of the ethical financial industry.

Peer2Peer (P2P) financing has created an impact to the world financial system, by giving better financial returns and social impact as compared to conventional financing institution (Zhao, Liu, Ge, & Wang, 2017). Moreover, P2P financing plays significant roles to enhance social development, especially in the Islamic world through Islamic finances (Ali, 2018). One of the best examples of Islamic P2P crowdfunding is *Ethis Ventures* that can connect the unbanked population to the financial system and bring economic benefits to the poor. However, the conventional P2P financing performs better in terms of facilitation and growth of SMEs especially in China and it grew rapidly with the number of P2P lenders growing from 50 to nearly 3,500 between 2011 to 2015 (Tao & Wei, 2019). Thus, the spill over effect of P2P could be enjoyed with all segments of people. Moving forward, Islamic financial institution could go the extra mile such as using cash waqf to enter a *Musyarakah* contract with the SMEs to provide financing that generates a better return and impact to the real economy.

The global takaful market has reached \$19 billion in 2017 (IMARC Group, 2018). The market is projected to exceed \$40 billion worth of global takaful market by 2023 with Cumulative Average Growth Return (CAGR) of 13% for 2017 until 2023 (IMARC Group, 2018). Although *takaful* growth is comparatively higher than conventional insurance, Fintech development in the *takaful* industry is significantly low. However, there is still room and opportunity for the *takaful* industry to access general and family *takaful* products to Muslim countries. Therefore, continuous innovation of big data analytics and quantum computing by start-ups and government are required to penetrate the market where most customers want lower prices of *takaful* products, but with full coverage and of protection (Mohamed & Alhabshi, 2015).



## Conclusion

The implementation of several Fintech tools by Islamic banks such as P2P financing, crowdfunding, Robo-advisory and remittance have showcased their commitments in adapting to the current IR4.0 trend. At present, most of the conventional financial institutions incorporated latest fintech adaptation in their business operation such as CIMB, HSBC, and Standard Chartered. Despite that, Islamic banks are still lagging behind the conventional rivals whose high-level technologies are well-developed in their banking system. Moreover, the regulation pressure and lack of human capital in the software development further impede the Fintech growth in Islamic banks. Certain gaps and areas shall be improved notably on the integration of big data and AI in Islamic banking product and services, the fusion of blockchain in assisting Islamic trade finance, expansion of Islamic P2P financing and Fintech adaption in *Takaful* industry. This paper recommends more empirical studies on engagements with IR4.0 to encourage more interests and awareness of financial technology in the Islamic banking industry.

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